Behavioural Change and Alcohol-Fuelled Violence: An Experiment[1]

Iain W. Long[2]
Cardiff University
Cardiff Business School

Kent Matthews
Cardiff University
Cardiff Business School

Vaseekaran Sivarajasingam
Cardiff University
School of Dentistry

University of Nottingham
Ningbo, China

INTRODUCTION

Alcohol is involved in more than forty percent of violent crime in the UK (Office for National Statistics 2020). Whilst a causal link between its consumption and aggression is well established, *why* it exists is uncertain (Markowitz et al. 2012; Page et al. 2017). Does alcohol alter the brain's chemistry? Is it due to environmental factors associated with drinking? Are individuals aware of changes they undergo that lead them to become involved in violence? We present the results of a pilot study designed to take a first step towards addressing these questions.

Explanations currently fall into four categories. Perhaps the most obvious is that alcohol-induced changes to the brain's chemistry may, for example, boost excitability (Fagan 1993). However, recent lab work has cast doubt on this explanation where, across a wide range of decision-theoretic experiments, intoxication was found to have no effect on behaviour (Corazzini et al. 2015; Bregu et al. 2017).

Alternatively, alcohol and violence may simply be complementary consumption goods (Markowitz 2000, 2005). The drinking environment itself could change behaviour due, for example, to overcrowding (Graham and Homel 1997) or noise levels (Quigley et al. 2003).

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[2] Corresponding author: Cardiff University, Cardiff Business School, Colum Drive, Cardiff, CF10 3EU, UK; longiw@cardiff.ac.uk.

Society is often more forgiving of poor behaviour under the influence of alcohol, potentially providing violent individuals with an incentive to drink (Gelles and Cornell 1990).

Understanding whether individuals correctly anticipate any changes in their underlying preferences is also important. In much the same way that whether a hyperbolic discounter understands the preferences of their future self affects their actions today (O'Donoghue and Rabin 1999), whether a sober individual understands the preferences of their intoxicated self is likely to affect their responsiveness to changes in policy.

EXPERIMENTAL DESIGN

Given the pilot nature of the study, a simple within subject design was adopted. Subjects were recruited from the Cardiff University Students' Union bar. They completed a breath test, providing a blood-alcohol content (BAC) score, before attempting a computer-based overconfidence test in z-Tree (Fischbacher 2007). This consisted of ten patterns from Raven's Standard Progressive Matrices (Raven et al. 2003). Each pattern had a section missing, and subjects needed to select which of six or eight candidate pieces completed it. No feedback was given. They were then asked to predict how many of the ten missing pieces they correctly identified.

Subjects were invited to a second session held one week later, during the day. After taking a breath test, we asked them to predict their session one score and prediction. They then did another overconfidence test with new, equally difficult questions.

Subjects received £10 for participating and up to £10 based on their performance in a randomly selected stage of the experiment. For a score, they received £1 per correct answer. Otherwise, they received £10 for a correct prediction, declining in £1 intervals as it became less accurate.

Running experiments in the field with intoxicated subjects placed several ethical constraints on the design. The intoxicated session had to be run first, rather than randomising, and no payment could be made at the end of session one. Both were felt to implicitly encourage drinking. Controls were only collected in session two, to reduce concerns about informed consent. Further details are available in the working paper (Long et al. 2020).

DATA AND ESTIMATION

Data

We recruited 140 subjects, of whom 106 returned for session two. The latter group formed our sample. We checked BAC and various measures of performance in session one and found no significant difference between those who did, or did not, return.

Table 1: Descriptive statistics

	Mean	Std. Dev.	Min.	Max.
Personal characteristics				
Age (years)	20.67	2.54	18	31
Female	0.34	0.48	0	1
Height (cm)	174.69	11.38	144.5	194.5
Weight (kg)	72.07	13.46	54.5	114.5
Body Mass Index	23.41	3.74	10.01	38.62
Holds a degree	0.34	0.48	0	1
Lifestyle				
Single	0.57	0.50	0	1
Drinks frequently (3+ times per week)	0.42	0.50	0	1
Units of alcohol per session	8.88	5.76	2	35
Smokes	0.25	0.44	0	1
Violent incidents in last 12 months	0.25	0.57	0	3
Experimental results				
Session 1				
BAC	0.36	0.24	0	1.42
Score	6.60	1.69	1	10
Prediction	7.06	1.55	2	10
Time (seconds)	251.25	100.13	85.88	721.28
Session 2				
BAC	0.00	0.00	0.00	0.19
Score	8.56	1.37	4	10
Prediction	7.80	1.38	4	10
Time (seconds)	236.02	86.76	100.31	500.23
Prediction of session 1 score	6.45	1.91	2	10
Prediction of session 1 prediction	6.49	1.84	2	10

Table 1 presents descriptive statistics. The majority of our sample were male undergraduates who were non-smoking, single, drank alcohol frequently, and consumed the equivalent of one bottle of wine per drinking session. The number of violent incidents subjects reported involvement in ranged between zero and three, with an average of 0.25.

In session one, subjects' average BAC was slightly above the UK drink-driving limit of 0.35mg/l. They were overconfident, predicting more correct answers than they achieved. In session two, their score improved. Subjects underestimated this improvement. They had a reasonable understanding of their likely session one score but appeared to believe that their intoxicated self would be equally accurate.

Estimation of Behavioural Changes

The analysis initially seeks to understand the effect of both intoxication and the drinking environment on two characteristics: cognitive ability, proxied for by score; and overconfidence bias, measured by:

$$Over_{it} = Prediction_{it} - Score_{it},$$

where $i = 1, \ldots, 106$ and $t = 1, 2$ denote the individual and session. The larger $Over_{it}$, the more overconfident the subject is.

For each $y_{it} \in \{Score_{it}, Over_{it}\}$, suppose that the data is generated by the following:

$$y_{it} = \beta_0 + \beta_1\, bar_{it} + \beta_2\, BAC_{it} + x_i'\gamma + (bar_{it} \times x_i)'\zeta + \varepsilon_{it},$$

where bar_{it} is an indicator, taking value 1 in a drinking environment, BAC_{it} is blood-alcohol content, x_i is a vector of individual controls and ε_{it} is an i.i.d. error. Whilst the working paper presents employs a variety of estimation techniques, for brevity, the within design is exploited here by focusing on the difference estimator:

$$\Delta y_i = \beta_1 + \beta_2\, \Delta BAC_i + x_i'\zeta + \Delta\varepsilon_i,$$

where $\Delta z_i = z_{i1} - z_{i2}$ is the increase in a variable when in a drinking environment relative to daytime. $\Delta bar_i = 1 - 0 = 1$, for all subjects.

Variation in BAC_{i1} between subjects is exploited to identify the effects of the environment and intoxication.

Anticipation of Behavioural Change

If subjects' underlying preferences do change, an important policy question is whether these changes are correctly anticipated. To begin to address this, their anticipated (*A*) behavioural change was constructed by:

$\Delta Score_i^A$ = (Session 2 prediction of $Score_{i1}$) – (Session 2 prediction of $Score_{i2}$),
$\Delta Over_i^A$ = (Session 2 prediction of session 1 prediction) – (Session 2 prediction of $Score_{i1}$).

An individual who believes that their ability increases when intoxicated would, when sober, predict a higher score in session one: $\Delta Score_i^A > 0$. Similarly, an individual who believes that they become more overconfident when intoxicated would, when sober, anticipate that their intoxicated self would make a higher prediction about their session one score than they would: $\Delta Over_i^A > 0$. The unanticipated change (*U*) can then be calculated as the residual: $\Delta y_i^U = \Delta y_i - \Delta y_i^A$.

Estimation of Alcohol-Fuelled Violence

The analysis finally considers what role the behavioural changes we observe play in explaining variation in subjects' recent history of violence. Given the low frequency of incidents, Poisson regressions are employed. For robustness, negative binomial estimations were also performed. The results were largely unchanged.

RESULTS

Ability

Table 2 presents difference regressions for $\Delta Score_i$. Differences in the time taken to complete the test were controlled for, along with several personal and lifestyle characteristics. A common criticism of BAC is that individuals with different body shapes and the same BAC are not equally intoxicated. This was addressed by interacting ΔBAC_i with subjects' body mass index (BMI).

Table 2: Difference regressions of score on intoxication and environment

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: $\Delta Score_i$					
Δbar_i	-1.683***	-1.724***	-1.769***	-1.431***	-1.449***	-1.491***
	(0.294)	(0.303)	(0.297)	(0.329)	(0.337)	(0.420)
ΔBAC_i	-0.750	-0.733		-0.798	-0.780	-0.798
	(0.702)	(0.719)		(0.756)	(0.755)	(0.745)
$\Delta \ln T_i$		0.665	0.751	0.636	0.626	0.626
		(0.440)	(0.461)	(0.424)	(0.426)	(0.422)
$\Delta BAC_i \times BMI_i$			-0.027			
			(0.030)			
Has degree				-0.790**	-0.787**	-0.756**
				(0.332)	(0.333)	(0.341)
Smokes					0.043	-0.064
					(0.359	(0.362)
Drinks frequently						0.490
						(0.320)
Units						-0.016
						(0.023)
N	106	106	103	106	106	106
R^2	0.597	0.605	0.602	0.627	0.627	0.636
p-value	0.000	0.000	0.000	0.000	0.000	0.000
Log-likelihood	-201.019	-199.857	-195.096	-196.867	-196.860	-195.651

Robust standard errors in parentheses
* p<0.10, ** p < 0.05, *** p < 0.01.

Being in a drinking environment lowers performance by around 1.5 correct answers. Intoxication has no significant effect, although the coefficient on BAC is always negative, consistent with recent lab studies. Replacing BAC with dummies representing different ranges of intoxication yields the same conclusion, ruling out a nonlinear relationship.

Overconfidence

Table 3 presents results $\Delta Over_i$. The picture is remarkably similar. Being in the bar significantly increases overconfidence. Subjects predicted an average of 0.8 extra correct answers relative to their score. Whilst intoxication's coefficient is also positive, it is never significant, again consistent with recent lab findings.

Table 3: Difference regressions of overconfidence on intoxication and environment

	(1)	(2)	(3)	(4)	(5)	(6)
			Dependent variable: $\Delta Over_i$			
Δbar_i	0.979***	1.015***	1.039***	0.756***	0.763**	0.826*
	(0.265)	(0.270)	(0.280)	(0.279)	(0.312)	(0.493)
ΔBAC_i	0.637	0.622		0.679	0.673	0.697
	(0.550)	(0.565)		(0.558)	(0.556)	(0.558)
$\Delta \ln T_i$		-0.595	-0.651	-0.569	-0.566	-0.566
		(0.548)	(0.576)	(0.541)	(0.541)	(0.533)
$\Delta BAC_i \times BMI_i$			0.023			
			(0.027)			
Has degree				0.697	0.696	0.655
				(0.431)	(0.434)	(0.454)
Smokes					-0.016	0.113
					(0.421)	(0.434)
Drinks frequently						-0.568
						(0.373)
Units						0.016
						(0.032)
N	106	106	103	106	106	106
R^2	0.284	0.293	0.285	0.314	0.314	0.328
p-value	0.000	0.000	0.000	0.000	0.000	0.000
Log-likelihood	-220.131	-219.486	-214.508	-217.896	-217.896	-216.818

Robust standard errors in parentheses
* p<0.10, ** $p < 0.05$, *** $p < 0.01$.

Anticipation of Behavioural Changes

Table 4 presents several *t*-tests, designed to test whether the subjects understood the changes the drinking environment appears to cause:

Table 4: Anticipation *t*-Tests

Null Hypothesis	*N*	*t*-statistic	*p*-value
$E(\Delta Score_i^A) = 0$	106	-7.650	0.000
$E(\Delta Score_i^U) = 0$	106	-2.733	0.004
$E(\Delta Over_i^A) = 0$	105	0.358	0.361
$E(\Delta Over_i^U) = 0$	105	5.695	0.000

Subjects, on average, partially grasp their change in score. They understand that being in a drinking environment significantly reduces their cognitive ability (row one), but also significantly underestimate the magnitude of the fall (row two).

In contrast, subjects seem to be completely unaware of changes in overconfidence. They do not anticipate any significant change (row three). The resulting increase in overconfidence is therefore unanticipated.

Behavioural Change & Violence

Finally, whether the behavioural changes identified above have any predictive power regarding the number of violent incidents subjects were involved in over the previous year was investigated. The results are presented in Table 5. Drinking behaviour was incorporated to control for other drivers of violence that may be linked to alcohol, along with physical characteristics that may encourage or deter a violent attack.

Table 5: Poisson regressions of incidents on changes score and overconfidence

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: $Incidents_i$					
$\Delta Score_i$	0.399**	0.334**	0.404**	0.363***	0.352**	0.375**
	(0.179)	(0.148)	(0.178)	(0.140)	(0.138)	(0.146)
$\Delta Over_i$	0.189	0.202	0.177	0.225*	0.212	0.211*
	(0.138)	(0.136)	(0.136)	(0.124)	(0.131)	(0.122)
Drinks frequently		1.055**		0.963*	1.148**	0.987*
		(0.466)		(0.520)	(0.510)	(0.513)
Units		0.053*		0.059**	0.059***	0.062***
		(0.027)		(0.023)	(0.021)	(0.021)
Height			0.057	0.051		0.053*
			(0.037)	(0.042)		(0.031)
Weight			0.004	-0.002		-0.003
			(0.019)	(0.021)		(0.022)
Female					-0.644	0.080
					(0.756)	(0.743)
$\Delta \ln T_i$					-0.705	-0.657
					(0.579)	(0.581)
Constant	-0.968***	-2.244***	-11.349**	-11.219*	-2.231***	-11.411**
	(0.290)	(0.512)	(5.632)	(6.330)	(0.513)	(4.726)
N	106	106	103	103	103	103
Pseudo-R^2	0.043	0.138	0.102	0.187	0.173	0.196
p-value	0.080	0.001	0.003	0.000	0.000	0.000
Log-likelihood	-64.191	-57.818	-58.302	-52.790	-53.731	-52.214

Robust standard errors in parentheses
* $p<0.10$, ** $p < 0.05$, *** $p < 0.01$.

A smaller decline in score, which proxies for ability, is associated with significantly more violent incidents. Greater increases in overconfidence also appear to be a significant predictor, but only after controlling for drinking behaviour, and only at the ten percent level. Both drinking frequency and the average number of units of alcohol consumed are significant, suggesting that the two channels explored here do not provide the whole picture.

The results are, at first pass, surprising. Individuals who believe that their decision-making has not been badly impaired by alcohol – either due to a small decline in ability or a much greater overconfidence – appear to be involved in more incidents. We speculate that such individuals may feel relatively confident entering into a fight. Those with a larger perceived decline may view the likely costs involved in violence as prohibitive.

CONCLUSION

We present the results of a pilot study designed to be a first step in investigating the causal mechanism underpinning alcohol-fuelled violence. We find that being in a drinking environment, rather than intoxication, is associated with increased overconfidence and reduced cognitive ability. Whilst both appear connected with our subjects' recent history of violence, it is those who experience a smaller perceived decline in ability that seem to become involved in more fights.

That these changes potentially cause alcohol-fuelled violence presents policymakers with a dilemma. Individuals appear to be unaware of the effect of the environment on their overconfidence and underestimate its effect on their ability. When deciding whether to enter such an environment, they may underestimate their true likelihood of being involved in violence, viewing policies designed to tackle the problem as less relevant.

The analysis suffers several shortcomings driven, in part, by the pilot nature of the study. The sample is small, and questions of external validity arise from our use of convenient undergraduate subjects. The procedures also need refining, not least by expanding the biases and preference parameters we evaluate and by better understanding the drinking environment. We hope to do all this in future work. Nevertheless, we view the results as promising.

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