**Effect of swearing on strength: Disinhibition as a potential mediator**

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**Abstract**

**Introduction:** Swearing fulfils positive functions including benefitting pain relief and physical strength. Here we present three experiments assessing a possible psychological mechanism, increased state disinhibition, for the effect of swearing on physical strength.

**Method:** Three repeated measures experiments were carried out with sample sizes *N*=56, *N*=63 and *N*=118. All three included the Balloon Analogue Risk Task (BART) to measure risky behaviour. Experiments 1 and 3 included measures of physical performance assessing, respectively, grip and arm strength. Experiment 3, which was pre-registered, additionally assessed flow, self-confidence, anxiety, emotion including humour, and distraction including novelty.

**Results:** Experiments 1 and 3 found that repeating a swear word benefitted physical strength and increased risky behaviour, but risky behaviour did not mediate the strength effect. Experiment 2 showed no effect of listening to an audio track of a repeated swear word. Experiment 3 found that repeating a swear word increased flow, self-confidence, positive emotion, humour and distraction. Humour mediated the effect of swearing on physical strength.

**Discussion:** Consistent effects of swearing on physical strength indicate that this is a reliable effect. Swearing affected several constructs related to state disinhibition including increased self-confidence. Humour appeared to mediate the effect of swearing on physical strength, consistent with a hot cognitions explanation of swearing-induced state disinhibition. However, as this mediation effect was part of an exploratory analysis, further pre-registered experimental research including validated measures of humour is required.

**Keywords:** swearing,disinhibition, risk-taking, humour, confidence, mediation

**Introduction**

Offensive or obscene language is known as swearing in the UK and cursing in the US (Soanes, 2002). That most languages include swear words (Van Lancker & Cummings, 1999) suggests they fulfil one or more useful functions and researchers have begun to evidence a variety of beneficial effects of swearing. Repeating a swear word has been found to alleviate the physical pain of immersing one’s hand in ice cold water (Robertson, Robinson & Stephens, 2017; Stephens, Atkins & Kingston, 2009; Stephens & Umland, 2011; Stephens & Robertson, 2020) and the social pain of being ostracised (Philipp & Lombardo, 2017). Swearing also augments persuasiveness (Scherer & Sagrin, 2006), credibility (Rassin & Heijden, 2005) and has been shown to benefit physical tasks that rely on strength and power (Stephens, Spierer, & Katehis, 2018). This latter effect is the focus of the current study.

Stephens, Spierer and Katehis (2018) found that repeating a swear word benefitted performance of two quite different physical strength tasks; a highly intensive exercise bike-based task and a more moderate hand grip task. They found, in the swearing condition in which participants repeated a swear word during the task, average performance was improved by 4.5% on the bike task and 8% on the grip task, compared with repeating a neutral word. The study had been designed on the assumption that swearing would increase autonomic arousal, and that this increased autonomic arousal would mediate the effects of swearing on strength. However, no such autonomic activation was apparent. The authors suggested a psychological mechanism for the observed effect of swearing on strength, characterized as an increased state disinhibition wherein individuals did not hold back. A similar suggestion was made by O’Connell, Hinman, Hearne, Michael and Nixon (2014) in their study finding that grunting helped tennis players hit the ball with greater power compared with silence (mean increase 19-26%) and by Welch and Tschampl (2012) in their study of hand grip strength accompanied by shouting compared with silence (mean increase 7%).

Hirsh, Galinsky and Zhong (2011) have suggested a model of state disinhibition based on deactivation of Grays’s (1982) Behavioural Inhibition System (BIS). This theoretical system, closely linked with the septal-hippocampal network, functions to interrupt ongoing behaviours where they are perceived to lead to aversive consequences. Within this model disinhibition can be understood as a state in which the BIS is relatively inactivated, with the consequence that the number of competing responses computed is relatively reduced, simplifying the selection and execution of one particular response. This is contrasted with situations where the BIS is relatively activated and a larger number of competing responses are computed, making the decision of choosing one response more complex. In short, a deactivated BIS leads to reduced response conflict, simplifying decision making.

Three routes by which BIS activity may be reduced by state disinhibition are proposed by Hirsh, Galinsky and Zhong (2011). The first route is greater activation of the Behavioural Activation System (BAS), the dopaminergic-mediated circuit associated with pursuit of rewards. The BAS tends to narrow attention focus towards desired goals, reducing activation of less salient behaviours, thus reducing activation of the conflict-related BIS. Hirsh, Galinsky and Zhong (2011) describe this as BAS-related silencing of the BIS. Interestingly “hot cognitions” such as sexual arousal have been found to activate the BAS (Van den Bergh, Dewitte & Warlop, 2008). This opens the possibility that swearing, which may be considered a “hot cognition” based on its arousing properties (Stephens & Zile, 2016), may facilitate BAS-related silencing of the BIS leading to state disinhibition. Henceforth, we refer to this as the hot cognitions pathway for swearing-induced state disinhibition.

The second route by which Hirsh, Galinsky and Zhong (2011) propose BIS activity may be reduced, leading to state disinhibition, is narrowing of attention due to depleted cognitive resources. They suggest this route underlies the disinhibitory effects of alcohol intoxication. It is possible that swearing may similarly narrow attention via “distracting” the individual, directing attention towards processing the swear words, such that fewer of the limited attention resources are available to process competing responses. This would theoretically lead to attention-mediated reduction in BIS activity, and consequent disinhibition. Consistent with this suggestion, previous research has shown that swearing is rated as distracting (Stephens & Robertson, 2020). Henceforth, we refer to this as the distraction pathway for swearing-induced state disinhibition.

A third route for de-activating the BIS proposed by Hirsh, Galinsky and Zhong (2011) is a reduction in social desirability concerns. One way this can be influenced is via anonymity. Under such conditions the BIS remains relatively inactive as there is a lesser need to calculate pro- or anti-social consequences. Consequently, there are fewer competing behaviours to work through, such that choosing an appropriate behaviour becomes relatively easier. Swearing may bring about a reduction in social desirability concerns as the act of breaking taboo may effectively obliterate such concerns, rendering them redundant. One might describe this as a “*fuck-it effect*” in which breaking taboo by swearing outshines whatever social concerns were present, to the extent that these are no longer relevant. Henceforth, we refer to this as the social desirability pathway for swearing-induced state disinhibition.

Here we present three experiments designed to assess effects of swearing on state disinhibition. Mediation analyses were conducted in experiments 1 and 3 to assess whether indices of state disinhibition lie on the critical pathway between swearing and improved performance of physical strength tasks.

Experiment 1 employed the Balloon Analogue Risk Task (BART; Lejeuz, Read, Kahler, Richards, Ramsey, Stuart, et al. 2002) as a behavioural measure of risky behaviour linked to state disinhibition. This was based on our conceptualization of disinhibition as “not holding back”, and links in the literature between disinhibition and risky behaviour (e.g. Mullins-Sweatt, DeShong, Lengel, Helle & Krueger, 2019). The BART is a screen-based task requiring participants to pump up a virtual balloon. Credits are accrued for each successful pump, but there is an element of risk because any credits accrued are lost should the balloon burst. The probability that the balloon will burst increases with each pump. The usual outcome measure of risky behaviour for this task is the average number of pumps on unexploded balloons (Lauriola, Panno, Levin & Lejuez, 2014), also known as adjusted number of pumps (Lejeuz, Read, Kahler, Richards, Ramsey, Stuart, et al. 2002). Grip strength was assessed using a hand dynanometer using the same procedure as Stephens, Spierer and Katehis (2018).

In Experiment 1, performance of the grip task, and the BART were assessed in a within-subjects design with the conditions: swearing, comprising repeating a self-nominated swear word, and non-swearing, comprising repeating a self-nominated neutral word. It was hypothesised that: (i) repeating a swear word would benefit performance of a physical task such that there would be a higher mean isometric hand grip force score in the swearing condition compared to the non-swearing condition; (ii) that there would be an increased average number of pumps on unexploded balloons for the swearing condition compared with the neutral word condition; (iii) and that the predicted beneficial effect of swearing on physical task performance would be mediated by the disinhibition measure: average number of pumps on unexploded balloons.

**Methods**

**Participants**

Participants were mostly undergraduates with sample size *N* = 56, contacted via email, social media and word of mouth. There were 24 males and 32 females of mean age 21.6 (SD = 3.3) years. Participants provided informed consent to participate in the study, which was granted ethical approval by the Keele University Psychology Ethics Committee.

**Design and analysis**

**Grip strength and BART:** A one-way repeated measures design was implemented. The independent variable was vocalisation (repeating a swear word *vs.* a neutral word). The dependent variables were the mean hand grip score (kg) across three trials, and the average number of pumps on unexploded balloons on the BART. Condition order was randomised to minimize carryover effects. Data were analysed using one-way related ANOVAs.

**Mediation:** The mediation design assumes that swearing influences strength via increased state disinhibition. The predictor variable was vocalisation (repeating a swear word *vs.* a neutral word). The outcome variable was the mean hand grip score (kg) across three trials. The mediator variable was state disinhibition (average number of pumps on unexploded balloons on the BART). The repeated measures mediation analysis was carried out using the method developed by Montoya and Hayes (2017), implemented in R. The 95% CI around the indirect effect was estimated based on the calculation of 5,000 bootstrapped samples.

**Materials**

**Strength:** The JAMAR® hand dynamometer (Lafayette Instruments, Lafayette, IN) was used to assess preferred hand isometric grip force up to 90 kg.

**BART:** A version of the Balloon Analogue Risk Task (BART) deployed within Qualtrics was utilised (https://github.com/joyfulwei/Balloon-task-in-Qualtrics). Instructions were adapted from Lejeuz, Read, Kahler, Richards, Ramsey, Stuart, et al. (2002) and were as follows: “*You will be presented with 10 balloons, one at a time. For each balloon you can click on the button labelled ‘Inflate Balloon’ to increase the size of the balloon. You will accumulate 0.25 points for each pump. At any point, you can stop pumping up the balloon and click on the button labelled ‘Collect’. Clicking this button will start you on the next balloon and will transfer the accumulated points into your ‘Total Credit’. The amount you earned on the previous balloon is shown in the box labelled ‘Win last round’. It is your choice to determine how much to pump up the balloon, but be aware that at some point the balloon will explode. The explosion point varies across balloons, ranging from the first pump to enough pumps to make the balloon fill the entire computer screen. If the balloon explodes before you click on ‘Collect’, then you move on to the next balloon and all money in ‘Earn this round’ is lost. Exploded balloons do not affect the money accumulated in your permanent bank*.” The version used here consisted of 10 trials; a new trial commenced either when the participant chose to bank the credits on the current trial or when the balloon burst. Each trial had a potential maximum of 32 pumps of the balloon, and the probability that the balloon would burst increased with each successful pump. Data collected were the number of pumps on each trial; an indication of whether the balloon burst on each trial; and the number of points accrued overall, where 0.25 points are accrued for each pump on trials in which the balloon did not burst. The dependent variable, average pumps on successful trials, was calculated by multiplying points by 4 (to convert from credits to pumps) and dividing by the number of trials on which the balloon did not burst.

**Procedure**

Please note that the data presented here are from two separate experiments, both of which were interrupted by the March 2020 COVID-19 lockdown. Data presented were from measures common to both studies but there were some deviations in procedure. One study supplied *N*=30 cases. For this study, participants were given the word “Fuck” to repeat as the swear word and were asked for “a word you might use to describe a table” as the neutral word. In this study participants repeated the word for a single 10s interval prior to completing both tasks. The other study supplied *N*=26 cases. For this study participants nominated a swear word by being asked, “Choose a swear word that you might say if you bumped your head, such as ‘shit’”, and the neutral word by being asked to nominate “a word that you might say to describe a table, such as ‘hard’”.  In this study participants repeated the word for 10s prior to each task. Participants were asked to hold the dynamometer comfortably in their preferred hand. They squeezed the dynamometer grips as tightly as possible for up to 10s in silence. Mean maximum grip performance across three trials was calculated. The BART was always completed after the Grip Strength task.

One or other of the studies included additional measures not reported here as follows: Flanker task, Engeser Short Flow Scale, BIS scale, Freedom from Constraints Scale, and Haylings Sentence Completion.

**Results**

Descriptive data are shown in Table 1. Box and whisker plots showed 3 participants contributed 4 outliers in total, one for grip strength in the swearing condition, three for grip strength in the neutral word condition, and one for swearing BART trials. These were corrected via Winsorisation, as indicated in Table 1.

Table 1: Descriptive data

|  |  |  |  |
| --- | --- | --- | --- |
|  | Mean | SD | Winsorisation percentile |
| Hand grip across three trials (kg)  Neutral  Swear | 31.80  34.29 | 7.70  7.89 | 96th  98th |
| BART mean pumps on winning trials  Neutral  Swear | 9.20  11.34 | 4.80  5.22 | -  98th |

Mean grip performance was significantly greater for the swearing condition compared with the neutral word condition, *F*(1, 55) = 20.871, *p* < 0.001, *ηp²* = 0.275. The magnitude of the mean difference was 2.49kg (95% CI = 1.40:3.58). There was a significant main effect of vocalisation on the BART, *F*(1, 55) = 7.055, *p* = 0.010, *ηp²* = 0.114. Significantly more pumps were made after the swearing vocalisation compared with the neutral vocalisation (mean = 2.15; 95% CI = 0.53:3.77).

A visual representation of the mediation analysis is presented in Figure 1. The simple model showed swearing increased grip strength by, on average, 2.49 kg (*dz* = 0.61; *p* < .001). The mediation model showed that risky behaviour (BART score) was increased by swearing (*dz* = 0.36; *p* = .010), but a rise in risky behaviour did not increase grip strength (*p* = .051). While the mediated (indirect) route was significant (coefficient = 0.37, *p* < .05), it explained grip strength less well than the effect of swearing on grip strength controlling for the mediator (coefficient = 2.12; *p* <.001). This suggests that the direct effect of swearing on grip strength was more important than the mediated route.

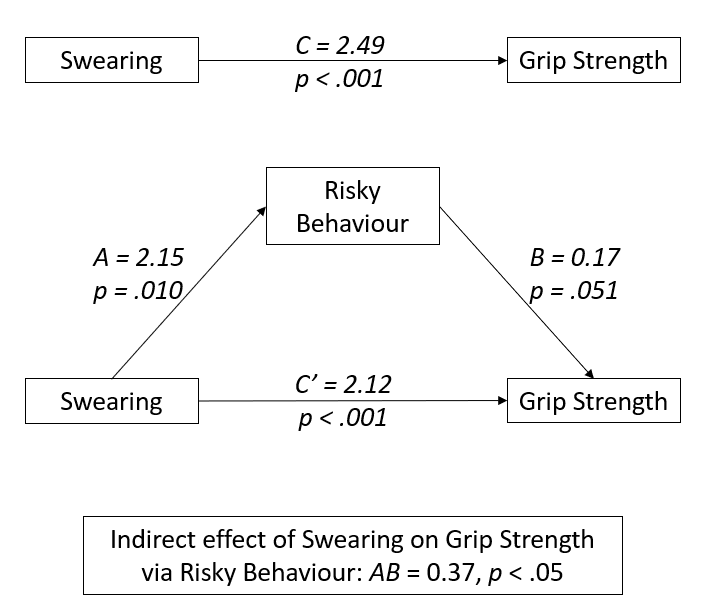


Figure 1: Visual representation of the mediation model of swearing on grip strength via risky behaviour. The model shows the direct effect (*C*), the direct effect controlling for risky behaviour (*C’*) and the indirect effect (*AB*).

**Experiment 1 Discussion**

This experiment replicated previous findings that swearing benefits grip strength (aim 1) and showed that swearing impacted one aspect of state disinhibition – risky behaviour (aim 2). While risky behaviour was affected by swearing, the data do not support this factor as part of the psychological mechanism by which swearing influences physical strength (aim 3), although this conclusion is weak due to several limitations in the study design. One such limitation was that the data came from two experiments with some procedural differences. It is also likely that the mediation analysis suffered from low power. A further study was required to rectify procedural and power issues. However, due to suspension of in-person laboratory data collection because of the pandemic, it was necessary to trial an online protocol. Experiment 2 was designed to trial such a protocol.

**Experiment 2 – Online Experiment**

Experiment 2 aimed to trial an online protocol for researching effects of swearing on constructs related to state disinhibition. Auditory presentation of repeated swear words and neutral words was utilised. This was on assumption that participants would be more likely to comply with a listening *vs.* a speaking instruction, and because it would not be possible to verify compliance with a request for participants to voice each word. As in Experiment 1 the BART was used as a measure of risky behaviour linked to state disinhibition. Several other constructs related to state disinhibition were also assessed, as follows. Psychological flow is the pleasurable psychological state wherein one becomes completely wrapped up in performing an activity to the exclusion of extraneous thoughts and feelings (Csikszentmihalyi, 1990). Flow has been characterised as a state in which pre-frontal brain regions are relatively inactive, consistent with a relaxation of cognitive control (Dietrich, 2004) so linking flow with state disinhibition. Flow was assessed using the 10-item Engeser Short Flow Scale (Engeser & Baumann, 2016). As already discussed, state disinhibition may reflect a quietening of the Behavioural Inhibition System (BIS) which, theoretically, would lead to a reduction in state anxiety levels (Hirsh, Galinsky & Zhong, 2011). State anxiety was assessed using the 6-item short version of the Spielberger State Anxiety Scale (Marteau & Bekker, 1992). Self-Efficacy was assessed using the General Self-Efficacy Scale (Chen, Gully & Evan, 2001). This variable was included as a construct related to confidence, which has been found to increase after alcohol consumption possibly due to deactivating the BIS system (Tiplady, Franklin & Scholey, 2004).

It was hypothesised that listening to a repeated swear word would lead to (i) an increase in average number of pumps on unexploded balloons of the BART, (ii) increased flow; (iii) reduced state anxiety and (iv) increased self-efficacy, compared with listening to a neutral word.

**Method**

**Participants**

While 70 individuals completed the online study, data were excluded for 7 participants due to possible sub-optimal engagement with the materials, indicated by completion times of under 7 minutes (*n*=3) or over 20 minutes (*n*=4). The remaining sample (*N*=63) included 40 females and 23 males of mean age 21.4 years (SD=5.4). All were aged 18 and over and were speakers of English as first language. A power calculation estimating effect size at *dz* = 0.36 (BART effect size from Experiment 1), with alpha set to 0.05 and power set to 0.8 indicated that a sample of minimum size *N*= 63 would be required. The Keele University Psychology Ethics Committee granted ethical approval for the study. Participants provided informed consent to participate in the study, which was advertised as “An investigation into how swearing can make us act and feel”.

**Design**

A one-way repeated measures design was implemented. The independent variable was swearing with two levels: listening to an audio recording of a swear word being repeated *vs.* a neutral word. The dependent variables were the average number of pumps on unexploded balloons on the BART, Engeser Short Flow Scale scores, State Anxiety Scale scores and Self-Efficacy Scale scores. Condition order was randomised.

**Materials**

**Auditory stimulus.** This consisted of an audio recording of an adult male voice repeating the swear word, “fuck”, or the control word, “flat”, for 20 seconds, at a rate of one repetition every 2 seconds. These recordings are included in the supplementary materials.

**BART:** This was the same version as used in Experiment 1.

**Engeser Short Flow Scale:** This 10-item questionnaire (example item: “I feel just the right amount of challenge”) was developed by Engeser and Baumann (2016). Responses are collected via 7-point Likert scales anchored from “not at all”, scoring 1, to “very much”, scoring 7. The final score is the mean score across all ten items and has a range of 1-7. A high score indicates a greater level of flow. The scale has been shown to be reliable, α = .92 (Engeser & Baumann, 2016).

**Spielberger State Anxiety Scale Short Form:** This 6-item questionnaire, known as the STAI-6 (example item: “I feel calm”) was developed by Marteau and Bekker (1992). Responses are collected via 4-point Likert scales anchored from “not at all”, scoring 1, to “very much”, scoring 4. The final score is the mean score across all six items and has a range of 1-4. A high score indicates a greater level of state anxiety. The scale has been shown to be reliable, α = .82 (Marteau & Bekker, 1992).

**General Self-Efficacy Scale:** This 8-item questionnaire (example item: “I will be able to achieve most of the goals that I set for myself”) was developed by Chen, Gully and Evan (2001). Responses are collected via 5-point Likert scales anchored from “strongly disagree”, scoring 1, to “strongly agree”, scoring 5. The final score is the mean score across all eight items and has a range of 1-5. A high score indicates a greater level of self-efficacy. The scale has been shown to be reliable, α = .86 (Chen, Gully & Evan, 2001).

**Procedure**

This online experiment was hosted in Qualtrics. Participants responded to adverts in social media with an option of completion for course credit. After clicking the link on a PC or handheld device, participants were presented with a consent form. Participants were directed to wear headphones or some other personal audio device rather than using speakers. After providing brief demographic information on age and sex, including the option “prefer not to say”, participants were asked to confirm English was their first language. Next came an audio sound check to set the volume. Then participants listened to either the swear word or neutral word audio clip for 20s before completing the BART, the Engeser Short Flow Scale, the Spielberger State Anxiety Scale Short Form and the General Self-Efficacy Scale. They then listened to the second audio stimulus (swear word or neutral word audio clip for 20s) before completing the dependent variable measures again. A final debrief screen thanked participants and provided contact details for any further questions.

**Results**

Descriptive data are shown in Table 2. Box and whisker plots were used to identify outliers which were corrected via Winsorisation, as indicated in Table 2.

Table 2: Descriptive data

|  |  |  |  |
| --- | --- | --- | --- |
|  | Mean | SD | Winsorisation percentile |
| BART mean pumps on winning trials  Neutral  Swear | 9.53  9.78 | 3.76  4.19 | 92nd  - |
| Engeser Short Flow Scale scores  Neutral  Swear | 3.95  3.99 | 0.73  0.81 | 95th  97th |
| Short Form State Anxiety Scale scores  Neutral  Swear | 2.40  2.43 | 0.71  0.71 | -  - |
| General Self-Efficacy Scale scores  Neutral  Swear | 3.64  3.61 | 0.50  0.35 | 95th  92nd |

Mean scores did not differ across the swearing and neutral word conditions for BART mean pumps on winning trials, *F*(1, 62) < 1.0, *ηp²* = 0.006, Engeser Short Flow Scale scores, *F*(1, 62) < 1.0, *ηp²* = 0.005, Short Form State Anxiety Scale scores, *F*(1, 62) < 1.0, *ηp²* = 0.012, or General Self-Efficacy Scale scores, *F*(1, 62) < 1.0, *ηp²* = 0.012.

**Experiment 2 Discussion**

Experiment 2 aimed to trial a swearing protocol suitable for online research. While listening to 20s audio tracks of a voice repeating a swear word was logistically suited to online delivery, the null effects are inconsistent with the findings of Experiment 1. For example, for BART scores there was an effect of repeating a swear word in Experiment 1 but no effect of listening to a swear in Experiment 2. Experiment 2 also showed no effects of listening to a swear word for Flow, State Anxiety or Self-Efficacy. This suggests either that the BART effect shown in Experiment 1 was artefactual, or that the online protocol trialled in Experiment 2 was not equivalent to the voicing procedure of Experiment 1. We assume the latter and suggest several explanations why that may be the case, before introducing Experiment 3, which further assessed effects of verbally repeating a swear word on the

BART and other measures related to state disinhibition.

One possible explanation why the online procedure in Experiment 2 produced null effects is that participants may not have activated sound on their device and so may not have listened to the repeated swear and neutral words. This is unlikely, however, as an auditory sound check was included in the procedure. A second explanation is that listening to a swear word may not produce equivalent psychological effects to those of voicing a swear word. We are aware of no previous research assessing effects of listening to swear words so this remains a possibility. A third explanation is that online disinhibition negated any disinhibiting effects of swearing. Online disinhibition is defined as a lowering of psychological constraints in cyberspace leading to changes in online interpersonal behaviours (Lapidot-Lefler & Barak, 2012). If participants were already operating in a disinhibited manner because of the online setting, then this would have attenuated the hypothesised disinhibiting effect of swearing.

In conclusion, Experiment 2 found that an online protocol for swearing research in which participants listened to audio recordings of repeated swear word and neutral word stimuli, produced null effects, possibly due to online disinhibition. In the context of the ongoing COVID pandemic a further online protocol was devised for researching the effects of vocal swearing on state disinhibition and physical strength. A hybrid online-lab protocol was developed and applied in Experiment 3 in which participants participated remotely via a live video link with a researcher. This enabled researchers to verify compliance with participants voicing swear words, consistent with the procedure used in Experiment 1 and prior research on swearing and physical performance (Stephens, Spierer, & Katehis, 2018). A further benefit of the hybrid online-lab protocol was that participants could be asked to make eye-contact with the researcher during the voicing of the swear words, albeit via the camera and screen. This was desirable as experimental research has shown that eye-contact via a web cam mitigates online disinhibition, indicated by reductions in spontaneous hostile expressions, insults, sarcasm and teasing during online chat (Lapidot-Lefler & Barak, 2012). Using webcams to facilitate eye-contact between researcher and participant had potential to reduce online disinhibition allowing any disinhibiting effects of swearing to be distinguishable. This hybrid online-lab protocol enabled research to proceed that would not have been possible to carry out face to face in a lab due to the suspension of lab-based research during the COVID-19 pandemic. Furthermore, in line with open science, Experiment 3 was pre-registered.

**Experiment 3 - Hybrid online-lab study**

A first aim of Experiment 3 was to assess effects of swearing on physical task performance in a pre-registered design. The pre-registration of this study, reference #53726, is here: <https://aspredicted.org/Z5L_THM>. A second aim was to assess whether a variety of constructs related to state disinhibition are affected by swearing. Experiment 1 showed such an effect with respect to risky behaviour, assessed using the BART, but Experiment 1 had several methodological limitations, specifically inconsistent swearing vocalisation procedures and small sample size. These limitations were addressed in Experiment 3, which assessed effects of swearing on the following constructs related to state disinhibition: risky behaviour, flow, self-confidence, anxiety, emotion including humour and distraction including novelty. A third aim was to assess whether psychological constructs related to state disinhibition mediate the beneficial effect of swearing on physical performance. A fourth aim was to trial a hybrid online-lab experimental protocol in which participants participated remotely via a live webcam link with a researcher, necessary due to precautions against spreading infection during the COVID-19 pandemic. Participants were asked to maintain eye contact with the researcher during the swearing and neutral word vocalisations, via webcam, to mitigate online disinhibition (Lapidot-Lefler & Barak, 2012).

In Experiment 3, a body-weight exercise suitable for performing remotely in an office-type environment was used to assess effect of swearing on physical performance. This was the chair push-up task. The task required participants to raise and then support their body weight on their hands and arms against the chair seat for as long as possible. Risky behaviour was assessed using the BART as in Experiments 1 and 2. The construct of flow was assessed, as in Experiment 2, using the Engeser Short Flow Scale. However, mindful of the null results of Experiment 2, the 3-item flow scale developed by (Ulrich, Keller, Hoenig, Waller & Grön, 2014) was used alongside. This second very brief scale assesses enjoyment, an aspect of flow omitted by the Engeser scale. Hirsh, Galinsky and Zhong (2011) have theorised that state disinhibition may arise due to quietening of the Behavioural Inhibition System (BIS). State confidence, state cognitive anxiety and state somatic anxiety, constructs likely to be affected by BIS quietening, were assessed via subscales of the 17-item Revised Competitive State Anxiety–2 scale (Cox, Martens, & Russell, 2003). Increased self-confidence has been noted after acute alcohol consumption (Tiplady, Franklin & Scholey, 2004), and the latter has been theorised to bring about quietening of the BIS (Hirsh, Galinsky & Zhong, 2011), suggesting that quietening of the BIS may increase self-confidence. Reduced state cognitive anxiety has been theorised to follow quietening of the BIS (Hirsh, Galinsky & Zhong, 2011). We predicted that state somatic anxiety would increase with swearing in line with studies showing increased heart rate (e.g. Stephens, Kingston & Atkinson, 2009) and skin conductance (e.g. Bowers & Pleydell-Pearce, 2011) after swearing.

Several visual analogue scales (VAS) requiring participants to rate the experience of voicing the swear word and neutral word were included to probe possible causes of quietening of the Behavioural Inhibition System (BIS). Positive emotion, negative emotion and humour were employed to assess the hot cognitions pathway for quietening of the BIS (Hirsh, Galinsky & Zhong, 2011). Positive and negative emotion were assessed based on previous research linking swearing to emotion (e.g. Stephens & Zile, 2016). We assessed humour based on the finding that the word “fuck” was rated in the top 1% funniest of 5000 individually presented English words (Engelthaler & Hills, 2018). Distraction and novelty were employed to assess the distraction pathway for quietening of the BIS (Hirsh, Galinsky & Zhong, 2011). Novelty was assessed on the basis that swearing as part of a research study may be perceived as an unusual and novel experience, which may itself cause distraction. Emotion, distraction and humour have previously been shown to be increased after swearing (Stephens & Robertson, 2020).

It was hypothesised that repeating a swear word, compared with a neutral word, would: (i) increase physical task performance; (ii) increase risky behaviour; (iii) increase flow; (iv) increase state confidence; (v) decrease cognitive anxiety; (vi) increase somatic anxiety; (vii) increase positive emotion and humour; (viii) decrease negative emotion; and (ix) increase distraction and novelty. It was further hypothesised (x) that the predicted beneficial effect of swearing on physical task performance would be mediated by BART scores; (xi) that the predicted beneficial effect of swearing on physical task performance would be mediated by flow; and (xii) that any other of the variables related to state disinhibition shown to be affected by swearing would mediate the predicted beneficial effect of swearing on physical task performance.

**Method**

**Participants**

Data were collected from 128 individuals contacted via email, social media and word of mouth. The study was advertised as “Effect of vocal expression on bodyweight exercise performance”. Recruitment materials stipulated that participants should be speakers of English as their first language, aged 18 years or over, and due to the body weight task, free from any chronic pain condition, heart condition, or problems with the arms, shoulders, neck or spine such as injuries or altered sensations in those regions. Data from 10 participants were excluded due to missing values on key variables (age, *n*=1; chair push-up scores, *n*=5) or participants not following instructions (*n*=4). Data for *N*=118 participants was entered for analysis comprising 63 males, 53 females, one non-binary individual and one individual who preferred to not disclose their gender, with mean age 25.8 (SD 10.0) years. For the effect of swearing on physical strength, a power calculation estimating effect size at *dz* = 0.61 (grip strength effect size from Experiment 1), with alpha set to 0.05 and power set to 0.8 indicated that a sample of minimum size *N*= 24 would be required. For the effect of swearing on BART scores, a power calculation estimating effect size at *dz* = 0.36 (BART effect size from Experiment 1), with alpha set to 0.05 and power set to 0.8 indicated that a sample of minimum size *N*= 63 would be required. For the mediation analyses, assuming a conservative within-subjects correlation of 0.6, the bootstrap method of estimating variability in the mediation coefficient, a medium effect of swearing on BART and a medium effect of BART scores on strength, a sample size of *N*=70 would be required to test a mediated model (Pan, Liu, Miao & Yuan, 2018). Participants provided informed consent to participate in the study, which was granted ethical approval by the Keele University Psychology Student Project Ethics Committee.

**Design**

A repeated measures design was applied with condition order randomised across participants. The independent variable was vocalisation (swearing *versus* neutral word). The dependent variables were scores on the chair push-up task, the BART, the Engeser and Ulrich flow scales, the confidence, somatic anxiety and cognitive anxiety scores from the Revised Competitive State Anxiety–2 scale, and the positive emotion, negative emotion, humour, distraction and novelty visual analogue scales.

**Materials**

**Vocalisations:** Participants were asked to “think of a swear word that you might use if you accidentally banged your head and type it into the space below” and also to “think of a word that you might use to describe a table and type it into the space below”. At certain times during the study participants were asked to “to repeat the word at normal speech volume and a steady pace, once every 2 seconds”.

**Chair Push-Up Task:** This desk-based isometric exercise was used to present a physical challenge. Prior to completing this task, the researcher checked verbally with the participant that their chair was sufficiently sturdy and, if wheeled, that the wheels were locked. Participants were asked first to place their hands on their chair beneath the thighs at 45 degrees, pointing inwards. Next, they were asked to lift their feet up off the floor and straighten the arms so that their full body weight was fully supported only by their two hands, against the chair seat. They were asked to hold this position for as long as they could. Participants were asked to stop if they reached 60s as a safety precaution. Participants were not informed of their score, which was hold time in seconds. The researcher coded the time using the square function and participants typed in their coded time for data recording purposes. For example, for a hold time of 20s the participant would have been asked to type in “400”.

**BART:** This was the same version as used in Experiment 1, although at the time of writing the pre-registration a non-standard outcome measure was specified: the total number of pumps of the balloon on burst and non-burst trials.

**Flow measures:** Flow was assessed using the 10-item Engeser Short Flow Scale (Engeser & Baumann, 2016) as in Experiment 2, and additionally the 3-item flow index used by Ulrich, Keller, Hoenig, Waller and Grön (2014). This latter scale collected responses to three items with respect to the chair push-up task: “I would love to repeat it again”; “I was thrilled”; “Task demands were well matched to my ability”. Response was via a 7-point Likert scale, ranging from 1 (“I do not agree at all”) to 7 (“I completely agree”). The final score is the sum across the 3 items, with a range of 3-21, where a high score indicates higher levels of flow. This scale has acceptable reliability (Cronbach’s alpha = 0.80; Ulrich, Keller, Hoenig, Waller & Grön, 2014).

**Revised Competitive State Anxiety–2:** This 17-item scale has the sub-scales: self-confidence, somatic anxiety and cognitive anxiety (Cox, Martens, & Russell, 2003). Participants were asked to rate how they felt when doing the chair push-up task a few moments before. The 6-item self-confidence sub-scale (e.g. “I feel self-confident”), the 7-item somatic anxiety sub-scale (e.g. “I feel jittery”) and the 5-item cognitive anxiety sub-scale (e.g. “I’m concerned about performing poorly”) were answered via 4-point Likert scales anchored “Not at all” (1), “Somewhat” (2), “Moderately” (3) and “Very Much” (4). Item 2 was modified by removing superfluous reference to a competition. Scores were obtained by summing all items on the subscale, dividing by the number of items, and multiplying by 10. Scores for each sub-scale range from 10 to 40 with a higher score indicating a higher level of the construct. Each sub-scale has been found to be reliable, with Cronbach’s alphas above 0.80 (Cox, Martens, & Russell, 2003).

**VAS scales:** Participants rated each vocalisation on 5 dimensions: positive emotion (“Repeating the word made me feel a positive emotion along the lines of excitement or happiness”); negative emotion (“Repeating the word made me feel a negative emotion along the lines of anger or sadness”); humour (“Repeating the word was funny or humorous”); distraction (“Repeating the word distracted me from thinking about other things”); and novelty (“Repeating the word felt like a new or different experience”). Ratings were made on Visual Analogue Scales (VAS), each consisting of a horizontal line anchored at its left side with “Not at all” and at its right side “A lot”. Participants moved a graphic slider yielding a score from 0-100, with a higher score indicating a higher level of the construct.

**Procedure**

Participants that responded to adverts were invited to book an appointment for an online meeting in Microsoft Teams. At the start of the data collection session the researcher explained to the participant that they must have their webcam and microphone turned on. Then the url to the Qualtrics page hosting the experiment was shared. Participants worked through the consent screen, with a verbal prompt encouraging asking of any questions. Once consent was complete, participants were verbally advised to follow the on-screen instructions and let the researcher know when they were prompted to talk to them. Qualtrics settings were used to randomise condition order (swearing *versus* neutral word). Participants were prompted “Please let the researcher know that it is time for the vocalisations”. The researcher gave instructions for this and then timed the participant repeating the appropriate word for 10s. After this, participants completed the BART and chair push-up task in random order, followed by the questionnaires in random order. Upon completion of both conditions a final debrief screen was presented. Before terminating the call the researcher verbally invited any further questions, checked the participant was ok, and thanked them.

**Results**

Descriptive data are shown in Table 3. Box and whisker plots were used to identify outliers which were corrected via Winsorisation, as indicated in Table 3. Hypothesis (i) was supported as there was a longer mean chair push-up hold time in the swearing compared with the neutral word condition, *F*(1, 117) = 10.755, *p* = 0.001, *ηp²* = 0.084. Hypothesis (ii) was also supported as there was a greater number of average pumps on win trials of the BART for the swearing condition *F*(1, 117) = 6.663, *p* = 0.011, *ηp²* = 0.054. Please note that we tested this hypothesis using a different BART score than the one described in the pre-registration in order to be consistent with Studies 1 and 2. Hypothesis (iii) was supported for the Ulrich Flow scale, with a higher score for the swearing condition, *F*(1, 117) = 4.486, *p* = 0.036, *ηp²* = 0.037, but not for the Engeser Short Flow scale, *F*(1, 117) < 1.0, *ηp²* = 0.008. Hypothesis (iv) was supported for self-confidence, with a higher score for the swearing condition *F*(1, 117) = 6.528, *p* = 0.012, *ηp²* = 0.053. Hypothesis (v) was not supported, with no effect of swearing for cognitive anxiety *F*(1, 117) = 3.708, *p* = 0.057, *ηp²* = 0.031. Hypothesis (vi) was not supported, with no effect of swearing for somatic anxiety, *F*(1, 117) = 1.221, *p* = 0.271, *ηp*² = 0.010. Hypothesis (vii) was supported with higher ratings of positive emotion for swearing, *F*(1, 109) = 33.724, *p* < 0.001, *ηp²* = 0.236, and higher ratings of humour for swearing, *F*(1, 115) = 43.094, *p* < 0.001, *ηp²* = 0.273. Hypothesis (viii) was not supported as there was no effect for negative emotion, *F*(1, 92) = 1.605, *p* = 0.208, *ηp²* = 0.017.

**Table 3.** Descriptive data.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Mean** | **SD** | **Winsorisation percentile** |
| **Chair push-up score (s)**  Neutral  Swear | 26.88  29.55 | 16.78  16.62 | -  - |
| **BART mean pumps on winning trials**  Neutral  Swear | 8.92  9.67 | 3.34  3.72 | 97th  - |
| **BART mean pumps on losing trials**  Neutral  Swear | 7.38  7.53 | 4.01  3.78 | 97th  - |
| **Engeser Short Flow Scale scores**  Neutral  Swear | 5.10  5.20 | 1.38  1.25 | 97th  94th |
| **Ulrich Flow Scale scores**  Neutral  Swear | 12.98  13.60 | 4.32  4.34 | -  - |
| **Confidence Scale scores**  Neutral  Swear | 23.83  25.29 | 7.35  7.87 | -  - |
| **Cognitive Anxiety Scale scores**  Neutral  Swear | 22.02  20.93 | 7.87  7.90 | -  - |
| **Somatic Anxiety Scale scores**  Neutral  Swear | 21.69  21.16 | 6.49  6.80 | 99th  - |
| **Positive Emotion rating**  Neutral  Swear | 29.19  48.11 | 25.04  27.91 | -  - |
| **Negative Emotion rating**  Neutral  Swear | 16.10  18.83 | 19.35  19.95 | 95th  96th |
| **Humour rating**  Neutral  Swear | 55.01  74.21 | 31.43  25.48 | -  - |
| **Distraction rating**  Neutral  Swear | 56.15  66.66 | 27.70  25.55 | -  - |
| **Novelty rating**  Neutral  Swear | 58.50  55.35 | 30.84  31.65 | -  - |

Hypothesis (ix) was partially supported with higher ratings for distraction with swearing, *F*(1, 115) = 17.545, *p* < 0.001, *ηp²* = 0.132, and but no effect of novelty, *F*(1, 110) = 1.665, *p* = 0.200, *ηp²* = 0.015. Please note that some participants did not complete all of the VAS measures used to test hypotheses (vii) to (ix).

Mediation

Repeated measures mediation analysis was carried out using the method developed by Montoya and Hayes 2017 implemented in R code. In the estimation of the 95 CI around the indirect effect, 5,000 bootstrapped samples were calculated.

Hypothesis (x) was not supported as the mediated route for the prediction of the effect of swearing on chair push-up task performance via BART average pumps on win trials score was not significant, coefficient = -0.193, *p* > 0.05. Please note that we tested this hypothesis using a different BART score than the one described in the pre-registration. Hypothesis (xi) was also not supported as the mediated route for the prediction of the effect of swearing on chair push-up task performance via the Engeser flow score was not significant, coefficient = 0.065, *p* > 0.05, and neither was the mediated route via the Ulrich flow score, coefficient = 0.415, *p* > 0.05.

Hypothesis (xii) was tested by individually assessing the indirect effects of each of the variables shown to be affected by swearing as potential mediators of the effect of swearing on chair push-up performance. Analyses were carried out for the potential mediator variables: self-confidence, positive emotion, humour and distraction. These analyses should be considered unplanned as they were not included in the pre-registration. Non-significant indirect effects were found for self-confidence, coefficient = 0.461, *p* > 0.05, positive emotion, coefficient = 0.672, *p* > 0.05, and distraction, coefficient = 0.711, *p* > 0.05. However, the indirect effect for humour was significant, coefficient = 1.104, *p* < 0.05. Furthermore, the direct effect of swearing on chair push-up time controlling for humour was not significant (*p* = .130). This suggests that the mediated effect of swearing on chair push-up time, via humour, is important. This is illustrated in Figure 2, below.

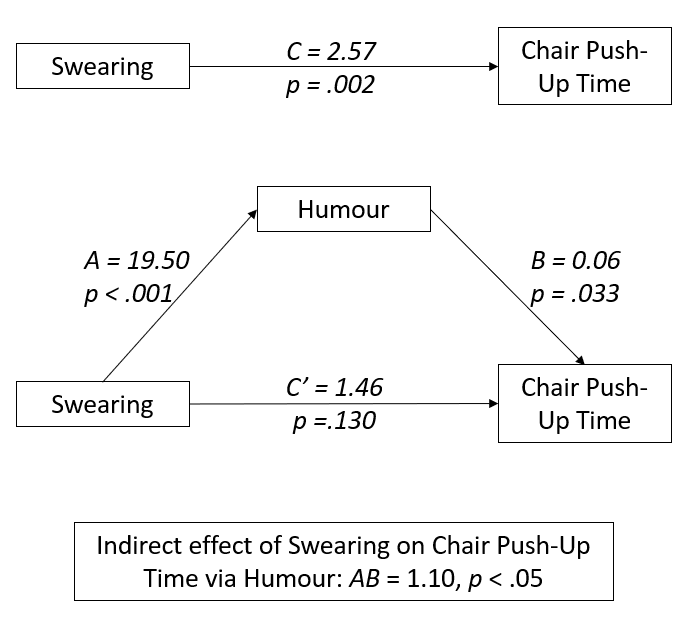


Figure 2: Visual representation of the mediation model of swearing on chair push-up performance via humour. The model shows the direct effect (*C*), the direct effect controlling for humour (*C’*) and the indirect effect (*AB*).

**Experiment 3 Discussion**

The first aim of Experiment 3 was to assess effects of swearing on physical task performance. The pre-registered hypothesis that repeating a swear word would benefit performance of a physical task compared with repeating a neutral word was supported. Participants held the chair push-up for a mean 10% longer in the swearing condition.

The second aim was to assess whether constructs related to state disinhibition were affected by swearing. Several effects of repeating a swear word relative to a neutral word were observed, comprising increased risky behaviour, increased flow, increased self-confidence, increased positive emotion, increased humour and increased distraction. These effects will be discussed in turn.

For risky behaviour, we should note here that we used a different BART score in these analyses compared to the one stated in the pre-registration. In the pre-registration we based our prediction on a misguided preliminary analysis of the Experiment 1 BART data, assessing effects of swearing on total pumps on win and loss trials. Yet, the recommended outcome measure of risky behaviour for the BART is the average number of pumps on win trials (Lauriola, Panno, Levin & Lejuez, 2014), also known as adjusted number of pumps (Lejeuz, Read, Kahler, Richards, Ramsey, Stuart, et al. 2002). While an effect of swearing on raised levels of risky behaviour is in keeping with our state disinhibition theory of beneficial effects of swearing on physical performance, one might argue that this analysis should be considered exploratory, and a pre-registered replication is required to confirm this. This will be revisited in the general discussion.

An effect of swearing on flow is also in keeping with swearing producing state disinhibition as the construct of flow has been characterised as a state in which pre-frontal brain regions are relatively inactive (Dietrich, 2004), consistent with the notion that flow may be a consequence of, or give rise to, state disinhibition. The Ulrich scale places more emphasis on enjoyment, than the Engeser scale, suggesting that enjoyment aspects of flow are most influenced by swearing. We recommend that further research assessing the effects of swearing on flow should use the Ulrich Flow Scale. This enjoyment aspect is also in keeping with the effects shown for positive emotion and humour. Theoretically, increased positive emotion and humour consequent to swearing would be predicted to activate the BAS leading to increased state disinhibition via BAS-related silencing of the BIS (Hirsh, Galinsky & Zhong, 2011); this we have termed the hot cognitions pathway for swearing-induced state disinhibition. Repeating a swear word was also rated as more distracting than repeating a neutral word, which could also theoretically deactivate the BIS via attentional mechanisms, leading to increased state disinhibition (Hirsh, Galinsky & Zhong, 2011). This we have termed the distraction pathway for swearing-induced state disinhibition. We should note also that previous research has found that repeating a swear word was rated by participants as emotion-inducing, distracting and humorous (Stephens & Robertson, 2020).

With respect to beneficial effects of swearing on self-confidence, to the best of our knowledge, this is the first study to show that repeating a swear word can benefit self-confidence. We included a measure of self-confidence on the assumption that swearing would increase state-disinhibition via deactivation of the BIS (Hirsh, Galinsky & Zhong, 2011), and consequently self-confidence would be greater. Given the plausibility of this effect, and that this was a pre-registered prediction, this study provides reasonable evidence that swearing can boost self-confidence.

That repeating a swear word had no effect on negative emotion is a novel finding, notwithstanding that absence of evidence is not the same as evidence of absence. Still, this finding is in line with contemporary understandings of the relative harmlessness of swearing (Jay & Janschewitz, 2012). Similarly, the absence of an effect of swearing on novelty ratings is not surprising given that swearing is, contemporaneously, commonplace. Absence of effects of swearing on cognitive anxiety may reflect the context in which the study was carried out; concerns about the pandemic may have raised anxiety (Yıldırım, Akgül, & Geçer, 2021) to levels above and beyond fluctuations due to swearing. The absence of an effect on somatic anxiety is in keeping with recent studies that have not shown signs of autonomic arousal after swearing (Stephens, Spierer, & Katehis, 2018; Stephens & Robertson, 2020).

A third aim was to assess whether psychological constructs related to state disinhibition mediated the beneficial effect of swearing on physical performance. The pre-registered predictions for mediation effects were not supported, with no mediating effect of risky behaviour or flow evident for the effect of swearing on physical task performance. Several other potential mediators linked to state disinhibition, specifically those that showed swearing effects in the previous analyses – self-confidence, positive emotion, distraction and humour – were assessed in unplanned mediation analyses. While no mediation effects were in evidence for self-confidence, positive emotion or distraction, humour was shown to mediate the effect of swearing on physical performance. This mediation effect is interesting and appears to support the hot cognitions pathway by which swearing brings about state disinhibition via BAS-related silencing of the BIS (Hirsh, Galinsky & Zhong, 2011). On the other hand, while prior research has shown that participants rated repeating a swear word in the context of a painful stimulus as humorous, humour did not mediate the beneficial effect of swearing on pain in that study (Stephens & Robertson, 2020). This might indicate that the psychological mechanism by which swearing contributes to beneficial effects is context specific. Furthermore, the mediating effect of humour in the present study should be treated with caution, first because this effect was not predicted in the pre-registration, and so needs validation in further confirmatory research, and second because humour was measured using a single item VAS scale (“Repeating the word was funny or humorous”) which may lack validity.

A fourth aim of Experiment 3 was to trial a protocol for conducting research on the effects of swearing on physical performance in a COVID-secure fully online procedure. The hybrid online-lab experimental design in which participants participated remotely via a live video link with a researcher successfully replicated lab-based effects shown previously, namely an effect of swearing on physical strength and risky behaviour. This procedure has the advantage over fully online studies of ensuring compliance with the vocalisation instructions. While not formally tested, it appears that the procedure of asking participants to look at the image of the eyes of the researcher while carrying out the vocalisations may have been successful in mitigating any online disinhibition which potentially disrupted Experiment 2. The chair push-up task was designed for this study as a physical task that precluded the logistical problems of supplying specialist equipment such as a hand dynamometer, while also not compromising participant safety. We would recommend exploring similar protocols in other studies where lab-based effects have not transferred to online research designs.

**General Discussion**

This paper has presented three experiments designed to assess whether constructs related to state disinhibition mediate the beneficial effect of swearing on physical strength. Due to the onset of the COVID-19 pandemic, the paper also tested two different online protocols for research of this nature. With respect to a beneficial effect of swearing on physical strength, Experiments 1 and 3 showed consistent effects with, on average, an 8% increase in grip strength shown in Experiment 1 and a 10% longer chair push-up hold time in Experiment 3. Previously, swearing has produced, on average, a 5% increase in Wingate Peak Power and an 8% increase in grip strength (Stephens, Spierer & Katehis, 2018). Thus, across several studies, including the pre-registered Experiment 3 from this paper, consistent performance benefits of swearing for relatively short, intense physical tasks, have been evidenced. Based on these repeated similar findings, the beneficial effect of swearing on physical performance appears to be reliable.

This paper presents emerging evidence that constructs related to state disinhibition may mediate this beneficial effect of swearing on grip strength. Evidence for this, spanning three separate strands, will now be reviewed.

Firstly, two variables theoretically linked to state disinhibition, risky behaviour and flow, were shown to be influenced by swearing. It was notable that Experiment 1 and 3 both found that repeating a swear word led to more risky behaviour on the BART, with risky behaviour being a recognised sub-component of disinhibition (Mullins-Sweatt, DeShong, Lengel, Helle & Krueger, 2019). It should be noted that as we did not specify the BART variable “average number of pumps on win trials” in the pre-registration, on its own the Experiment 3 BART effect should be considered exploratory. However, given that Experiment 3 replicated the BART effect shown in Experiment 1, a stronger case may be made for the validity of this effect. Overall, the BART data presented in Experiments 1 and 3 support the conclusion that swearing increases risky behaviour, a construct related to state disinhibition. Flow is also linked to state disinhibition based on it being characterised as a state in which pre-frontal brain regions are relatively inactive, consistent with a relaxation of cognitive control (Dietrich, 2004). Experiment 3 evidenced increased flow following swearing, presenting further evidence of an effect of swearing on state disinhibition. However, while there was evidence that swearing affected these constructs linked to state disinhibition, mediation analyses conducted for Experiments 1 and 3 found no evidence that risky behaviour mediated the effect of swearing on physical performance, and mediation analyses conducted in Experiment 3 did not show a mediation effect for flow. Thus, it appears that while risky behaviour and flow, constructs related to increased state disinhibition, are likely to be increased by swearing, they do not appear to be part of the psychological mechanism by which swearing benefits physical performance.

Secondly, a number of variables theoretically linked to increased state disinhibition via a quietening of the BIS (Hirsh, Galinsky & Zhong, 2011) were shown to be influenced by swearing in Experiment 3. We earlier outlined a distraction pathway for swearing-induced state disinhibition based on the writing of Hirsh, Galinsky and Zhong (2011). They cite the example of alcohol intoxication which disrupts attention, making it difficult to focus on alternative, competing courses of action. A consequence of this is reduced activity of the BIS, which simplifies the decision process of choosing one course of action, manifesting as state disinhibition. Distraction, which is a recognised sub-component of disinhibition (Mullins-Sweatt, DeShong, Lengel, Helle & Krueger, 2019) was shown to be raised in the swearing condition in Experiment 3 consistent with an attention-mediated reduction in BIS activity. Acute alcohol consumption has also been noted to increase self-confidence (Tiplady, Franklin & Scholey, 2004), possibly via the same BIS-quietening mechanism. The finding of increased self-confidence after swearing in Experiment 3 is consistent with a BIS-quietening explanation. As this novel finding was predicted in the pre-registration it may be considered reliable. However, similar to the findings noted above, in mediation analyses there was no evidence that distraction mediated the beneficial effect of swearing on physical performance.

We also earlier outlined a hot cognitions pathway for swearing-induced state disinhibition based on Hirsh, Galinsky and Zhong (2011). By this route, hot cognitions can activate the BAS leading to BAS-related silencing of the BIS and consequent disinhibition. Two variables linked to hot cognitions, positive emotion and humour, were found to be raised in the swearing condition in Experiment 3. Moreover, humour was shown to mediate the effect of swearing on physical strength. This mediation effect is consistent with the hot cognitions pathway since, as a rewarding experience, humour would be predicted to activate the BAS, consequently reducing activity of the BIS (Hirsh, Galinsky & Zhong, 2011). A link between swearing and humour is plausible when one considers the use extensive use of swearing in stand-up comedy, and the finding in the literature that that the word “fuck” was rated in the top 1% funniest of 5000 individually presented English words (Engelthaler & Hills, 2018). On the other hand, our method of assessing humour was unsophisticated, and this analysis was not pre-registered, so a mediation effect of humour is only weakly evidenced. Further pre-registered research should utilise more valid measures of humour to confirm a mediating effect.

Thirdly, the absence of any effects of swearing in Experiment 2, when online disinhibition was uncontrolled, is consistent with a state disinhibition explanation of the beneficial effects of swearing for physical strength. One would expect the observed null effects if participants were disinhibited in both the swearing and neutral word conditions, as they would have been in Experiment 2. We acknowledge alternative explanations for the null findings of Experiment 2, such as a differential effect of listening to a swear word as opposed to voicing it, or problems with remotely accessing the audio stimuli used in Experiment 2. Nevertheless, these null findings are consistent with a state disinhibition mechanism for the beneficial effect of swearing on physical performance.

Overall, these experiments have shown that swearing appears to influence several constructs linked to state disinhibition, namely risky behaviour, flow, self-confidence and positive emotion including humour. We have also outlined several plausible psychological mechanisms by which swearing can bring about state disinhibition, with some evidence favouring the distraction and hot cognitions pathways. The absence of such effects following swearing when online disinhibition was uncontrolled is also consistent with a state disinhibition explanation.

We suggest several avenues of further research probing the link between swearing, physical task performance and state disinhibition. One would be to assess the individual difference variable, neuroticism. Hirsh, Galinsky and Zhong (2011) report that as neurotic individuals have a higher baseline level of BIS activity, one should see a larger behavioural effect of disinhibition in such individuals. This predicts that one should see stronger effects of swearing on physical strength in individuals higher in neuroticism, and a more pronounced mediation effect of humour. The same authors also suggest that the EEG variable Error-Related Negativity, which is linked to BIS activity, should be reduced following an intervention to bring about disinhibition via the BIS system. This predicts a reduction in EEG Error-Related Negativity for a swearing condition compared with a non-swearing condition. Additionally, assessing effects on physical performance using methods other than swearing to inactivate the BIS system could be tested. These might include an intervention requiring participants to recall a time in which they acted without inhibitions (Hirsh, Galinsky & Zhong, 2011), or dim lighting, shown to reduce social desirability (Steidle & Werth, 2013; study 4). In this latter study, social desirability was assessed via a two-item measure of freedom from constraints. There is also scope to assess other constructs related to state disinhibition. Mullins-Sweatt, DeShong, Lengel, Helle and Krueger (2019) list five sub-components of disinhibition: irresponsibility, impulsivity, distractibility, risky behaviour, and lack of rigid perfectionism. Quantitative measures of components of state disinhibition other than risky behaviour and distraction may show greater sensitivity in mediation analyses.

In conclusion, across three experiments, one of which was pre-registered, evidence is presented showing that swearing consistently benefitted performance of a physical strength task. Swearing was also shown to increase self-confidence in pre-registered analyses. Swearing affected a variety of constructs linked to state disinhibition, suggesting that such constructs may provide a possible psychological mechanism for the beneficial effect of swearing on physical performance. Mediation analyses suggested that humour may mediate the beneficial effect of swearing on physical performance, supporting the hot cognitions pathway for swearing-induced state disinhibition. Further pre-registered experiments utilising reliable and valid measures of humour would be required to confirm this.

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