*Original Article*

QJEP

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

Quarterly Journal of Experimental Psychology
1–14

DOI: 10.1177/17470218221082657
qjep.sagepub.com
SAGE

**Richard Stephens, Harry Dowber, Amber Barrie, Sannida Almeida and Katie Atkins**

**Abstract**

Swearing fulfils positive functions, including benefitting pain relief and physical strength. Here we present two experiments assessing a possible psychological mechanism, increased state disinhibition, for the effect of swearing on physical strength. Two repeated measures experiments were carried out with sample sizes $N = 56$ and $N = 118$. Both included the measures of physical performance assessing, respectively, grip and arm strength, and both included the Balloon Analogue Risk Task (BART) to measure risky behaviour. Experiment 2, which was pre-registered, additionally assessed flow, emotion including humour, distraction including novelty, self-confidence, and anxiety. Experiments 1 and 2 found that repeating a swear word benefitted physical strength and increased risky behaviour, but risky behaviour did not mediate the strength effect. Experiment 2 found that repeating a swear word increased flow, positive emotion, humour, distraction, and self-confidence. Humour mediated the effect of swearing on physical strength. Consistent effects of swearing on physical strength indicate that this is a reliable effect. Swearing influenced 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

Received: 24 September 2021; revised: 25 January 2022; accepted: 7 February 2022

## Introduction

Offensive or obscene language is known as swearing in the United Kingdom and cursing in the United States (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 et al., 2017; Stephens et al., 2009; Stephens & Robertson, 2020; Stephens & Umland, 2011) and the social pain of being ostracised (Philipp & Lombardo, 2017). Swearing also augments persuasiveness (Scherer & Sagarin, 2006), credibility (Rassin & Heijden, 2005) and has been shown to benefit physical tasks that rely on strength and power (Stephens et al., 2018). This latter effect is the focus of the current study.

Stephens et al. (2018) found that repeating a swear word benefitted the 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,

School of Psychology, Keele University, Staffs, UK

**Corresponding author:**
Richard Stephens, School of Psychology, Keele University, Staffs ST5 5BG, UK.
Email: r.stephens@keele.ac.uk

characterised as an increased state disinhibition wherein individuals did not hold back. A similar suggestion was made by O'Connell et al., (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%).

This article further investigates the link between swearing, state disinhibition, and physical strength. Trait disinhibition can be defined as "a broad personality trait reflecting individual differences in self-regulation or control of one's behaviour, tending towards under-controlled rather than over-controlled" (based on the definition by Clark & Watson, 2008, as cited in Mullins-Sweatt et al., 2019). By extension, state disinhibition can be defined as "temporarily tending towards behaviours that are under-controlled rather than over-controlled." Hirsh et al. (2011) have suggested a model of state disinhibition based on the deactivation of Gray'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, allowing cognitive control processes to be implemented with the aim of facilitating behaviours with more desirable 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, leading to state disinhibition, are proposed by Hirsh et al. (2011). The first route is the greater activation of the Behavioural Activation System (BAS), the dopaminergic-mediated circuit associated with the pursuit of rewards. The BAS tends to narrow attention focus towards desired goals, reducing activation of less salient behaviours, thus reducing the activation of the conflict-related BIS. Hirsh et al. (2011) describe this as BAS-related silencing of the BIS. Interestingly, "hot cognitions," such as sexual arousal, have been theorised to activate the BAS (Van den Bergh et al., 2008). This opens the possibility that swearing, which may be considered a "hot cognition" based on its arousing properties (Stephens & Zile, 2017), 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 et al. (2011) propose BIS activity may be reduced, leading to state disinhibition, is the narrowing of attention due to reduced cognitive bandwidth. They suggest that this route underlies the disinhibitory effects of alcohol where intoxication acts to limit bandwidth by depleting cognitive resources. It is possible that swearing may similarly narrow attention through "distracting" the individual, directing attention towards processing the swear words, and reducing cognitive bandwidth as 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 deactivating the BIS proposed by Hirsh et al. (2011) is a reduction in social desirability concerns. One way this can be influenced is through 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 two experiments designed to assess beneficial effects of swearing on physical strength and whether state disinhibition mediates any such effects. Given its salience in the context of swearing, Experiment 1 assessed one potential mediator variable closely linked to the hot cognitions pathway, whereas Experiment 2 assessed a wider range of potential mediator variables, mapping across the three pathways for swearing-induced state disinhibition described above: hot cognitions, distraction, and social desirability.

Experiment 1 employed the Balloon Analogue Risk Task (BART; Lejuez et al. 2002) as a behavioural measure of risky behaviour. Previous research has shown that a higher dispositional BAS correlates with more risky behaviour in terms of betting higher stakes during a slot-machine gambling task (Demaree et al., 2008). 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 et al., 2014), also known as adjusted number of pumps (Lejuez et al., 2002). The BART was chosen as it is likely to be sensitive to behavioural activation and thus elucidate influence of the hot cognitions pathway to state disinhibition described earlier. Grip strength was assessed using a hand dynamometer using the same procedure as Stephens et al. (2018).

In Experiment 1, performance of the hand 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 (1) repeating a swear word would benefit the performance of a physical task such that there would be a higher mean isometric hand grip force score in the swearing condition compared with the non-swearing condition; (2) that there would be an increased average number of pumps on unexploded balloons for the swearing condition compared with the neutral word condition; (3) and that the predicted beneficial effect of swearing on physical task performance would be mediated by the state 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 minimise the carryover effects. Data were analysed using one-way related ANOVAs.

*Mediation.* The mediation design assumes that swearing influences strength through 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 the average number of pumps on unexploded balloons on the BART as a measure of state disinhibition. 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 BART deployed within Qualtrics was used (https://github.com/joyfulwei/Balloon-task-in-Qualtrics). Instructions were adapted from Lejuez 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 the measures common to both studies, but there were some deviations in the procedure. One study supplied $N=30$ cases. For this study, participants were given the

**Table 1.** Descriptive data.

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

SD: standard deviation.

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 10-s 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 10 s 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 10 s 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, the Barratt Impulsiveness Scale, Freedom from Constraints Scale, and Hayling Sentence Completion. These are not reported due to small sample size and consequent low power.

### Results

Descriptive data are shown in Table 1. Outliers were defined at the upper end as scores more than three times the interquartile range above the 75th percentile value, and at the lower end as scores more than three times the interquartile range below the 25th percentile value. Box and whisker plots showed three participants contributed four 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.

Mean grip performance was significantly greater for the swearing condition compared with the neutral word condition, $F(1, 55)=20.871$, $p<.001$, $\eta_p^2=0.275$. The magnitude of the mean difference was 2.49 kg (95% CI=[1.40, 3.58]). There was a significant main effect of vocalisation on the BART, $F(1, 55)=7.055$, $p=.010$, $\eta_p^2=0.114$. Significantly more pumps were made after the swearing vocalisation compared with the neutral vocalisation ($M=2.15$; 95% CI=[0.53, 3.77]). Condition order effects were assessed by re-running these ANOVAs, including condition order and the vocalization × condition order interaction, for grip performance and BART. Neither condition order nor the vocalization × condition order interaction was significant.

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 pumps) 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.

### Experiment 1 discussion

This experiment replicated the previous findings that swearing benefits grip strength (Aim 1) and showed that swearing impacted one element of state disinhibition linked to the hot cognitions pathway to state disinhibition described in the "Introduction," 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 pre-registered study was designed to rectify procedural and power issues, also employing a wider range of state disinhibition measures relating to the three pathways to state disinhibition described by Hirsh et al. (2011). In addition, due to suspension of in-person laboratory data collection because of COVID, an online protocol was developed.

## Experiment 2—hybrid online laboratory study

The first aim of Experiment 2 was to assess the effects of swearing on the physical task performance in a

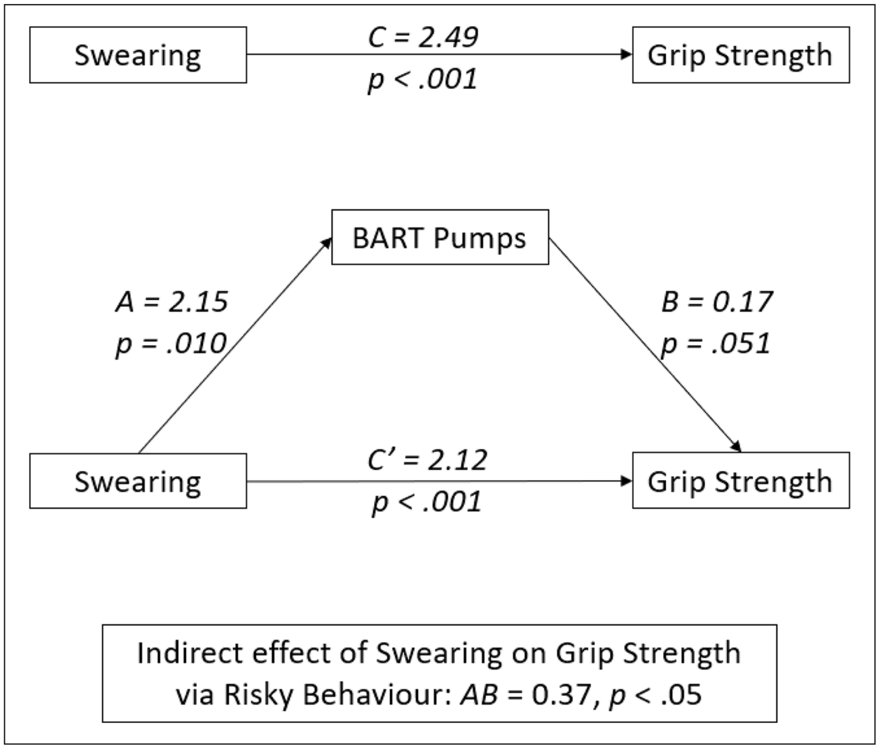


**Figure 1.** Visual representation of the mediation model of swearing on grip strength through BART pumps. The model shows the direct effect (*C*), the direct effect controlling for BART pumps (*C'*), and the indirect effect (*AB*).

pre-registered design. The pre-registration of this study, reference #53726, is here: https://aspredicted.org/Z5L_THM. The second aim was to assess whether a variety of constructs related to state disinhibition were 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 2, which assessed the effects of swearing on a wider range of measures linked to state disinhibition through lowered BIS activation, across the three pathways identified by Hirsh et al. (2011): risky behaviour, flow, emotion including humour, distraction including novelty, self-confidence, and anxiety. The third aim was to assess whether these psychological constructs related to state disinhibition mediated the beneficial effect of swearing on physical performance. The fourth aim was to trial a hybrid online laboratory 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. This hybrid protocol was developed following a fully online pilot study ($N$=63; repeated measures design) which found no effect of listening to a 20-s audio recording of a repeated swear on the BART. Under the hybrid protocol, 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 2, a body weight exercise suitable for performing remotely in an office-type environment was used to assess the 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.

Several potential mediator variables linked to the hot cognitions pathway were assessed. Risky behaviour was assessed using the BART as in Experiment 1. 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) and state disinhibition. As flow is linked to subjectively experience enjoyment and activation of reward pathways (Ulrich et al., 2014), this construct can be seen to map onto the activated BAS/hot cognitions pathway for swearing-induced state disinhibition. Flow was assessed using the 10-item Engeser Short Flow scale (Engeser & Baumann, 2016) and the 3-item flow scale developed by Ulrich et al. (2014). This second very brief scale assesses enjoyment, an aspect of flow omitted by the Engeser scale.

In addition, positive emotion, negative emotion, and humour were assessed using visual analogue scales (VAS) requiring participants to rate the experience of voicing the swear word and neutral word. Positive and negative emotions, two opposite sides of the coin with respect to the reward-seeking nature of BAS activation (Hirsh et al., 2011), were assessed based on the previous research linking swearing to emotion (e.g., Stephens & Robertson, 2020; Stephens & Zile, 2017). 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). Humour, also linked with the activation of reward circuitry in the brain (Watson et al., 2007) and therefore with BAS activity, has previously been shown to be increased after swearing (Stephens & Robertson, 2020).

Two variables linked to the distraction pathway were assessed using VAS: distraction and novelty. Distraction, previously been shown to be increased after swearing (Stephens & Robertson, 2020), is directly related to the distraction pathway for swearing-induced state disinhibition. 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.

Two variables linked to the social desirability pathway for swearing-induced state disinhibition through quietening of the BIS were assessed: state self-confidence and state anxiety. As described in the "Introduction," a "fuck-it effect" of swearing in which social desirability concerns are overcome by breaking taboo would be expected to impact on increasing self-confidence and reducing state anxiety, through the BIS quietening mechanism for state disinhibition suggested by Hirsh et al. (2011). State confidence, state cognitive anxiety, and state somatic anxiety were assessed through the sub-scales of the 17-item Revised Competitive State Anxiety-2 scale (Cox et al., 2003). Note that while we would expect state cognitive anxiety to be reduced by swearing through this mechanism, we predicted that state somatic anxiety would increase with swearing in line with the studies showing increased heart rate (e.g., Stephens et al., 2009) and skin conductance (e.g., Bowers & Pleydell-Pearce, 2011) after swearing.

It was hypothesised that repeating a swear word, compared with a neutral word, would (1) increase physical task performance, (2) increase risky behaviour, (3) increase flow, (4) increase positive emotion and humour, (5) decrease negative emotion, (6) increase distraction and novelty, (7) increase state self-confidence, (8) decrease cognitive anxiety, and (9) increase somatic anxiety. It was further hypothesised (10) that the predicted beneficial effect of swearing on physical task performance would be mediated by BART scores; (11) that the predicted beneficial effect of swearing on physical task performance would be mediated by flow; and (12) 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 above, 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 the instructions ($n=4$). Data for $N=118$ participants were entered for the analysis comprising 63 males, 53 females, 1 non-binary individual, and 1 individual who preferred not to 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 .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 .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 .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 et al., 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 vs 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 VAS.

## 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 s."

*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°, 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 60 s 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 20 s, 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. We entered the standard BART score for analysis—average number of pumps on win trials—consistent with Experiment 1.

*Flow measures.* Flow during the chair push-up task was assessed using the 10-item Engeser Short Flow Scale (Engeser & Baumann, 2016) and the 3-item flow index used by Ulrich et al. (2014). The Engeser Short Flow Scale (example item: "I feel just the right amount of challenge") collects responses through 7-point Likert-type scales anchored from "*not at all*," scoring 1, to "*very much*," scoring 7. The final score is the mean score across all 10 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, $\alpha = .92$ (Engeser & Baumann, 2016). Ulrich et al.'s flow index collects responses ("I would love to repeat it again"; "I was thrilled"; "Task demands were well matched to my ability") through 7-point Likert-type scales anchored at 1 ("*I do not agree at all*") and 7 ("*I completely agree*"). The final score is the sum across the three items, with a range of 3–21, where a high score indicates higher levels of flow. This scale has acceptable reliability (Cronbach's alpha = .80; Ulrich et al., 2014).

*VAS.* Participants rated each vocalisation on five 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 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 to 100, with a higher score indicating a higher level of the construct.

*Revised competitive state anxiety-2.* This 17-item scale has the sub-scales: self-confidence, somatic anxiety, and cognitive anxiety (Cox et al., 2003). Participants were asked to rate how they felt when doing the chair push-up task a few moments before. The six-item self-confidence sub-scale (e.g., "I feel self-confident"), the seven-item somatic anxiety sub-scale (e.g., "I feel jittery"), and the five-item cognitive anxiety sub-scale (e.g., "I'm concerned about performing poorly") were answered through 4-point Likert-type 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 sub-scale, 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 .80 (Cox et al., 2003).

## Procedure

Participants who 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 vs 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 10 s. After this, participants completed the BART and chair push-up task in random order, followed by the questionnaires in random order. On completion of both conditions, a final debrief screen was presented. Before terminating

**Table 2.** Descriptive data.

| | *n* | *M* | *SD* | Winsorisation percentile |
|---|---|---|---|---|
| Chair push-up score (s) | | | | |
| Neutral | 118 | 26.88 | 16.78 | – |
| Swear | | 29.55 | 16.62 | – |
| BART mean pumps on winning trials | | | | |
| Neutral | 118 | 8.92 | 3.34 | 97th |
| Swear | | 9.67 | 3.72 | – |
| Engeser short flow scale scores | | | | |
| Neutral | 118 | 5.10 | 1.38 | 97th |
| Swear | | 5.20 | 1.25 | 94th |
| Ulrich flow scale scores | | | | |
| Neutral | 118 | 12.98 | 4.32 | – |
| Swear | | 13.60 | 4.34 | – |
| Positive emotion rating | | | | |
| Neutral | 110 | 29.19 | 25.04 | – |
| Swear | | 48.11 | 27.91 | – |
| Humour rating | | | | |
| Neutral | 115 | 55.01 | 31.43 | – |
| Swear | | 74.21 | 25.48 | – |
| Negative emotion rating | | | | |
| Neutral | 93 | 16.10 | 19.35 | 95th |
| Swear | | 18.83 | 19.95 | 96th |
| Distraction rating | | | | |
| Neutral | 115 | 56.15 | 27.70 | – |
| Swear | | 66.66 | 25.55 | – |
| Novelty rating | | | | |
| Neutral | 110 | 58.50 | 30.84 | – |
| Swear | | 55.35 | 31.65 | – |
| Self-confidence scale scores | | | | |
| Neutral | 118 | 23.83 | 7.35 | – |
| Swear | | 25.29 | 7.87 | – |
| Cognitive anxiety scale scores | | | | |
| Neutral | 118 | 22.02 | 7.87 | – |
| Swear | | 20.93 | 7.90 | – |
| Somatic anxiety scale scores | | | | |
| Neutral | 118 | 21.69 | 6.49 | 99th |
| Swear | | 21.16 | 6.80 | – |

SD: standard deviation.

the call, the researcher verbally invited any further questions, checked the participant was ok, and thanked them.

## 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. Hypothesis (1) was supported as there was a longer mean chair push-up hold time in the swearing compared with the neutral word condition, $F(1, 117) = 10.755$, $p = .001$, $\eta_p^2 = 0.084$. Hypothesis (2) was also supported as there was a greater number of average pumps on win trials of the BART for the swearing condition, $F(1, 117) = 6.663$, $p = .011$, $\eta_p^2 = 0.054$. Please note that we tested this hypothesis using a different BART score than the one described in the pre-registration, consistent with Experiment 1. Hypothesis (3) was supported for the Ulrich flow scale, with a higher score for the swearing condition, $F(1, 117) = 4.486$, $p = .036$, $\eta_p^2 = 0.037$, but not for the Engeser Short Flow scale, $F(1, 117) < 1.0$, $\eta_p^2 = 0.008$. Hypothesis (4) was supported with higher ratings of positive emotion for swearing, $F(1, 109) = 33.724$, $p < .001$, $\eta_p^2 = 0.236$, and higher ratings of humour for swearing, $F(1, 115) = 43.094$, $p < .001$, $\eta_p^2 = 0.273$. Hypothesis (5) was not supported as there was no effect for negative emotion, $F(1, 92) = 1.605$, $p = .208$, $\eta_p^2 = 0.017$. Hypothesis (6) was partially supported with higher ratings for distraction with swearing, $F(1, 115) = 17.545$, $p < .001$, $\eta_p^2 = 0.132$, but no effect of novelty, $F(1, 110) = 1.665$, $p = .200$, $\eta_p^2 = 0.015$. Hypothesis (7) was supported, with a higher state self-confidence score for the swearing condition, $F(1, 117) = 6.528$, $p = .012$, $\eta_p^2 = 0.053$. Hypothesis (8) was not supported,

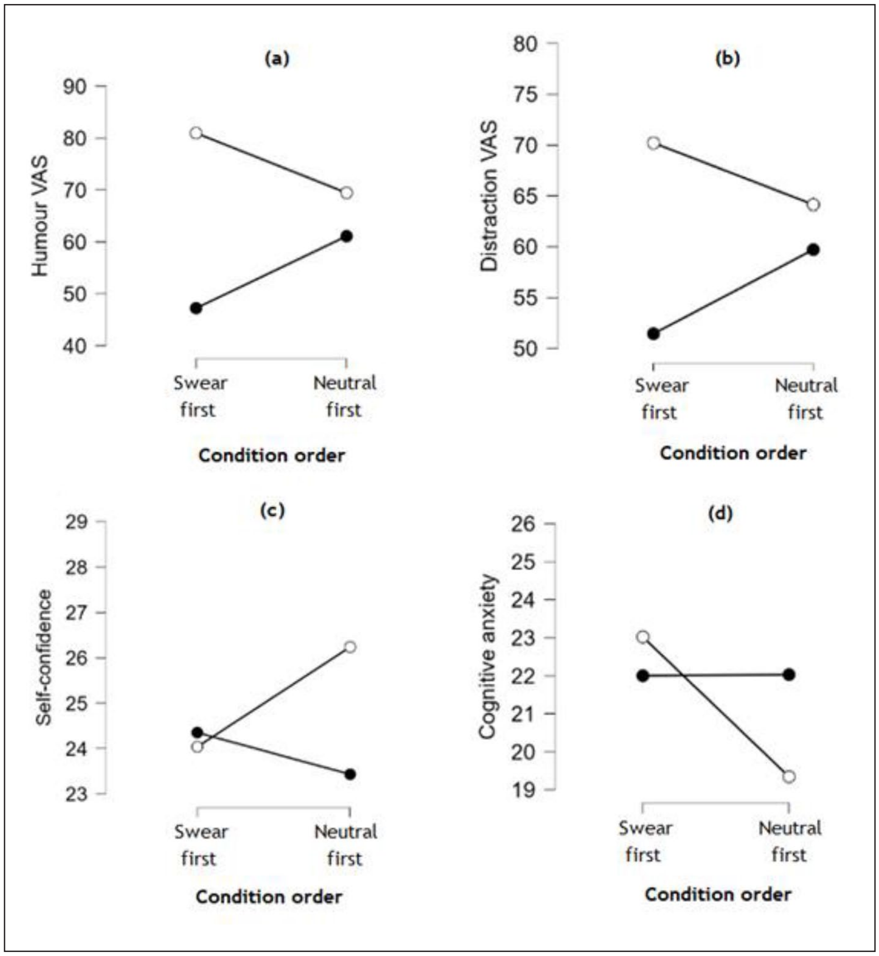


**Figure 2.** (a) Humour, (b) distraction, (c) self-confidence, and (d) cognitive anxiety, by vocalisation (swearing vs neutral word) and condition order (swearing first vs neutral first). White dots—swearing condition; black dots—neutral word condition.

with no effect of swearing for cognitive anxiety, $F(1, 117) = 3.708$, $p = .057$, $\eta_p^2 = 0.031$. Hypothesis (9) was not supported, with no effect of swearing for somatic anxiety, $F(1, 117) = 1.221$, $p = .271$, $\eta_p^2 = 0.010$. Please note that some participants did not complete all VAS measures used to test Hypotheses (4)–(6).

Condition order effects were assessed by re-running these ANOVAs, including vocalisation, condition order, and the vocalisation × condition order interaction, for each dependent variable assessed in Hypotheses (1)–(9). There were no main effects of condition order. The vocalisation × condition order interaction was significant for humour, $F(1, 114) = 21.078$, $p < .001$, $\eta_p^2 = 0.156$, for distraction, $F(1, 114) = 8.346$, $p = .005$, $\eta_p^2 = 0.068$, for self-confidence, $F(1, 116) = 7.763$, $p = .006$, $\eta_p^2 = 0.063$, and for cognitive anxiety, $F(1, 116) = 11.583$, $p < .001$, $\eta_p^2 = 0.091$. These interactions are illustrated in Figure 2.

### *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 (10) was not supported as the mediated route for the prediction of the effect of swearing on chair push-up task performance through BART average pumps on win trials score was not significant, coefficient = −0.193, $p > .05$. Please note that we tested this hypothesis using a different BART score than the one described in the pre-registration. Hypothesis (11) was also not supported as the mediated route for the prediction of the effect of swearing on chair push-up task performance through the Engeser flow score was not significant, coefficient = 0.065, $p > .05$, and neither was the mediated route through the Ulrich flow score, coefficient = 0.415, $p > .05$.

Hypothesis (12) 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: positive emotion, humour, distraction, and self-confidence. These analyses should be considered unplanned as they were not included in the pre-registration. Non-significant indirect effects were found for positive emotion, coefficient = 0.672, $p > .05$, distraction, coefficient = 0.711, $p > .05$, and

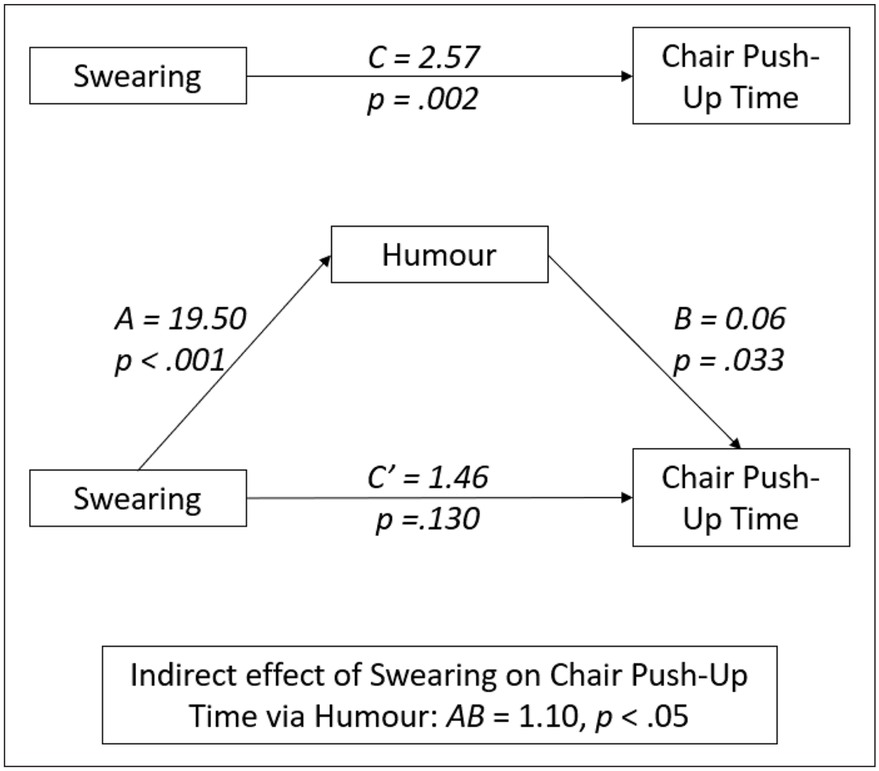


**Figure 3.** Visual representation of the mediation model of swearing on chair push-up performance through humour. The model shows the direct effect (*C*), the direct effect controlling for humour (*C'*), and the indirect effect (*AB*).

self-confidence, coefficient $=0.461$, $p>.05$. However, the indirect effect for humour was significant, coefficient $=1.104$, $p<.05$. 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, through humour, is important. This is illustrated in Figure 3.

## *Experiment 2 discussion*

The first aim of Experiment 2 was to assess the 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, while the third aim was to assess whether these constructs mediated the beneficial effect of swearing on physical performance. Experimental hypotheses were supported with respect to several of the constructs linked to the hot cognitions pathway for swearing-induced state disinhibition outlined in the "Introduction." These were increased risky behaviour (BART), increased flow, increased positive emotion, and increased humour after swearing.

With respect to the BART, we should note here that we used a different BART score in these analyses compared to the one stated in the pre-registration. It was only at the data analysis stage that we realised that the recommended outcome measure of risky behaviour for the BART is the average number of pumps on win trials (Lauriola et al., 2014), also known as adjusted number of pumps (Lejuez et al., 2002). Therefore, on its own, this analysis should be considered exploratory, and a pre-registered replication is required to confirm this. This will be revisited in the general discussion. However, there was no evidence that risky behaviour (BART score) mediated the effect of swearing on physical task performance, suggesting that the aspects of state disinhibition that are related to risky behaviour do not explain the effects of swearing on strength.

The observed effect of swearing on flow is in keeping with swearing producing state disinhibition through the hot cognitions pathway. This effect was shown for the Ulrich scale, which places more emphasis on enjoyment, but not the Engeser scale, suggesting that enjoyment aspects of flow are most influenced by swearing. On this basis, we recommend that further research assessing the effects of swearing on flow should use the Ulrich flow scale. However, as there was no mediation effect for flow, these data do not support flow as being an important psychological variable explaining how swearing brings about physical performance benefits.

The observed effects of swearing on positive emotion and humour and the observed mediation effect humour further support the hot cognitions pathway by which swearing brings about state disinhibition through BAS-related silencing of the BIS (Hirsh et al., 2011). We should note that previous research has also found that repeating a swear word was rated by participants as emotion-inducing and humorous (Stephens & Robertson, 2020). However, in prior research showing 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 (Stephens & Robertson, 2020). This might indicate that the psychological mechanism by which swearing contributes to beneficial effects is context-specific (that is, different for strength compared with pain relief). However, the mediating effect of humour in this study should be treated with caution; first, because this effect was not specifically included in the pre-registration and so requires 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.

Repeating a swear word was rated as more distracting than repeating a neutral word, supporting the distraction pathway for swearing-induced state disinhibition. This is consistent with prior research which has also shown that participants rated repeating a swear word in the context of a painful stimulus as distracting (Stephens & Robertson, 2020). However, the absence of a mediation effect of distraction suggests that the distraction pathway is of lesser importance compared with the hot cognitions pathway for physical performance enhancing swearing-induced state disinhibition.

With respect to the beneficial effects of swearing on self-confidence, to the best of our knowledge, this is the first study to confirm such a phenomenon. 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. We included a measure of self-confidence to assess the social desirability pathway for swearing-induced state disinhibition through quietening of the BIS (Hirsh et al., 2011). However, self-confidence showed no evidence of mediating the effect of swearing on strength. Still, the finding that swearing improved self-confidence ratings may be of benefit to society if it helps improve personal performance. Further research could usefully assess whether this occurs in other swearing contexts, such as swearing and pain (e.g., Stephens & Robertson, 2020), and investigating wider applications of self-confidence augmented by swearing, e.g., as preparation for performing in front of large public audiences.

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 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 the 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 et al., 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 & Robertson, 2020; Stephens et al., 2018).

The fourth aim of Experiment 2 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 laboratory experimental design in which participants participated remotely through a live video link with a researcher successfully replicated laboratory-based effects shown previously, namely effects 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 a fully online pilot study of swearing effects that returned null effects. 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 laboratory-based effects have not transferred to online research designs.

Condition order effects were assessed to check for carryover effects, defined as where participants in a repeated measures design are changed by experiencing one of the conditions. Problematic order effects in this study would be signs of increased disinhibition for the neutral word vocalisation where it came second compared with when it came first, due to a carryover effect of previously repeating a swear word. While there were significant vocalisation $\times$ condition order interaction effects for humour, distraction, self-confidence, and cognitive anxiety, none of these interactions were driven by increased state disinhibition for the neutral word vocalisation where it came second. Such effects would be visible in Figure 2 as lower disinhibition scores (lower humour, lower distraction, lower self-confidence, and higher cognitive anxiety) in the neutral condition for neutral first versus swear first. Therefore, carryover effects of swearing into the neutral word condition do not appear to be a limiting factor in interpreting these data with respect to state disinhibition.

## General discussion

This article has presented two 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 article also tested an online protocol for research of this nature. With respect to a beneficial effect of swearing on physical strength, Experiments 1 and 2 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 2. Previously, swearing has produced, on average, a 5% increase in Wingate Peak Power and an 8% increase in grip strength (Stephens et al., 2018). Thus, across several studies, including the pre-registered Experiment 2 from this article, 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 article presents emerging evidence that constructs related to state disinhibition may mediate this beneficial effect of swearing on grip strength. A number of variables theoretically linked to increased state disinhibition through a quietening of the BIS (Hirsh et al., 2011) were shown to be influenced by swearing in Experiments 1 and 2. Hirsh et al. (2011) outlined several pathways by which state disinhibition may be brought about by quietening of the BIS—the hot cognitions pathway, the distraction pathway, and the social desirability pathway. This study has found support for all of these in the context of swearing and strength, but with strongest though not definitive support for the hot cognitions pathway. By this mechanism, hot cognitions generated through swearing may activate the BAS leading to BAS-related silencing of the BIS and consequent disinhibition.

Evidence for the hot cognitions pathway was shown across Experiments 1 and 2, as both found that repeating a swear word led to more risky behaviour on the BART. 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 2 BART effect should be considered exploratory. However, given that Experiment 2 replicated the BART effect shown in Experiment 1, a stronger case may be made for the validity of this effect. Risky behaviour is a recognised sub-component of disinhibition (Mullins-Sweatt et al., 2019) linked to the hot cognitions pathway (Hirsh et al., 2011). Overall, the BART data presented in Experiments 1 and 2 support the conclusion that swearing increases risky behaviour, a construct related to state disinhibition. However, mediation analyses conducted for Experiments 1 and 2 found no evidence that risky behaviour mediated the effect of swearing on physical performance. Thus, it appears that while risky behaviour is likely to be increased by swearing, it does not appear to be part of the psychological mechanism by which swearing benefits physical performance.

Flow, positive emotion, and humour were also raised in the swearing condition in Experiment 2. Indeed, all variables predicted to be increased by swearing according to the hot cognitions pathway for swearing-induced state disinhibition demonstrated increases following swearing, a consistency which further supports the hot cognitions pathway as a likely route. Moreover, humour was shown to mediate the effect of swearing on physical strength. As a rewarding experience, humour would be predicted to activate the BAS, consequently reducing the activity of the BIS (Hirsh et al., 2011). A link between swearing and humour is plausible when one considers the 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). However, 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 use more valid measures of humour to confirm a mediating effect.

Although mediation effects were not in evidence, the pre-registered Experiment 2 also showed some support for the distraction pathway and the social desirability pathway for swearing-induced state disinhibition consequent to quietening of the BIS, as suggested by Hirsh et al. (2011). Distraction, which is a recognised sub-component of disinhibition (Mullins-Sweatt et al., 2019), was shown to be raised in the swearing condition in Experiment 2 consistent with a distraction of attention-mediated reduction in BIS activity. Self-confidence also showed evidence of a beneficial effect of swearing, adding further support to the theory that swearing may increase state disinhibition through lowered activity of the BIS. We would add that the hypothesis test for self-confidence was pre-registered, strengthening the credibility of our interpretation that swearing can boost self-confidence. However, similar to the findings noted above, in mediation analyses, there was no evidence that self-confidence mediated the beneficial effect of swearing on physical performance, and there was no evidence of mediation effects of distraction. Nevertheless, as this research is in its infancy, we would not rule out the distraction and social desirability pathways as being viable psychological mechanisms for the beneficial effects of swearing on physical strength; further confirmatory research is required to assess the importance of these pathways.

One might argue that this research is limited because we did not use a direct measure of BIS activity, such as the Behavioural Inhibition Scale (Carver & White, 1994). However, in the present context, this scale would be inappropriate as it is a *trait* measure whereas our theoretical interest relates to *state* (dis)inhibition. Therefore, our approach of assessing constructs related to state disinhibition that were predicted to be influenced by lowered BIS activity was appropriate. Wider interest in benefits of disinhibition is evidenced by van den Bos and Lind (2013), who argue that sometimes people may overthink situations, leading to the activation of the BIS for longer and with more intensity than needed, leading to less efficacious behaviour. We would support this position and add that if our theory is correct then it suggests that people may swear as a means of curtailing an overactive BIS, helping them to respond more efficiently in different situations.

Overall, these experiments have shown that swearing appears to influence several constructs linked to state disinhibition, namely risky behaviour, flow, positive emotion, including humour, distraction, and self-confidence. We have also outlined a plausible psychological mechanism by which swearing can bring about state disinhibition, through lowered activation of the BIS, with some evidence favouring the hot cognitions pathway for such lowering of BIS activation. We would contend that our model of swearing-induced state disinhibition consequent to lowered BIS activity offers a promising theoretical account of the benefits of swearing for physical strength, and below we suggest several avenues of further research probing the link between swearing, physical task performance, and state disinhibition.

One approach would be to assess the individual difference variable, neuroticism. Hirsh et al. (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 through the BIS system. This predicts a reduction in electroencephalogram (EEG) error-related negativity for a swearing condition compared with a non-swearing condition. It would also be of interest to assess the effects on physical performance using methods other than swearing to deactivate the BIS system. These might include an intervention requiring participants to recall a time in which they acted without inhibitions (Hirsh et al., 2011) or turning off the web cam.

In conclusion, across two experiments, one of which was pre-registered, evidence is presented showing that swearing consistently benefitted the performance of a physical strength task. This study has shown a variety of effects of swearing consistent with a lowering of BIS activity leading to increased state disinhibition, suggesting this as a viable theoretical account 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 using reliable and valid measures of humour would be required to confirm this. A further reliable and novel finding arising out of a pre-registered hypothesis was that repeating a swear word increased self-confidence, a finding which may have practical benefits across a wide range of applications, e.g., public speaking.

## Acknowledgements

The authors thank Tasnim Abdi, Ilaria Casadio, and Nat Maginnis for their assistance with data collection and management.

## Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

## ORCID iD

Richard Stephens https://orcid.org/0000-0002-5851-8975

## References

Bowers, J. S., & Pleydell-Pearce, C. W. (2011). Swearing, euphemisms, and linguistic relativity. *PLOS ONE*, *6*, Article e22341.

Carver, C. S., & White, T. L. (1994). Behavioral inhibition, behavioral activation, and affective responses to impending reward and punishment: The BIS/BAS Scales. *Journal of Personality and Social Psychology, 67*(2), 319–333. https://doi.org/10.1037/0022-3514.67.2.319

Cox, R. H., Martens, M. P., & Russell, W. D. (2003). Measuring anxiety in athletics: The Revised Competitive State Anxiety Inventory–2. *Journal of Sport and Exercise Psychology*, *25*(4), 519–533.

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*. Harper & Row.

Demaree, H. A., DeDonno, M. A., Burns, K. J., & Everhart, D. E. (2008). You bet: How personality differences affect risk-taking preferences. *Personality and Individual Differences*, *44*(7), 1484–1494.

Dietrich, A. (2004). Neurocognitive mechanisms underlying the experience of flow. *Consciousness and Cognition*, *13*(4), 746–761.

Engelthaler, T., & Hills, T. T. (2018). Humor norms for 4,997 English words. *Behavior Research Methods*, *50*(3), 1116–1124.

Engeser, S., & Baumann, N. (2016). Fluctuation of flow and affect in everyday life: A second look at the paradox of work. *Journal of Happiness Studies*, *17*(1), 105–124.

Gray, A. (1982). *The neuropsychology of anxiety*. Oxford University Press.

Hirsh, J. B., Galinsky, A. D., & Zhong, C.-B. (2011). Drunk, powerful, and in the dark: How general processes of disinhibition produce both prosocial and antisocial behavior. *Perspectives on Psychological Science*, *6*(5), 415–427.

Jay, T., & Janschewitz, K. (2012, May–June). The science of swearing. *Observer*, *25*(5). https://www.psychologicalscience.org/observer/the-science-of-swearing

Lapidot-Lefler, N., & Barak, A. (2012). Effects of anonymity, invisibility, and lack of eye-contact on toxic online disinhibition. *Computers in Human Behavior*, *28*(2), 434–443.

Lauriola, M., Panno, A., Levin, I., & Lejuez, C. (2014). Individual differences in risky decision making: A meta-analysis of sensation seeking and impulsivity with the balloon analogue risk task. *Journal of Behavioral Decision Making*, *27*(1), 20–36.

Lejuez, C., Read, J., Kahler, C., Richards, J., Ramsey, S., Stuart, G., Strong, D. R., & Brown, R. A. (2002). Evaluation of a behavioral measure of risk taking: The Balloon Analogue Risk Task (BART). *Journal of Experimental Psychology: Applied*, *8*(2), 75–84.

Montoya, A., & Hayes, A. (2017). Two-condition within-participant statistical mediation analysis: A path-analytic framework. *Psychological Methods*, *22*(1), 6–27.

Mullins-Sweatt, S. N., DeShong, H. L., Lengel, G. J., Helle, A. C., & Krueger, R. F. (2019). Disinhibition as a unifying construct in understanding how personality dispositions undergird psychopathology. *Journal of Research in Personality*, *80*, 55–61.

O'Connell, D., Hinman, M., Hearne, K., Michael, Z., & Nixon, S. (2014). The effects of "grunting" on serve and forehand velocities in Collegiate tennis players. *Journal of Strength and Conditioning Research*, *28*(12), 3469–3475.

Pan, H., Liu, S., Miao, D., & Yuan, Y. (2018). Sample size determination for mediation analysis of longitudinal data. *BMC Medical Research Methodology*, *18*, Article 32.

Philipp, M. C., & Lombardo, L. (2017). Hurt feelings and four letter words: Swearing alleviates the pain of social distress. *European Journal of Social Psychology*, *47*(4), 517–523.

Rassin, E., & Heijden, S. V. D. (2005). Appearing credible? Swearing helps!. *Journal of Psychology, Crime & Law*, *11*(2), 177–182.

Robertson, O. S., Robinson, S. J., & Stephens, R. (2017). A cross-cultural comparison of the effects of swearing on pain perception in a British and Japanese population. *Scandinavian Journal of Pain*, *17*(10), 267–272.

Scherer, C. R., & Sagarin, B. J. (2006). Indecent influence: The positive effects of obscenity on persuasion. *Social Influence*, *1*(2), 138–146.

Soanes, C. (2002). *Pocket Oxford English dictionary*. Oxford University Press.

Stephens, R., Atkins, J., & Kingston, A. (2009). Swearing as a response to pain. *NeuroReport*, *20*(12), 1056–1060.

Stephens, R., & Robertson, O. S. (2020). Swearing as a response to pain: Assessing hypoalgesic effects of novel "swear" words. *Frontiers in Psychology*, *11*, Article 723.

Stephens, R., Spierer, D. K., & Katehis, E. (2018). Effect of swearing on strength and power performance. *Psychology of Sport and Exercise*, *35*(3), 111–117.

Stephens, R., & Umland, C. (2011). Swearing as a response to pain—Effect of daily swearing frequency. *Journal of Pain*, *12*(12), 1274–1281.

Stephens, R., & Zile, A. (2017). Does emotional arousal influence swearing fluency? *Journal of Psycholinguistic Research*, *46*(4), 983–995.

Ulrich, M., Keller, J., Hoenig, K., Waller, C., & Grön, G. (2014). Neural correlates of experimentally induced flow experiences. *NeuroImage*, *86*(2), 194–202.

Van den Bergh, B., Dewitte, S., & Warlop, L. (2008). Bikinis instigate generalized impatience in intertemporal choice. *Journal of Consumer Research*, *35*(1), 85–97.

van den Bos, K., & Lind, E. A. (2013). On sense-making reactions and public inhibition of benign social motives: An appraisal model of prosocial behavior. *Advances in Experimental Social Psychology*, *48*, 1–58.

van Lancker, D., & Cummings, J. L. (1999). Expletives: Neurolinguistics and neurobehavioral perspectives on swearing. *Brain Research Reviews*, *31*(1), 83–104.

Watson, K. K., Matthews, B. J., & Allman, J. M. (2007). Brain activation during sight gags and language-dependent humor. *Cerebral Cortex*, *17*(2), 314–324.

Welch, A. S., & Tschampl, M. (2012). Something to shout about: A simple, quick performance enhancement technique improved strength in both experts and novices. *Journal of Applied Sport Psychology*, *24*(4), 418–428.

Yıldırım, M., Akgül, Ö., & Geçer, E. (2021). The effect of COVID-19 anxiety on general health: The role of COVID-19 coping. *International Journal of Mental Health and Addiction*, *11*(1), 1–12.