Reproduing analysis of: Unlearning implicit social biases during sleep (2015)

Richard Troise[1]

[1] Brooklyn College

Author Note

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Correspondence concerning this article should be addressed to Richard Troise, Postal address. E-mail: my@email.com

Abstract

There is evidence by Hu et al. (2015) on the unlearning of social bias by reinforcing a counterbias behavior during slow-wave/REM sleep - the optimal time frame to consolidate new memories. The reproduced analysis pertains to the interaction of cued and uncued reduction bias before sleep (prenap), then, one week later (delayed). A power analysis shows that the original effect size may only be observed approximately 14% of the time on average.

Keywords: unlearning, social biases, slow-wave sleep

Word count: X

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The experiment on unlearning social bias shows the relevance of sleep playing a role in the dissaption of a pre-existing implicit bias, Hu et al. (2015). The rationale comes from auditory information reinforcing learning behavior during slow wave sleep, causing a targeted memory reactivation. As a result of the auditory cue, counterbias behavior in participants was expected to increase. In addition, the memory reactivation should result in a sustained reduction in social bias, in that the measured bias does not differ between prenap and delay. The implications of such an effect may be relevant for unlearning other unwanted habits. The original data was downloaded from https://osf.io/b3k9a/

Methods

Participants

As stated in experiment, there were 40 participants recruited but only 38 were present for all groups.

Material

The details of the experiment can be found in Hu et al. (2015).

Procedure

In the reproduced analysis, the 38 participants' bias score were measured under four conditions: No auditory cue before sleep, then one week later; and a reinforced cue before sleep, then one week later.

Data analysis

We used R (Version 3.5.0; R Core Team, 2018) and the R-packages *bindrcpp* (Müller, 2018), *dplyr* (Version 0.8.0.1; Wickham, François, Henry, & Müller, 2019), *ggplot2* (Version 3.1.0; Wickham, 2016), *papaja* (Version 0.1.0.9842; Aust & Barth, 2018), *sjstats* (Version

0.17.4; Lüdecke, 2019), and *xtable* (Version 1.8.3; Dahl, Scott, Roosen, Magnusson, & Swinton, 2018) for all our analyses. Two participants had to be excluded from the analyses and were labelled as "NA" in the data sheet.

Results

IAT bias scores were grouped in R-studio for each participant in order to perform a 2x2 (cue/uncue vs prenap/delay) repeated measure ANOVA. The group means are displayed in Figure 1 followed by the ANOVA results in Figure 2. There was a main effect of Time, $F(1, 37) = 5.76$, $MSE = 0.15$, $p = .022$, $\hat{\eta}^2_G = .030$. Mean IAT scores remained lower after training, between prenap testing (0.447) and testing one week later (0.334). There was not a main effect of cue factor after learning, $F(1, 37) = 0.34$, $MSE = 0.28$, $p = .566$, $\hat{\eta}^2_G = .003$. The two-way interaction between Time and Cue after training was significant, $F(1, 37) = 4.67$, $MSE = 0.07$, $p = .037$, $\hat{\eta}^2_G = .012$. The difference in prenap and delay scores was significant only when the cue was not initiated, indicating that memory reactivation sustained after counterbias training.

Figure 1: Means of time and cue factor

GroupMean	Cue	Time	SEM
0.4034053	Cue	Prenap	0.0124207
0.4555480	Cue	Delay	0.0100403
0.2657306	Uncue	Prenap	0.0105882
0.4991466	Uncue	Delay	0.0118761

Figure 2: Results of 2x2 repeated measured ANOVA

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Residuals	37	9.4853844	0.2563617	NA	NA
cue_factor	1	0.0929324	0.0929324	0.3355098	0.5659427
Residuals	37	10.2485769	0.2769886	NA	NA
time_factor	1	0.8440958	0.8440958	5.7634410	0.0215060
Residuals	37	5.4189059	0.1464569	NA	NA
cue_factor:time_factor	1	0.3290260	0.3290260	4.6718467	0.0372022
Residuals	37	2.6058138	0.0704274	NA	NA

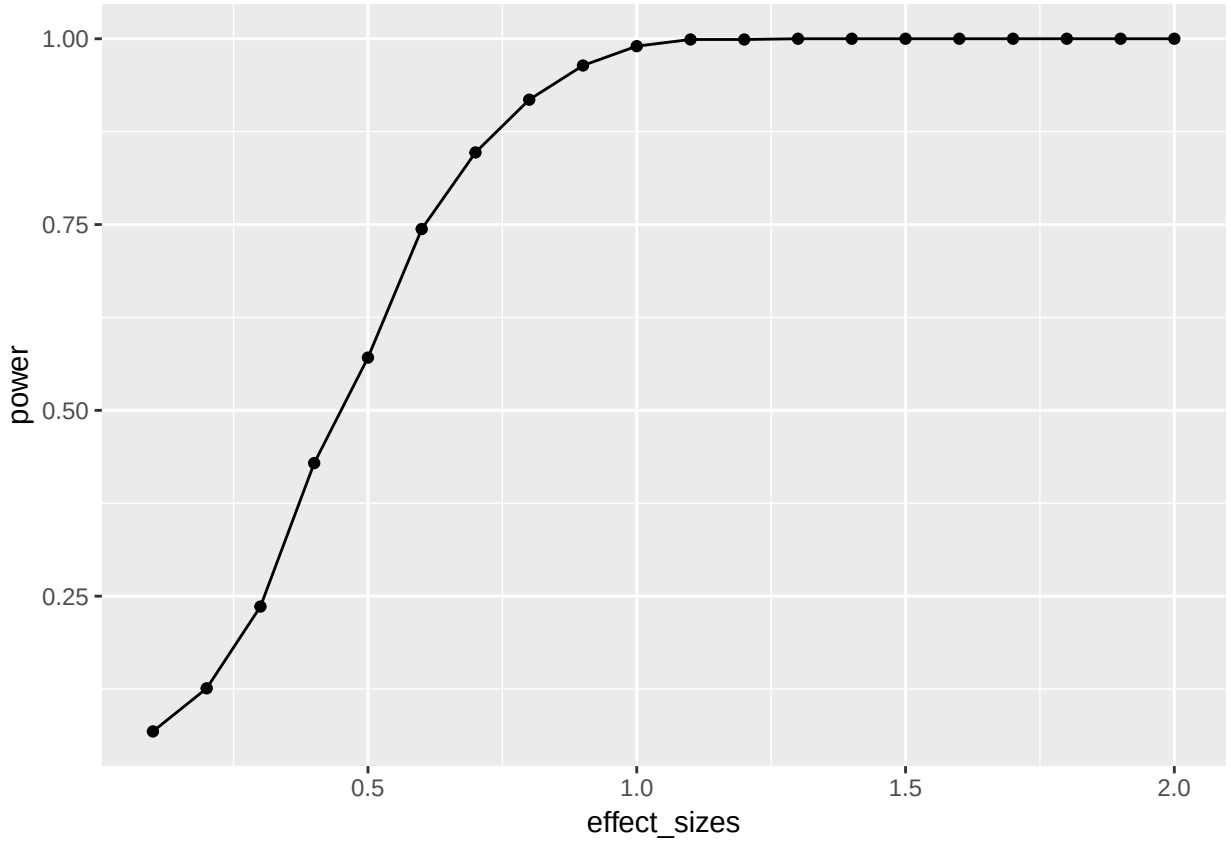
Discussion

The interaction result by Hu et al. (2015) was successfully replicated.

Power Analysis

The replicated interaction was due to a significant difference of the time factor in the uncued group. Since an F-value is equal to the square of a t-value, we can simulate power by simulating a t-test on the difference of time factor. The mean score difference between prenap and delay is (0.143) for cue and uncue. We applied this difference to our simulation assuming equal variance in our two samples (n = 38), and calculated an estimated power of 0.136, meaning the observed effect size may only occur 13.6% of the time.

Figure 3.Power analysis on the interaction of time/cue via t-test on time factor


1.00
0.75
0.50
0.25
power
0.5
1.0
1.5
2.0
effect_sizes

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