

1. Bastian, et al. (2011) published an article in *Psychological Science* titled “Cleansing the soul by hurting the flesh: The guilt-reducing effect of pain.” It’s a brief article, so I’ll reproduce much of it below:

Pain purifies. History is replete with examples of ritualized or self-inflicted pain aimed at achieving purification (Glucklich, 2001). Some people feel that they can achieve reparation for their sins by simply experiencing pain; this may be why seeking self-punishment is a basic response to feelings of guilt (Freud, 1916/1957; Nelissen & Zeelenberg, 2009).

Why are pain and suffering believed to serve as atonement for sin? One reason may be that the experience of physical pain alleviates feelings of guilt associated with immoral behavior (Tangney, Stuewig, & Mashek, 2007). There has been very little research on the psychological benefits of experiencing pain. We tested two hypotheses relating to when and why people are likely to be motivated to experience pain—that people should be more motivated to subject themselves to a painful experience when they are reminded of their own immoral deeds, and that the experience of pain should reduce feelings of guilt.

Method

In return for \$10, undergraduates participated in a study that they were told focused on mental acuity. They were allocated to one of three conditions. In the pain and no-pain conditions, participants wrote for 10 to 15 min about a time when they behaved unethically, that is, a time when they “rejected or socially excluded another person.” In the control condition, participants wrote about “an everyday interaction [they] had with another person yesterday.”

Next, participants were informed that they would participate in a different study on physical acuity. Participants in the pain and control conditions were presented with an ice bucket (0° C–2° C) and were instructed by the experimenter to “immerse your nondominant hand, up to your wrist, into the bucket for as long as you can.” Participants in the no-pain condition were instructed to do the same with a bucket of warm water (36° C–38° C) for 90 s while also moving paper clips, one at a time, between two boxes. Specifically, they were instructed to “use your dominant hand to move as many paper clips from one box to another as you can.” The ice-bucket and warm-water tasks were designed to be equivalent in length, perceived purpose (i.e., testing physical acuity), required compliance (i.e., participants were asked to exert effort), and sense of achievement.

Below is an analysis of the duration data (time in the water) for the three conditions. (Similar to their results.) Complete the source table and analyze the data as completely as you can. [15 pts]

Descriptives								
Time	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
pain	20	86.7000	3.84023	.85870	84.9027	88.4973	80.00	90.00
no pain	20	90.0000	.00000	.00000	90.0000	90.0000	90.00	90.00
control	20	64.4000	11.26429	2.51877	59.1282	69.6718	44.00	84.00
Total	60	80.3667	13.30728	1.71796	76.9290	83.8043	44.00	90.00

Test of Homogeneity of Variances				
Time	Levene Statistic	df1	df2	Sig.
Time	33.730	2	57	.000

The Levene test indicates that these data may violate the homogeneity of variance assumption ($p < .001$). Thus, we would analyze the data with $\alpha = .01$.

ANOVA

Time	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	7756.9	2	3878.45	82.153	.000
Within Groups	2690.97	57	47.21		
Total	10447.87	59			

$$HSD = 3.41 \sqrt{\frac{47.21}{20}} = 5.24$$

There was a significant effect of pain level and whether or not the participant wrote about an unethical behavior or not, $F(2,57) = 82.153$, $MSE = 47.21$, $p < .001$, $\eta^2 = .74$. Tukey's HSD indicates that the time in the water was significantly longer for people who wrote about behaving unethically, whether their hands were immersed in painfully cold water ($M = 86.7$) or in warm water ($M = 90.0$) compared to people who had not previously written about behaving unethically, but had their hands immersed in painfully cold water ($M = 64.4$).

2. So, do you read the last pages of a novel before you begin reading from the beginning? Leavitt and Christenfeld (2011) published a paper entitled "Story spoilers don't spoil stories." Here's what they say:

The enjoyment of fiction through books, television, and movies may depend, in part, on the psychological experience of suspense. Spoilers give away endings before stories begin, and may thereby diminish suspense and impair enjoyment; indeed, as the term suggests, readers go to considerable lengths to avoid prematurely discovering endings. *Transportation*, a distinct form of story engagement associated with vivid imagery and enhanced enjoyment (Green, Brock, & Kaufman, 2004), is highly associated with suspense via close attention to the unfolding plot and interest in how it will be resolved (Tal-Or & Cohen, 2010). However, people's ability to reread stories with undiminished pleasure, and to read stories in which the genre strongly implies the ending, suggests that suspense regarding the outcome may not be critical to enjoyment and may even impair pleasure by distracting attention from a story's relevant details and aesthetic qualities. In complex stories, developments hazy in their implications on first read are readily understood when the narrative is revisited, and nervous stirrings of uncertainty may become warm anticipation of coming events once the story is laid bare.

I'll simplify their study somewhat to tailor it to your knowledge. Each participant read two different mysteries, one spoiled (a separate spoiler paragraph presented before the story) and one unspoiled (story as originally written with no spoiler information in advance). They then rated their enjoyment of each story on a 10-point scale (1, *lowest rating*, to 10, *best rating*). For the data below, analyze the data as completely as you can. What would you conclude? [25 pts]

	Spoiled	Unspoiled	P
	7	6	13
	8	5	13
	6	7	13
	9	8	17
	8	6	14
	7	7	14
	8	6	14
	6	5	11
	7	6	13
ΣX	66	56	122
ΣX^2	492	356	848

Source	SS	df	MS	F
Between	5.55	1	5.55	7.97
Within	15.6	16		
Subject	10.1	8		
Error	5.5	8	.69	
Total	21.1	17		

$$F_{\text{Critical}}(1,8) = 5.32$$

You should note that the study could not have been properly counterbalanced with $n = 9$. With two conditions, complete counterbalancing would produce two orders, so the total number of participants must be a multiple of two.

There was a significant effect of whether or not participants were provided a spoiler, $F(1,8) = 7.97$, $MSE = .69$, $p < .05$, $\eta^2 = .5$. People rated the story as significantly more enjoyable if they had been given a spoiler ($M = 7.33$) than if they had not been given a spoiler ($M = 6.22$).

3. Suppose that you've analyzed an experiment as a repeated measures ANOVA. You've obtained an $F(3,12) = 5$. Your $MS_{\text{Error}} = 1$ and there are (obviously) 5 scores in each condition. Later, however, you find out that you *should* have computed an independent groups ANOVA. Fill in the source table below as it should appear with the appropriate independent groups analysis (i.e., assuming that all the scores are the same). [5 pts]

Source	SS	df	MS	F
Between	15	3	5	2.5
Within	32	16	2	
Total	47			

4. Suppose that you were interested in computing an ANOVA on data from 30 different people placed into three groups as seen below, for which summary statistics are shown. [5 pts]

	Group 1	Group 2	Group 3
Mean	15	20	40
Variance	10	20	60
n	10	10	10

a. What parameter is the MS_{Within} intended to estimate? σ^2

b. What would the MS_{Within} be in the ANOVA computed on the data? **30**

c. [Careful!] What F_{Crit} would you use to evaluate the F_{Obs} ? **F_{Max} is significant, so with $\alpha = .01$ $F_{\text{Critical}}(2,27) = 5.49$.**

5. Not only are repeated measures designs more powerful than independent groups designs, they are also more efficient ("more bang for the buck"). Give a specific example to illustrate the efficiency of a repeated measures design compared to an independent groups design. [3 pts]

Suppose, for example, that you wanted to have a minimum of 20 scores per cell. In an independent groups design with 4 conditions, you'd need 80 people. However, even with complete counterbalancing, you'd need only 24 people to run a repeated measures study.

6. People like Jacob Cohen suggest that we should conduct experiments with power of at least .80. What are they saying about the level of Type II error that they are willing to tolerate? [2 pts] **$\beta = .20$**