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Active relaxation counteracts the effects of ego depletion on performance under evaluative pressure in a state of ego depletion

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Abstract

We tested the assumption that active relaxation following an ego-depletion task counteracts the negative effects of ego depletion on subsequent performance under evaluative pressure. $N = 39$ experienced basketball players were randomly assigned to a relaxation condition or to a control condition, and then performed a series of free-throws at two points of measurement (T1: baseline vs T2: after working on a depleting task and either receiving active relaxation or a simple break). The results demonstrated that performance remained constant in the relaxation condition, whereas it significantly decreased in the control condition. The findings are in line with the notion that active relaxation leads to a quicker recovery from ego depletion.

Keywords: basketball, ego depletion, self-control, self-regulation, sport

Active relaxation counteracts the effects of ego depletion on performance under evaluative pressure

1 In sports, for successful completion of far-aiming tasks (e.g., dart throwing), it is essential
2 to selectively control one's attention (e.g., Boutcher, 2002; Oudejans, van de Langenberg, &
3 Hutter, 2002). Irrelevant stimuli—for instance, internal worrisome thoughts or boisterous crowds
4 during a basketball match—need to be blocked out and attentional focus needs to be shifted to
5 the relevant stimuli (e.g., the bull's-eye in dart throwing) in order to perform at a high level (e.g.,
6 Vickers, 2011). However, according to attentional control theory (ACT; Eysenck, Derakshan,
7 Santos, & Calvo, 2007), evaluative pressure and accompanying sensations of anxiety can lead to
8 increased distractibility. Eysenck and colleagues argue that increased anxiety levels lead to a
9 domination of the bottom-up stimulus-driven attentional system, making it harder for athletes to
10 volitionally regulate their attention and perform optimally (Corbetta & Shulman, 2002). The
11 effect of evaluative pressure and anxiety on attention regulation and athletic performance is well
12 documented in the literature and has been replicated by several researchers (e.g., Wilson, Vine,
13 & Wood, 2009; Nibbeling, Oudejans, & Daanen, 2012). According to ACT, individuals are
14 generally capable of counteracting these detrimental anxiety effects on attention regulation by
15 investing additional effort. Recent research indicates that their success seems to depend on
16 available *self-control strength* (e.g., Englert & Bertrams, 2012, 2013, 2015). In the present work,
17 it was tested whether a brief intervention to keep self-control strength available helps to
18 counteract the detrimental effects of evaluative pressure on performance in a far-aiming task
19 (i.e., basketball free-throws).

20 Based on the assumptions of the strength model of self-control, all acts of self-control are
21 based on one resource with limited capacity (e.g., Baumeister, Bratslavsky, Muraven, & Tice,

1 1998). This resource can become temporarily depleted after having previously exerted self-
2 control (i.e., *ego depletion*). As the resource is not immediately replenished, initial exertion of
3 self-control can negatively affect subsequent self-control performance (e.g., Baumeister,
4 Heatherton, & Tice, 1994). In this context, self-control is defined as the ability to volitionally
5 regulate one's impulses or response tendencies, and to instead display another, more desirable
6 behavior in order to achieve a specific goal (e.g., Baumeister et al., 1994). Acts requiring self-
7 control include for instance emotion regulation, attention regulation, or impulse regulation (e.g.,
8 Friese, Hofmann, & Wänke, 2008; Schmeichel & Baumeister, 2010). In sports, athletes with
9 depleted self-control strength have been found to be less persistent in physically demanding tasks
10 (e.g., Englert & Wolff, 2015) and to display impaired tactical decision making (e.g., Furley,
11 Bertrams, Englert, & Delphia, 2013). The results of a recent meta-analysis revealed a medium-
12 to-large effect size of ego depletion on subsequent self-control performance (Hagger, Wood,
13 Stiff, & Chatzisarantis, 2010).

14 An integration of ACT (Eysenck et al., 2007) and the strength model of self-control (e.g.,
15 Baumeister et al., 1998) may explain under which circumstances individuals can counteract the
16 detrimental effects of evaluative pressure on performance. In general, anxiety hinders selective
17 attention regulation and automatically increases the degree of distractibility, which can impair
18 performance (e.g., Eysenck et al., 2007). Numerous studies have delivered evidence of the
19 negative effects of anxiety on performance (e.g., Wilson et al., 2009; Nibbeling et al., 2012). But
20 according to ACT, the negative anxiety effects on attention regulation can be counteracted by
21 initiating self-regulatory processes (Eysenck et al., 2007). Recent research has shown, that
22 evaluative pressure and related anxiety were associated with impaired performance only when an
23 initial self-control demand had recently depleted a person's self-control strength (i.e., during ego

1 depletion). No performance decrements emerged, however, for people whose self-control
2 strength had not previously been depleted. This pattern was found in multiple experiments, for
3 cognitive as well as far-aiming tasks (e.g., Bertrams, Englert, Dickhäuser, & Baumeister, 2013;
4 Englert & Bertrams, 2012, 2013). Speaking in terms of ACT, these results indicate that
5 individuals who had available self-control strength were able to volitionally work against the
6 detrimental effects of anxiety on attention regulation. As attention regulation can be understood
7 to be a process that depends on self-control strength (e.g., Schmeichel & Baumeister, 2010), self-
8 control strength may serve as a protective shield against attention disruption.

9 Research based on the strength model also has revealed that self-control strength can be
10 improved and revitalized. Baumeister and colleagues used a muscle analogy in their
11 conceptualization of self-control strength: Self-control strength can become depleted after a
12 primary self-control demand, just like a muscle can become exhausted after having previously
13 performed a straining task (e.g., Baumeister et al., 1998). Sticking to the muscle analogy, self-
14 control strength can also be boosted, like a muscle, for instance by regularly exerting self-control
15 strength over a two-week period (Baumeister, Gailliot, DeWall, & Oaten, 2006). There are also
16 possibilities to replenish self-control strength after previous acts of self-control. Mindfulness
17 meditation, for instance, can serve as a strategy to revitalize one's depleted self-control strength
18 (e.g., Friese, Messner, & Schaffner, 2012). Moreover, relaxation and rest have been found to
19 help replenish self-control strength (e.g., Baumeister et al., 1994).

20 Tyler and Burns (2008) had participants take a short break after a primary self-control
21 task. In that study, one half of the participants were simply told that a second task would follow
22 after three minutes, and they would have a break until the experiment resumed, whereas the
23 other half of the sample applied additional active relaxation techniques. Participants from the

1 of last season: $M = 62.38$, $SD = 12.68$; years of league play: $M = 10.46$, $SD = 5.10$). Participants
2 were randomly assigned to a relaxation condition ($n = 20$) or a control condition ($n = 19$). The
3 results of a G*Power analysis revealed that our sample size was adequate in detecting at least a
4 medium effect (Faul, Erdfelder, Lang, & Buchner, 2007; parameters: $f = .25$, $\alpha = .05$, $1-\beta = .80$,
5 $r_{\text{repeated measures}} = .50$, $\epsilon = 1$). Before starting the experiment, participants delivered written
6 informed consent. The study was carried out in accordance with the Helsinki Declaration of
7 1975.

8 **Procedure**

9 The study was conducted by the same experimenter in single sessions in the indoor
10 training facilities of the respective player (there was no effect of training facility on the
11 performance measures in the current study). After reporting demographic information,
12 participants performed a series of 20 free-throws from the regular basketball free-throw line
13 (distance: 4.60 m) on a regulation-height basket (height: 3.04 m). The total number of successful
14 shots out of 20 free-throws served as the performance measure. To match game situations, there
15 was always a short interval after two free-throws (approximately three seconds). This measure
16 served as a baseline measure of basketball free-throw performance, and as there had not been any
17 manipulations up to this point, no differences between the two experimental conditions were
18 expected.

19 In a next step, self-control strength was experimentally depleted in all participants by
20 administering a transcription task which has been frequently used for this purpose (e.g.,
21 Bertrams, Englert, & Dickhäuser, 2010; Wolff, Baumgarten, & Brand, 2013). Participants
22 transcribed a neutral text on a separate sheet of paper for six minutes and were instructed to omit
23 the letters “e” and “n” while transcribing the text, which are the most frequent letters in the

1 German alphabet. Volitionally overriding well-learned writing habits requires a great deal of
2 self-control; therefore, completing this task depletes self-control strength, as several studies have
3 demonstrated (e.g., Englert & Bertrams, 2012; Bertrams et al., 2013; Wolff et al., 2013). The
4 number of transcribed words and the number of mistakes were counted in order to make sure that
5 both groups performed at a comparable level. Additionally, there were also several control
6 measures applied, which will be described in more detail below.

7 Next, all participants put on stereo-headphones and were informed that there would be a
8 two-minute break until the experiment continued. However, the instructions differed between the
9 experimental conditions: In the active relaxation condition, participants were explicitly told to
10 relax as much as possible and they additionally listened to a relaxing song (Erik Satie's
11 Gymnopedie No. 1; Thibaudet, 2002) via stereo headphones. Participants from the control
12 condition did not listen to any music and were simply told that the study would resume after two
13 minutes. This procedure corresponded to Tyler and Burns (2008).

14 Following several control measures, participants performed a second series of 20 free-
15 throws, however, this time under high pressure—they were informed that they would receive
16 personal feedback, they would be videotaped, and that their video would be shown during a
17 lecture in the upcoming semester (for this procedure, see also Behan & Wilson, 2008; Wilson et
18 al., 2009; Englert & Bertrams, 2012). Before actually performing the free-throws, level of
19 anxiety was measured. After finishing the free-throw task, we thanked participants for their
20 participation, probed them for suspicion, and debriefed them. They were further explicitly told
21 that their videos would not be shown during a lecture.

22 **Measures**

1 As trait anxiety can negatively affect one's level of accuracy in far-aiming tasks (e.g.,
2 Wilson et al., 2009), we assessed participants' level of trait sports anxiety. For that cause, we
3 applied the German version of the Sports Anxiety Scale-2 (WAI-T; Brand, Ehrlenspiel, & Graf,
4 2009). Participants reported their level of dispositional sport anxiety on 12 items, with each item
5 answered on 4-point Likert-type scales (1 = *not at all* to 4 = *very much*). The WAI-T consists of
6 three subscales, with each subscale containing four items: worry (e.g., "I worry that I will not
7 play well"; $\alpha = .86$), somatic (e.g., "My body feels tense"; $\alpha = .74$), and concentration (e.g., "It is
8 hard to concentrate"; $\alpha = .73$).

9 To rule out pre-experimental differences in trait self-control strength, the German short
10 version of the Self-Control Scale was administered (SCS-K-D; Bertrams & Dickhäuser, 2009).
11 Participants answered 13 items (e.g., "I am good at resisting temptations"; $\alpha = .84$) on five-point
12 Likert-type scales ranging from 1 (*not at all*) to 5 (*very much*).

13 After finishing the transcription task, we applied a measure of the degree of self-control
14 exerted while working on the transcription task, consisting of four items (e.g., "How strongly did
15 you have to regulate your writing habits"; $\alpha = .59$; Bertrams et al., 2010). Each item was
16 answered on four-point Likert-type scales ranging from 1 (*not at all*) to 4 (*very much*). The
17 purpose of this measure was to make sure that participants from the relaxation condition and the
18 control condition would not differ in the amount of self-control strength invested while working
19 on the transcription task.

20 Participants' mood was assessed by applying the German version of the Positive and
21 Negative Affect Schedule (PANAS; Krohne, Egloff, Kohlmann, & Tausch, 1996). The PANAS
22 was applied in order to rule out the possibility that the experimental manipulation of relaxation
23 led to differences in participants' mood because we did not aim at improving mood with our

1 relaxation task, but to replenish self-control strength. Within the PANAS, ten items assess
2 positive mood (e.g., “enthusiastic”; $\alpha = .82$) and ten items assess negative mood (e.g., “afraid”; α
3 = .61), with each item being answered on four-point Likert-type scales (1 = *not at all* to 4 = *very*
4 *much*).

5 After the two-minute break, participants were asked to indicate their experience with and
6 their attitude toward relaxation techniques on three items (“Have you ever applied relaxation
7 techniques?”; “Would you be open to using relaxation techniques in the future?”; “Do you think
8 relaxation in general is useful?”), which had to be answered on a four-point Likert-type scale (1
9 = *not at all* to 4 = *very much*). We additionally asked all participants how relaxed they were
10 feeling now compared to their state before the break. Answers were given on a four-point Likert-
11 type scale (1 = *not at all* to 4 = *very much*). It was expected that participants from the relaxation
12 condition compared to the control condition would report a higher level of perceived relaxation.

13 Following the pressure induction, four positive (joviality, self-assurance, attentiveness,
14 and serenity) and four negative emotional states (sadness, hostility, guilt, and anxiety) derived
15 from the Expanded Form of the Positive and Negative Affect Schedule (PANAS-X; Watson &
16 Clark, 1992) were measured by applying thermometer scales (e.g., Houtman & Bakker, 1989).
17 As state anxiety is a reliable indicator of perceived pressure, the anxiety thermometer was our
18 main interest (e.g., Gucciardi, Longbottom, Jackson, & Dimmock, 2010). The measurements of
19 the other emotional states served as distractors so that it would not be too obvious that the
20 previous pressure instruction aimed at inducing anxiety. On each thermometer, participants
21 placed a cross on a horizontal 10-cm continuous scale, with 0 on the left side of the scale,
22 indicating that the respective emotional state was not experienced at all, and 10 on the right side
23 of the scale, indicating that the respective emotional state was experienced at the highest degree.

1 The distance from 0 to the cross mark the participant made (in mm) served as the thermometer
2 value for each participant.

3 Results

4 Preliminary Analyses

5 The descriptive statistics for the following analyses are depicted in Table 1. An analysis
6 of variance (ANOVA) revealed no significant differences in two of the subscales of the German
7 sports anxiety scale: somatic anxiety $F(1, 37) = 0.81, p = .37, \eta^2_p = .02$, concentration $F(1, 37) =$
8 $0.22, p = .64, \eta^2_p = .01$. However, a significant difference emerged in the worry subscale, $F(1,$
9 $35) = 4.73, p = .04, \eta^2_p = .12$. Therefore we added the worry subscale as a covariate to our main
10 analyses.

11 Participants in the relaxation condition did not differ significantly from participants in the
12 control condition in terms of their trait self-control strength, $F(1, 37) = 0.01, p = .97, \eta^2_p = .00$,
13 and in the manipulation check for ego depletion, $F(1, 37) = 2.83, p = .10, \eta^2_p = .07$. The groups
14 also did not differ significantly in their self-reported positive, $F(1, 36) = 0.10, p = .76, \eta^2_p = .00$,
15 or negative mood, $F(1, 36) = 0.08, p = .78, \eta^2_p = .00$, following the transcription task.

16 Participants in the relaxation condition did not differ from participants in the control
17 condition in the number of transcribed words, $F(1, 37) = 1.20, p = .28, \eta^2_p = .03$, but they made
18 significantly fewer mistakes compared to participants in the control condition, $F(1, 37) = 5.03, p$
19 $= .03, \eta^2_p = .12$. Therefore, we included this measure as a covariate to our main analyses.

20 As expected, participants did not differ in their attitudes toward relaxation techniques in
21 general, $ps > .62$. Participants from the active relaxation condition reported higher levels of
22 perceived relaxation following the two-minute break compared to participants in the control

1 $p = .95$, whereas performance in the control condition got worse from T1 to T2, $p = .001$ (post-
2 hoc pair-wise comparisons with Bonferroni corrections).

3 **Discussion**

4 Performing at a high level in far-aiming tasks requires selective attention because one
5 needs to shift attention onto the relevant stimuli at hand while ignoring task-irrelevant stimuli
6 (e.g., Vickers, 2011). But, according to attentional control theory, individuals are typically less
7 adept at ignoring task-irrelevant stimuli and find it harder to volitionally regulate their attention
8 under high levels of evaluative pressure (Eysenck et al., 2007). As attention regulation can be
9 considered a self-control act (e.g., Schmeichel & Baumeister, 2010), Englert and Bertrams
10 (2012, 2013) concluded that individuals with available self-control strength can overcome the
11 automatic attention impairments under evaluative pressure by exerting self-control strength. This
12 strength may, however, not always be available. According to the strength model of self-control
13 (Baumeister et al., 1994), the capacity of self-control strength is limited and can be temporarily
14 depleted, causing an impairment of subsequent self-control acts (e.g., Baumeister et al., 1998).
15 During depleted self-control strength, pressure-based problems in attention regulation may
16 therefore not be counteracted, leading to impaired performance. The present work demonstrated
17 how a strategy to restore depleted self-control strength can be used to avoid decrements in far-
18 aiming tasks in evaluative pressure situations.

19 Previous research has indicated that rest and active relaxation can lead to a quicker
20 replenishment of self-control strength, enabling individuals to perform up to their capabilities
21 (Tyler & Burns, 2008). In the present studies, initial support was found for the hypothesis that
22 active relaxation can protect against the repeatedly documented negative effects of ego depletion
23 on performance under evaluative pressure (Englert & Bertrams, 2012, 2013).

1 We would also like to address two central limitations of our studies: We only tested
2 participants with depleted self-control strength and did not include control groups that did not
3 become ego depleted. In the same vein, anxiety was not experimentally manipulated. A
4 comparison with other studies in which similar experimental setups were applied revealed
5 comparable anxiety scores (e.g., Oudejans & Pijpers, 2010) and similar scores on the ego
6 depletion manipulation check (e.g., Englert & Bertrams, 2012), indicating that we successfully
7 induced anxiety and ego-depletion. The reason why we only addressed situations in which
8 people are ego depleted and additionally under pressure was that related previous research
9 reliably found performance decrements only under such conditions; no performance impairment
10 emerged when individuals were not depleted or felt no pressure (e.g., Bertrams et al., 2013;
11 Englert & Bertrams, 2012, 2013).

12 Second, we postulated that ego depletion would negatively affect attention regulation,
13 which can be overcome by active relaxation. However, we did not assess attention regulation
14 directly. This limitation can be overcome in future research by applying sophisticated methods,
15 such as eye-tracking technology. The gaze behavior of an individual can be viewed as an
16 indicator of efficient attention regulation (Henderson, 2003). Shorter fixation durations on the
17 relevant target areas are a sign of less efficient selective attention regulation (e.g., Wilson et al.,
18 2009). To conclude, the present studies should be replicated by additionally assessing
19 participants' attentional focus (e.g., with respect to specific areas on the basket) to further foster
20 our argument that active relaxation leads to a quicker replenishment of self-control strength and
21 can improve performance in far-aiming tasks requiring selective attention regulation.

22 As previously mentioned, apart from active relaxation (Tyler & Burns, 2008), there are
23 also other possibilities to improve self-control strength and to counteract ego-depletion effects

1 (for an overview, see Baumeister et al., 2006), for instance, regular self-control exertion (e.g.,
2 Oaten & Cheng, 2006; Gailliot et al., 2007) or mindfulness meditation (Friese et al., 2012). Thus
3 far, these other training techniques have not been transferred to the field of sports. Future
4 research should therefore also apply such training regimens to these domains in the hopes of
5 improving (athletic) performance under pressure.

6 The present finding could have important implications for the way breaks are being used
7 during sporting competitions. Apparently simply resting does not have the same favorable effects
8 as active relaxation. These results are in line with other research in the field of sport psychology
9 that has also stressed the beneficial effects of relaxation for peak performance (e.g., Williams,
10 2006). Some sports do include breaks (e.g., halftime break during a soccer match) while other
11 sports do not offer the opportunity to just rest for a short period of time (e.g., running).
12 Therefore, future studies should aim to identify ways to revitalize depleted self-control strength
13 even in sports where there are no official breaks. To conclude, we feel that active relaxation can
14 be a quick and efficient way to enable athletes to display their optimal level of performance
15 under evaluative pressure, even if any demands recently stressed their self-control strength.
16 Thus, we would recommend implementing active relaxation before and during sporting
17 competitions.

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Table 1

Descriptive Statistics: Means and Standard Deviations (N = 39)

Variable	Experimental condition			
	Relaxation		Control	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Free-Throws (total score)				
T1 (baseline)	14.65	2.83	13.63	3.11
T2 (after break)	14.70	3.34	11.74	2.94
SCS-K-D	3.23	0.59	3.22	0.71
WAI-T				
Somatic	2.05	0.57	2.22	0.64
Worry	2.08	0.67	2.51	0.54
Concentration	1.64	0.68	1.72	0.44
Transcription task				
Self-control exerted	2.99	0.44	3.21	0.38
Number of transcribed words	86.80	11.05	91.63	16.13
Number of mistakes	3.90	2.63	6.58	4.61
PANAS				
Positive affect	2.93	0.66	2.87	0.59
Negative affect	1.27	0.29	1.25	0.29
Manipulation check				
Relaxation experienced	3.15	0.88	2.58	0.84
Thermometer Scales				
Joviality	5.90	1.99	5.50	2.24
Self-assurance	6.48	1.34	5.93	2.18
Attentiveness	6.16	1.44	6.65	1.26
Serenity	5.97	1.76	5.28	2.16
Sadness	0.74	1.19	1.20	1.53
Hostility	0.92	1.21	1.25	2.03
Guilt	0.59	0.66	0.65	0.92
Anxiety	3.83	2.37	4.05	2.48

1 *Note.* $n = 20$ in relaxation condition, $n = 19$ in control condition. Overall scores of a
2 psychometric scale were obtained by averaging the responses to the scale items. Free-throws T1
3 = Total number of successful basketball free-throws out of 20 throws at T1. Free-throws T2 =
4 Total number successful of basketball free-throws out of 20 throws at T2. WAI-T =

- 1 Wettkampfstressinventar (German version of the Sports Anxiety Scale, SAS-2). SCS-K-
- 2 D = German short version of the Self-Control Scale. PANAS positive = German version of the
- 3 Positive and Negative Affect Schedule – positive affect. PANAS negative = German version of
- 4 the Positive and Negative Affect Schedule – negative affect.