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Are Target-Shooters More Aggressive Than the General Population?

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Although psychological research shows that guns are aggressive cues, proponents of liberal gun control argue that people rather than guns are to blame for gun-related violence. For instance, athletic target-shooters might classify guns as athletic rather than aggressive stimuli and thus should not be more aggressive than the general population. The present work investigated aggression and emotion-regulation in target-shooters. A longitudinal study found that initial self-reported aggression in target-shooters was higher than in the general population and further increased over 1 year. Additionally, the sample exhibited deficient emotion-regulation strategies, and this was related to self-reported aggression. In contrast, their implicit self-construct became more peaceful over time but was unrelated to all other measures. Two further cross-sectional experiments explored the causal impact of athletic target-shooting and other athletic activities (shooting a basketball) on aggression. Target-shooters and basketball players were tested before and after their regular team practice and aggressive thoughts and feelings were measured. Target-shooting but not basketball practice activated aggressive and anxiety-related thought more strongly than positive thought. Future research avenues, implications for the indirect measurement of aggression, and possible interventions to decrease aggression in target-shooters are discussed. Aggr. Behav. 9999:1–11, 2016. © 2016 Wiley Periodicals, Inc.

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INTRODUCTION

Tragedies where young adults go on killing sprees using firearms have left the general public stunned, and unfortunately such events are becoming more and more frequent (List of school shootings in the United States, 2016). Whereas the public agrees that these acts are tragic, there is no consensus on their causes and possible preventions. Many potential contributing factors have been discussed, for instance, exposure to violent video games (Anderson et al., 2010) and media (Krahé, 2014), or the prevalence of guns (Richardson & Hemenway, 2011). While in the United States of America multiple presidential executive actions have been proposed recently to institute stricter gun legislation, in Germany the biggest tragedies of Erfurt and Winnenden already have led to stricter gun laws. Furthermore, because either the perpetrators or their parents were members of a shooting club, the media prematurely concluded that shooting makes people more aggressive and so the public image of the German Shooting Sport and Archery Federation (DSB) was damaged.

The question of whether shooting club membership increases aggression is interesting because, on the one hand, social psychological research demonstrates that guns constitute an aggressive cue (Anderson, Benjamin, & Bartholow, 1998; Berkowitz & LePage, 1967; Carlson, Marcus-Newhall, & Miller, 1990). On the other hand, opponents of stricter gun control usually argue that weapons per se are not aggressive, but rather aggressive people interpret them in this way. Indeed, hunters exhibit no association between hunting rifles and aggression, implying that they classify these rifles as working tools and not weapons (Bartholow,

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Anderson, Carnagey, & Benjamin Jr., 2005). The same could also be true for target-shooters who might represent their weapon as a sports-instrument or for people carrying guns to protect themselves rather than to act aggressively.

The empirical question that arises is whether the mere act of shooting can cause aggression. There exists only one paper addressing this question—unfortunately with inconclusive results (Buss, Booker, & Buss, 1972). Athletic shooting is especially interesting in this regard, because it additionally lacks the "goal of hurting another living being," which is a central definitional criterion of aggression (Baron & Richardson, 1994, p. 7). Note that there is only mixed evidence for relations between contact sports and aggression (see, e.g., Lemieux, McKelvie, & Stout, 2002; Maxwell, Visek, & Moores, 2009; Reynes & Lorant, 2001), although these sports are likely to fulfill this criterion more than target-shooting.

To resolve these questions empirically, the DSB commissioned a project to explore whether athletic target-shooters are more aggressive than other people are, and whether target-shooting increases aggression. A longitudinal and two cross-sectional studies were conducted.

DATA ANALYSIS

The first study was exploratory without an a priori hypothesis. Since there was no specific hypothesis about the development of aggression, longitudinal data was tested for linear and quadratic trends (i.e., all possible trends). This was undertaken to avoid problems when sphericity between measurement times was not given and to avoid inflation of false positive rates by computing multiple comparisons (cf. Tabachnick & Fidell, 2007, p. 330). Experiment 2a directly followed from the longitudinal observations, and hence the hypothesis was directional. Study 1 and Experiment 2a aimed at samples as large as practically possible. The sample size of Experiment 2b was based on Experiment 2a. All measures and exclusion criteria are reported. All data and materials are available at https://osf.io/p2nr6/.

STUDY 1

The development of implicit self-concept and self-reported levels of aggression, as well as emotion-regulation strategies in young target shooters who joined a shooting club around one year prior to assessment was assessed longitudinally. For new members, the effects of target-shooting were expected to be largest. Since shooting is a very sensitive topic in Germany, the DSB did not want to include control groups in the study, because this would have made it necessary to debrief non-DSB members about the purpose of the study and this information could have been brought to the media. Mostly norm-calibrated measures were administered to ensure that a standard of comparison was present nonetheless.

Methods

Sample. Participants were recruited over the DSB newsletter to all its members. Participation was voluntary and no compensation was granted. The initial sample was $N = 75$ target-shooters ($N = 30$ female; $M_{age} = 12.57$, $SD = 1.75$). Due to drop out, this number went down to $N = 45$ ($N = 20$ female; $M_{age} = 13.38$, $SD = 1.64$) at the last measurement. Average shooting-club membership duration at the first measurement was 16 months. Thus, the aim to test primarily adolescents who recently joined a shooting club was achieved.

Materials and procedure. Three times (every 6 months), the volunteers completed a test battery online at home. The Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998) was used to measure whether participants had an aggressive or peaceful implicit self-concept. The K-FAF (for children older than 15 years; Heubrock & Petermann, 2008) and the FAVK (for children younger than 15 years; Görtz-Dorten & Döpfner, 2010) were administered as measures of self-reported aggression. The FEEL-KJ (Grob & Smolenski, 2005) was used to measure emotion-regulation. All three questionnaires are well-established German measures in clinical and research practice. The measures offer different norms for children of different ages. Therefore, the normed values account for changes in self-reported aggression and emotion regulation that occur normally during the development of a child. Furthermore, the questionnaires assess a variety of types of aggression (e.g., the subscales of the K-FAF encompass spontaneous, reactive or self-aggression, irritability and aggression-inhibition; cf. Heubrock & Petermann, 2008). The measurement order was always IAT, FEEL-KJ, FAVK/K-FAF, and demographics (see https://osf.io/p2nr6/). Due to drop-out, technical problems, PC malfunctions, and test abortions, not all participants managed to complete all measures at all measurement times.

IAT. The IAT involves mapping four different constructs, two of which each belong to one dimension (Greenwald et al., 1998; for an overview, see Teige-Mocigemba, Klauer, & Sherman, 2010). During the critical phase of the IAT, two response categories share one response key. In the present study, the attributes *aggressive* (exemplary stimulus: hit) and *peaceful* (e.g., forgive) were mapped with either *self* (e.g., me) or *others* (e.g., he). Faster reactions to *self + aggressive* and *others + peaceful* versus *self + peaceful* and *others + aggressive* were treated as indicative of an

aggressive implicit self-concept. The IAT-stimuli are available at https://osf.io/p2nr6/.

FAVK. Participants aged below 15 years received the FAVK (German: *Fragebogen zum aggresiven Verhalten von Kindern*; translated: questionnaire for the assessment of aggressive behavior in children) as a self-report measure of aggression (exemplary item: "I frequently end arguments by hitting or insulting other people because this is what I can do best."). For the FAVK, test norms for children between 9:00 and 14:11 years of age exist. The present analyses focused on participants' total FAVK-scores relative to the age-corresponding test norm (cf. Görtz-Dorten & Döpfner, 2010).

K-FAF. The participants aged over 15 years received the K-FAF (German: *Kurzfragebogen zur Erfassung von Aggressivitätsfaktoren*; translated: short questionnaire for the assessment of components of aggression) as a self-report measure of aggression (exemplary item: "I would rather hit somebody than be a coward."). For the K-FAF, test norms for children above 15:00 years of age exist. The present analyses focused on participants' total K-FAF-score relative to the age-corresponding test norm (cf., Heubrock & Petermann, 2008).

FEEL-KJ. The FEEL-KJ (German: *Fragebogen zur Erhebung der Emotionsregulation bei Kindern und Jugendlichen*; translated: questionnaire for the assessment of emotion-regulation in children and adolescents; Grob & Smolenski, 2005) was used to assess participants' emotion-regulation abilities. Specifically, it measures adaptive (e.g., problem-oriented action or acceptance), maladaptive (e.g., aggression or retreat), and other (e.g., social support) emotion-regulation strategies for anger, anxiety, and sadness.

Results

Missing data were handled by listwise deletion (resulting sample $N = 44$ for IAT and FEEL-KJ, $N = 38$ for the aggression questionnaires). No further participants were excluded. IAT data were analyzed according to the improved D-score algorithm of Greenwald, Nosek, and Banaji (2003, p. 214). For all questionnaires, raw scores were calculated and transformed to the respective test-norms for the respective age groups (T [$M = 50$; $SD = 10$] for the FEEL-KJ and the K-FAF, *Stanine* [$M = 5$; $SD = 2$] for the FAVK). In order to have a comparable metric, these normed scores were then linearly transformed into the standard normal distribution ($M = 0$; $SD = 1$). $Z = 0$ in this distribution corresponded to the 50th percentile of the respective norming samples. This further made it possible to include subjects who surpassed the age of 15 during the longitudinal study in the longitudinal analysis.

Implicit self-concept. A repeated-measures ANOVA on the D-scores of the IAT yielded a significant linear trend, $F(1,43) = 6.33$, $p = .016$, $\eta_p^2 = .13$. D-scores decreased linearly over time and were significantly below zero at all measurements (all $ts < -4.04$, all $ps < .001$, all $ds > .60$). Thus, participants were faster to classify the combination of *self + peaceful* and *others + aggressive* than the opposite mapping, which a priori was assumed to reflect a peaceful self-concept (Fig. 1).

Self-reported aggression. A repeated-measures ANOVA on the *z*-standardized normed scores of the two aggression questionnaires yielded a significant linear trend, $F(1,37) = 6.98$, $p = .012$, $\eta_p^2 = .16$. Self-reported levels of aggression were significantly higher than the expected value of the norming sample (i.e., 0 on the ordinate in Fig. 2) at all measurement times (all $ts > 2.87$, all $ps \leq .007$, all $ds > .46$) and increased linearly over time (Fig. 2).

Emotion-regulation. Adaptive and maladaptive emotion-regulation scores on the FEEL-KJ were computed first globally across all three emotions, and then separately for anger, anxiety, and sadness (cf., Grob & Smolenski, 2005). Since the focal interest of this paper is aggression, only global and anger-specific analyses are reported (see https://osf.io/p2nr6/ for the anxiety and sadness analyses).

Global analysis. A 2 (Strategy: adaptive vs. maladaptive; within) × 3 (Measurement Time; within) ANOVA on the *z*-standardized normed scores of the FEEL-KJ found a significant linear, $F(1,43) = 15.64$, $p < .001$, $\eta_p^2 = .27$, and quadratic trend for the interaction term, $F(1,43) = 16.43$, $p < .001$, $\eta_p^2 = .28$. To specify this, we examined the longitudinal trends for adaptive and maladaptive strategies separately.

Adaptive strategies decreased over time and showed both a linear, $F(1,43) = 6.44$, $p = .015$, $\eta_p^2 = .13$, and a quadratic trend, $F(1,43) = 4.65$, $p = .037$, $\eta_p^2 = .10$. As can be seen in Figure 3, the first two measurements did not differ significantly, $t(43) = -.93$, $p = .36$, $d_z = .14$, but at the last measurement participants reported

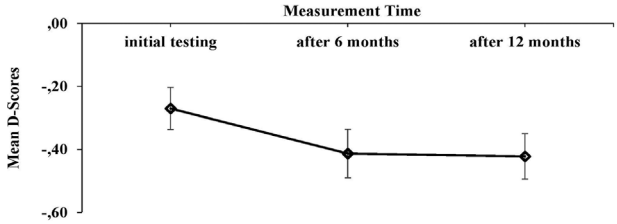

Figure 1. D-scores across time. More negative scores indicate faster mappings of *self + peaceful* versus *others + aggressive* than the opposite mapping. Error bars represent ±1 standard error of means (SEM).

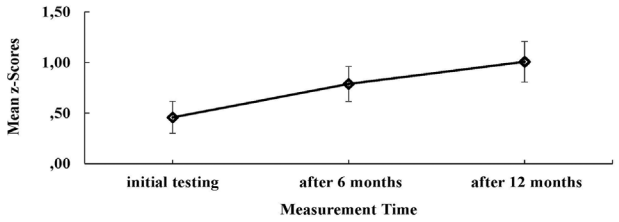

Figure 2. Mean level of self-reported aggression across the three measurement times in relation to the norming sample. Error bars represent ±1 SEM.

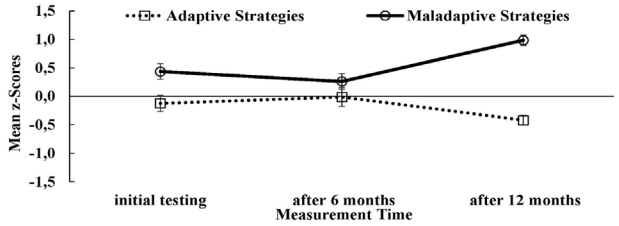

Figure 3. Mean levels of adaptive and maladaptive emotion-regulation strategies across the three measurement times in relation to the norming sample. Error bars represent ±1 SEM.

significantly less adaptive emotion-regulation strategies than at the earlier measurements (both ts > 2.55, both ps $\leq .014$, both d_zs $> .38$). Adaptive emotion-regulation strategies did not differ from norm at the first two measurements (both ts $< -.89$, both ps $> .38$, both ds $< .13$), but fell significantly below norm at the last measurement time, $t(43) = -5.04$, $p < .001$, $d = .76$ (Fig. 3).

Maladaptive strategies, reversely, increased over time and showed both a linear, $F(1,43) = 14.17$, $p < .001$, $\eta_p^2 = .25$, and a quadratic trend, $F(1,43) = 18.72$, $p < .001$, $\eta_p^2 = .30$. Again the first two measurements did not differ significantly, $t(43) = 1.37$, $p = .178$, $d_z = .24$, but participants indicated significantly more maladaptive emotion-regulation strategies at the last measurement than at both earlier measurements (both ts > 3.76, both ps $\leq .001$, both d_zs $> .54$). The level of maladaptive emotion-regulation was above norm at the first and last (both ts > 3.20, both ps $\leq .003$, both ds $> .48$), but not at the second measurement, $t(43) = 1.89$, $p = .066$, $d = .28$ (Fig. 3).

Anger-specific analyses. A 2 (Strategy: adaptive vs. maladaptive) × 3 (Measurement Time) × 3 (Emotion: anger vs. anxiety vs. sadness) repeated-measures ANOVA found multiple significant trends for the three-way interaction, which justified the anger-specific analysis reported here. Table I shows all significant results of the trend analysis.

For anger, a 2 (Strategy: adaptive vs. maladaptive) × 3 (Measurement Time) repeated-measures ANOVA yielded a significant "linear trend" of Strategy, $F(1,43) = 11.69$, $p = .001$, $\eta_p^2 = .21$, that is, participants reported more maladaptive than adaptive anger-regulation strategies across measurements times, and a significant linear-quadratic trend of the interaction, $F(1,43) = 4.76$, $p = .035$, $\eta_p^2 = .10$. This is best described as the absence of an effect for adaptive (all Fs $\leq .76$, all ps $> .38$, η_p^2s $< .01$), combined with a quadratic trend for maladaptive anger-regulation strategies, $F(1,43) = 6.62$, $p = .014$, $\eta_p^2 = .13$.

Adaptive anger-regulation strategies did not differ from the expected value of the norming sample, nor from each other (all ts $< .42$, all ps $> .67$, all ds $< .07$), but were descriptively highest at the second measurement. Maladaptive anger-regulation strategies were significantly different between the second and third measurement, $t(44) = 2.95$, $p = .005$, $d_z = .44$, and were above norm at the first and last (both ts > 4.57, both ps $< .001$, both ds $> .69$), but not at the second measurement, $t(43) = 1.95$, $p = .058$, $d = .29$ (Fig. 4).

Relational analyses. Scores on all measures correlated significantly across time (see diagonals in Table III; all rs $> .52$, all ps $< .001$ for the IAT), indicating re-test reliability of the measures used. The only significant correlation between the IAT and any other measure was between adaptive emotion-regulation strategies at the initial testing and the D-score after 12 months, $r(44) = .30$, $p = .049$. Since this correlation is likely to be a false-positive (given the high number of correlations that were tested), the IAT is not discussed any further. Nonetheless, all data are available at https://osf.io/p2nr6/ for further analyses.

Cross-sectional. As would be expected, self-reported aggression was positively related to maladaptive emotion-regulation strategies on a global, $\bar{r} = .31$, 95% CI (.06, .57), as well as anger-specific level, $\bar{r} = .26$, 95% CI (.01, .52). Conversely, it was negatively related to adaptive emotion-regulation strategies on a global, $\bar{r} = -.25$, 95% CI (−.51, .00), as well as anger-specific level, $\bar{r} = -.26$, 95% CI (−.53, −.01). The individual correlations at the three measurements varied around these mean correlations (Table II), which is to be expected given the small sample size. Anger-specific and global adaptive and maladaptive emotion-regulation strategies were always highly correlated (all $|r|$s $\geq .78$, all ps $< .001$).

Longitudinal. As mentioned above, scores on the same measure generally correlated significantly across time, as shown in the diagonals of Table III. Correlations between the initial and the last measurement were lower than the correlations between adjacent measurement times (i.e., the correlations between T0 and T1 and between T1 and T2), which is to be expected given the longer time between measurements for T0 and T2. Furthermore, there were significant correlations between

TABLE I. Significant Trends of the 2 (Strategy) × 3 (Emotion) × 3 (Measurement Time) Trend Analysis

	Strategy	Emotion	Measurement Time	*F*	*p*	η_p^2
Main effects	Linear	-	-	25.32	<.001	.37
	-	Linear	-	13.07	.001	.23
Two-way interactions	Linear	Quadratic	-	15.85	<.001	.27
	Linear	-	Linear	16.20	<.001	.27
	Linear	-	Quadratic	16.56	<.001	.28
Three-way interactions	Linear	Linear	Linear	5.30	.026	.11
	Linear	Quadratic	Linear	19.86	<.001	.32
	Linear	Quadratic	Quadratic	17.87	<.001	.29

Note. For all tests $df = (1,43)$.

earlier emotion-regulation (global and anger-specific) and later aggression, which were comparable to the correlations observed in the above-mentioned cross-sectional analyses: earlier maladaptive strategies on a global, $\bar{r} = .36$, 95% CI (.09, .66), as well as anger-specific level, $\bar{r} = .27$, 95% CI (−.02, .56), were positively related to later aggression. Conversely, adaptive strategies on a global, $\bar{r} = -.32$, 95% CI (−.61, −.04), as well as anger-specific level, $\bar{r} = -.33$, 95% CI (−.63, −.06), were negatively related to later self-reported aggression. Taken together, it seems that (deficient) emotion regulation abilities are an important precursor of high aggression. All other correlations yielded unstable patterns and hence are not discussed here any further (Table III).

Discussion

Whereas the implicit self-concept of the sample became seemingly less aggressive over time, self-reported aggression increased over time. The average percentile ranks of the aggression questionnaires relative to the norming samples were 67, 78, and 84 at the respective measurement times. Thus, after 1 year of observation the average target-shooter reported more aggression than 84% of the age-matched norming samples. Note that there is no standard of comparison for the D-scores of the IAT, which makes it hard to interpret the self-concept in absolute terms. Irrespective of the absolute nature of the self-concept, this trend must be arranged with the opposite results of the normed self-report measures.

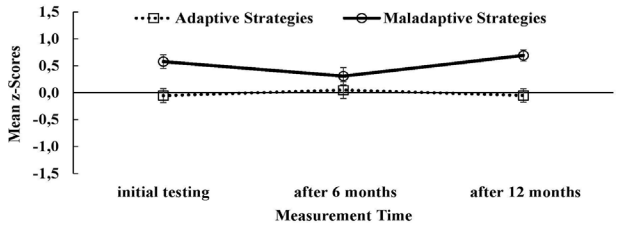

Figure 4. Mean level of adaptive and maladaptive anger-regulation strategies across the three measurement times in relation to the norming sample. Error bars represent ±1 SEM.

First, the results of the IAT are less informative than the questionnaire measures, because they cannot be compared to a norming sample. A linear decrease in D-scores, for instance, could also be explained simply as a practice effect or familiarity with the measure.

Second, concerning the "dissociation" between the IAT and the remaining measures, it is debatable whether the IAT actually provided divergent or concurrent results to the questionnaires: the mapping of *self + peaceful* versus *others + aggressive* was considered as a peaceful self-concept. However, recent research showed that individuals who score high on measures of depression actually exhibit *high* D-scores on a self-esteem IAT (see, e.g., Remue, De Houwer, Barnes-Holmes, Vanderhasselt, & De Raedt, 2013; Risch et al., 2010). This research showed that the IAT measures ideal self-esteem, that is, an association related by the proposition "I want to be" [positive]. The proposition "I want to be peaceful" would reflect low implicit peacefulness (i.e., high implicit aggressiveness). Future research therefore should employ indirect measures, which are able to measure associative propositions, like the Implicit Relational Assessment Procedure (Barnes-Holmes et al., 2006) or the IAT-GOAL (Eder, Rothermund, & De Houwer, 2013) and compare aggressive and non-aggressive people in a known-group paradigm.

Third, young target shooters displayed high levels of maladaptive emotion-regulation strategies, especially for anger (and anxiety; see https://osf.io/p2nr6/). Longitudinally, maladaptive strategies increased in a curvilinear trend. Levels of adaptive emotion-regulation strategies were generally low, yet not consistently below the expected value of the norming sample. These deficits in emotion-regulation correlated as would be expected with participants self-reported aggression both cross-sectional and longitudinally. There were no correlations between emotion-regulation and the IAT, further emphasizing the higher validity of the self-report findings.

To summarize, in spite of the interpretational issues of the IAT, the questionnaires form a highly coherent picture of high levels of aggression, which coincide with deficits in emotion-regulation in general and specific anger-regulation deficits. Discarding the non-normed IAT results, based on the self-report measures it is tentatively concluded that target-shooters are likely to be more aggressive than the general population. Two further experiments addressed the question of whether increases in aggressive thoughts and feelings can be causally linked to the mere act of shooting regularly.

EXPERIMENTS 2A AND 2A

If shooting-club membership were the only systematic difference between the sample of Study 1 and the general population, then repeated shooting practice might be responsible for the observed effects. To test this, two experiments assessed the accessibility of aggression-related concepts directly before and after shooting practice in young target-shooters (Experiment 2a) and basketball players (Experiment 2b). It was predicted that firing a gun enhances the salience of aggressive thought more than other concepts, even if it is done for sport. Shooting a basketball for sport, on the other hand, should not make aggression salient, because a basketball is not an intrinsically aggressive stimulus (for similar effects of tennis rackets, see Berkowitz & LePage, 1967). In addition to comparing two types of athletes, the accessibility of different constructs was tested in these experiments as well. Specifically, also the accessibility of anxiety and positive affect was assessed before and after target-shooting or basketball training. We predicted that target-shooting enhances the accessibility of aggressive thoughts more strongly than it affects anxiety and positive thoughts. Basketball, on the other hand, was expected to have no differential effect on the three constructs.

Methods

Samples. In order to recruit people for this study, shooting coaches in southern Germany (within a radius of 200 km around Würzburg) were contacted. Three coaches agreed to have a psychological testing at their club during regular shooting practice. A total of $N = 33$ target shooters ($N = 9$ female; $M_{age} = 14$, $SD = 2$) participated voluntarily. $N = 1$ participant had to leave practice early and finished only one measurement. The Lexical Decision Task (LDT) data of $N = 1$ participant was lost due to technical problems. Furthermore, $N = 29$ basketball players ($N = 6$ female; $M_{age} = 14$, $SD = 2$) were recruited from the junior athletes of the Turngemeinde Würzburg von 1948 e.V. (TGW), a large basketball team in Würzburg. The test was also included in their regular training. The samples did not differ in age ($t(60) = .37$, $p = .712$) or gender distribution ($X^2(1) = .37$, $p = .546$).

Materials and procedure. In cooperation with the local coaches, the shooting training was standardized to four rounds of ten shots; an ecologically valid training procedure that the coaches used regularly even in our absence. The basketball coaches were asked to come up with similar ecologically valid training procedures that emphasize aiming and concentration rather than physical exhaustion, like shooting jump-shots from various spots on the court from a stand still. The times of measurement for both experiments were immediately before and after these standardized training procedures, which took about 40 minutes each. Supporting the idea that the training procedures were comparable, target-shooters and basketball players rated their respective trainings as equally exhausting ($t(60) = .78$, $p = .439$) and reported being equally tired afterwards ($t(60) = .50$, $p = .616$). Furthermore, the samples reported comparable levels of accuracy during the training ($t(60) = .32$, $p = .744$) and satisfaction with their performance ($t(60) = .50$, $p = .622$). Thus, any group differences were not attributable to sample characteristics, idiosyncrasies of the different training procedures or frustration of the participants with the training.

LDT. Before and after the training, a LDT (Meyer & Schvaneveldt, 1971) was used as a well-established response-time (RT) measure of concept activation. In this task, subjects have to indicate whether a presented letter string is a word or not. Faster RTs for a given concept are interpreted as semantic activation of that concept. Three groups of words from the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) were presented: aggression-related, anxiety-related, and positive words (and non-words to justify the LDT task). Anxiety was measured because participants of the longitudinal study also exhibited emotion-regulation deficits for anxiety (and less so for sadness, see https://osf.io/p2nr6/) and because it is theoretically linked more closely to aggression (Berkowitz, 1990). Positive affect was introduced to balance the design because measurement of only negative stimuli before practice could induce negative mood. Also, the introduction of different word categories made it possible to control for regression to the mean phenomena: it was likely that RTs would be faster after shooting practice because participants completed the LDT for the second time. However, this practice effect should be equally large for all stimuli unless there were an additional effect of practice on the activation of the different concepts.

PANAS. In addition, before and after shooting, participants indicated how well the LDT stimuli describe their current affect. Additionally, participants

TABLE II. Correlations Between Self-Reported Aggression, Adaptive, and Maladaptive Emotion-Regulation Strategies (Global and Anger-Specific) Within the Three Measurements

	1. Self-Reported Aggression Total Score	2. Adaptive Emotion-Regulation	3. Maladaptive Emotion-Regulation	4. Adaptive Anger-Regulation	5. Maladaptive Anger-Regulation
Initial testing, $N \leq 75$					
1.	–	−.18	.42***	−.12	.30*
2.		–	−.22	.86***	−.20
3.			–	−.23	.86***
4.				–	−.15
5.					–
After 6 months, $N = 61$					
1.	–	−.41**	.45***	−.41**	.39**
2.		–	−.13	.94***	−.22
3.			–	−.11	.85***
4.				–	−.20
5.					–
After 12 months, $N \leq 49$					
1.	–	−.15	−.04	−.30*	.03
2.		–	.78***	.89***	.55***
3.			–	.62***	.78***
4.				–	.41**
5.					–

Notes. ***$p < .001$; **$p < .01$; *$p < .05$.

provided demographic information at the end of the testing.

Results

Concept activation. RT outliers were removed from the LDT data (target-shooters: 4.5 % and 4.2 % of all trials before and after practice, respectively, basketball players: 7.0% and 5.5%; cf. Tukey, 1977). $N = 1$ subject from the target-shooting sample was removed from the analysis (95% errors, overall RT > 3 *SD* above the sample mean).

Data were subjected to a 2 (Measurement Time: before vs. after practice; within) × 3 (Word Category: aggression vs. anxiety vs. positive; within) × 2 (Sport: target-shooting

TABLE III. Correlations Between Self-Reported Aggression, Adaptive, and Maladaptive Emotion-Regulation Strategies (Global and Anger-Specific) Across the Three Measurements

	1. Self-Reported Aggression Total Score	2. Adaptive Emotion-Regulation	3. Maladaptive Emotion-Regulation	4. Adaptive Anger-Regulation	5. Maladaptive Anger-Regulation
T0 and T1, $N \leq 59$					
1.	.55***	−.40**	.42**	−.38**	.35**
2.	−.01	.64***	−.16	.58***	−.04
3.	.41**	-.10	.53***	−.06	.44**
4.	−.00	.57***	-.17	.55***	−.07
5.	.33*	−.11	.45***	−.01	.41**
T0 and T2, $N \leq 45$					
1.	.36*	−.28	.28	−.33*	.23
2.	.03	.58***	.06	.48**	−.00
3.	.12	−.36*	.24	.28	.16
4.	−.41**	.68***	-.17	.64***	−.17
5.	.32*	.16	.23	.06	.06
T1 and T2, $N \leq 45$					
1.	.77***	−.24	.35*	-.28	.19
2.	−.17	.60***	.19	.46**	.11
3.	−.04	.35*	.47**	.31*	.37*
4.	−.34*	.73***	−.02	.66***	−.03
5.	.21	.11	.49**	.07	.51***

Notes. The chronologically first measurement is in the columns, the later one in the rows. ***$p < .001$; **$p < .01$; *$p < .05$.

vs. basketball; between) mixed-models ANOVA, which yielded significant main effects of Word Category, $F(2,56) = 39.48$, $p < .001$, $\eta_p^2 = .59$, Measurement Time, $F(1,57) = 52.99$, $p < .001$, $\eta_p^2 = .48$, and Sport, $F(1,57) = 11.30$, $p = .001$, $\eta_p^2 = .17$, significant two-way interactions between Measurement Time and Condition, $F(2,56) = 4.96$, $p = .030$, $\eta_p^2 = .08$, and Measurement Time and Word Category, $F(2,56) = 3.59$, $p = .034$, $\eta_p^2 = .11$, and most crucially a significant three-way interaction, $F(2,56) = 4.24$, $p = .019$, $\eta_p^2 = .13$. To specify this three-way interaction, separate two-way ANOVAs were computed for the two samples.

For the target-shooters, there were significant main effects of Word Category, $F(2,28) = 17.81$, $p < .001$, $\eta_p^2 = .56$, Measurement Time, $F(1,29) = 26.38$, $p < .001$, $\eta_p^2 = .48$, and an interaction, $F(2,28) = 5.06$, $p = .013$, $\eta_p^2 = .27$. People reacted most quickly to positive words and were faster at the second measurement (likely due to familiarity with the LDT). The interaction effect, however, shows that this pre-post-RT-difference was differently large for the different word categories. To inspect this further, the pre-post-difference in RTs for the three word categories was computed and the three differences were compared to each other with pair-wise *t*-tests. As predicted, the RT decrease from the pre- to the post-training LDT was greater for aggression-related ($M_{difference} = 416$ ms, $SD = 528$) than for positive words ($M_{difference} = 334$ ms, $SD = 389$), $t(29$, one-tailed$) = 2.01$, $p = .027$, $d_z = .37$. Unexpectedly, also anxiety-related words showed a greater RT difference ($M_{difference} = 483$ ms, $SD = 447$) than positive words, $t(29) = 3.23$, $p = .003$, $d_z = .59$; and this gain did not differ from aggression-related words, $t(29$, one-tailed$) = -1.62$, $p = .059$, $d_z = .29$. Therefore, it seems that aggression and anxiety were activated more strongly through target-shooting practice than positive affect, although on a mean level positive affect still was activated most strongly (i.e., exhibited the lowest RTs of all three word categories; Fig. 5).

For the basketball players, this analysis yielded significant main effects of Word Category, $F(2,27) = 42.94$, $p < .001$, $\eta_p^2 = .76$, and Measurement Time, $F(1,28) = 54.46$, $p < .001$, $\eta_p^2 = .66$, but no interaction, $F(2,27) = .49$, $p = .620$, $\eta_p^2 = .04$. Again, participants responded most quickly to positive words and responded faster at the second measurement. Contrary to the target-shooters, however, the lack of an interaction shows that the decrease in RTs from pre- to post measurement was equally large for all stimulus categories (Aggression: $M_{difference} = 210$ ms, $SD = 166$; Anxiety: $M_{difference} = 220$ ms, $SD = 168$; Positive affect: $M_{difference} = 224$ ms, $SD = 181$; all ts $< .83$, all ps $\geq .417$).

Finally, we compared the pre-post RT-differences of target-shooters and basketball players. While these differences were equal for positive words, $t(58) = 1.54$, $p = .130$, $d = .40$, RT decreased more strongly in target-shooters for both aggression, $t(58$, one-tailed$) = 2.11$, $p = .019$, $d = .55$, and anxiety, $t(58) = 2.94$, $p = .005$, $d = .77$. In other words, target-shooting practice activated aggression- and anxiety-related thoughts relatively more strongly than basketball training while both trainings had equal influence on the activation of positive concepts (Fig. 5).

Affect. A 2 (Measurement Time: before vs. after practice; within) × 3 (Emotion: aggression vs. anxiety vs. positive; within) × 2 (Sport: target-shooting vs. basketball; between) mixed-models ANOVA yielded only a significant main effect of Emotion, $F(2,59) = 164.51$, $p < .001$, $\eta_p^2 = .85$. Both samples exhibited more positive affect than both aggression and anxiety, there was no difference between sports, and also no influence of practice.

Discussion

These experiments provide some evidence that the context in which a gun is fired cannot prevent aggressive thoughts completely. Target shooters come to practice to improve and have fun and clearly not to be aggressive. Still, the difference in concept activation was larger for aggressive thoughts than positive thoughts for target-shooters. Basketball players, on the other hand, did not show such differences in concept activation after practice. Target-shooting (but

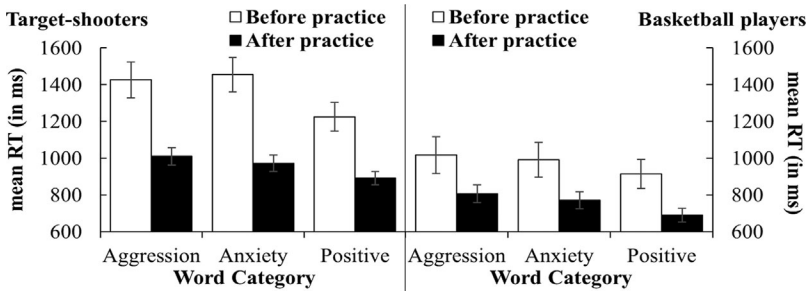

Figure 5. RTs before and after practice for aggression-, anxiety-related, and positive words for target-shooters (left) and basketball players (right). Error bars represent ±1 SEM.

not basketball) practice also activated anxiety-related thoughts. Thus, target-shooting practice might trigger general negative affect rather than aggression specifically. To test this, RTs to anxiety and aggression-related words were combined into an index of negative affect, which was activated significantly more through practice than positive affect, $t(29) = 3.01$, $p = .005$, $d_z = .55$. According to cognitive neo-association theory (Berkowitz, 1990), negative affect is a precondition of both aggression (see Study 1) and anxiety, which was not assessed in Study 1. The longitudinal study already indicated dysfunctional anxiety-regulation. Therefore, it is possible that target-shooters also exhibit high levels of anxiety, which should be investigated in future studies. Furthermore, anxiety is another plausible associate of guns in general, because guns can be used to intimidate other people, too. In any case, since the anxiety and aggression pre-post-differences were equally large this does not challenge the relevant conclusion that athletic target-shooting activates aggressive thought, too, whereas shooting a basketball does not.

What is unclear is how the enhanced salience of aggressive thought could contribute to higher levels of aggression in general (Study 1), but not on the PANAS in Experiment 2. Potentially, greater accessibility contributes to a hostile attribution bias (cf. Crick & Dodge, 1996; or De Castro, Veerman, Koops, Bosch, & Monshouwer, 2002 for a meta-analysis). If participants interpreted more events aggressively, this would enhance general aggression, but not state aggressive affect after practice because this situation is not ambiguous. Another possibility is that the PANAS was not sensitive enough to capture this effect.

GENERAL DISCUSSION

Target shooters reported more aggression, and levels of aggression increased over time on reliable and construct-valid self-report measures. Furthermore, aggressive thought was activated by target-shooting but not basketball practice. The most proximate explanation for these observations of course are shooting club membership (Study 1) and actual target-shooting (Experiment 2a), which were the only systematic differences between the present samples and the general population and the control group in Experiment 2b. Given that our studies were carried out in the field, alternative explanations which were not assessed in the present studies remain viable, although such accounts seem more distal and need a theoretical basis that is not immediately obvious to the authors. Future research obviously should work to uncover alternative or additional explanations for the high levels of aggression found in our samples. Our work also has some direct implications.

Implications for Indirect Measurement of Aggression

The longitudinal study yielded a dissociation between the IAT and the aggression questionnaires. Furthermore, the IAT did not correlate with any other measure of the study. Since the observed dissociation is theoretically implausible, this finding highlights the need for adequate indirect measures of aggression. Such measures are able to bridge the gap between often unreliable or unfeasible behavioral measures and self-reports which are subject to social desirability. More propositional indirect measures, which are able to tease apart the motivation to act aggressively and an aggressive self-concept, seem most promising in this regard and have already been developed, for instance, in the context of depression (see, e.g., Remue et al., 2013; Risch et al., 2010).

Generalizability to Shooting in General

Target-shooting in Germany differs from shooting at gun ranges in the USA in important ways: first, it happens more frequently and regularly. Secondly, training is more supervised in shooting-clubs. Finally, the motivation of target-shooters is athletic competition. In the USA, people can shoot also for completely different reasons (e.g., to "blow off steam"). Research indicates that this might be conducive to high levels of aggression (Bushman, 2002). Overall, German shooting-clubs appear to be a rather *non-aggressive* context for shooting, which makes the present results even more alerting. Combined with the stricter legislation of gun ownership in Germany, this could mean that shooters in the USA are possibly not only more aggressive than in Germany, but also more numerous. Taken together this warrants a similar investigation of gun-range visitors in the USA.

Generalizability to Behavior and Possible Interventions

It is important to note that only self-reports of aggression were assessed and not aggressive behavior in target-shooters. However, behavior is what politicians and the media discussed in Germany after acts of violence were committed. While this conclusion might be intuitively appealing, we want to emphasize that our data do not support a direct causal link between shooting-club membership and acts of aggression.

Nonetheless, the DSB (and other shooting federations) should strongly feel encouraged to counteract aggressive tendencies of their members based on the present results because anything should be done to prevent such tragic

acts of aggression. For instance, Study 1 identified deficient emotion-regulation as one correlate of aggression in shooters and Experiment 2a showed that shooting practice activated aggressive (or negative) rather than positive thought and this did not occur for another athletic activity (i.e., basketball training). Interventions to address both of these deficiencies can be designed by psychologists and sports-scientist and implemented directly during shooting practice and as part of advanced training for shooting coaches. Regardless of their eventual effectiveness, this will at least help to improve the damaged image of target-shooting in the public.

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The research reported has been carried out in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki). Informed consent of all participants (and their parents) was acquired beforehand and their privacy rights are protected. None of the authors had any conflict of interest. The submitted manuscript was neither previously published, nor is it under review at another journal. All authors approved the final version of the manuscript for publication.

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