

Self-Control, Self-Regulation, and Doping in Sport:
A Test of the Strength-Energy Model

Derwin K. C. Chan¹, Vanessa Lentillon-Kaestner², James A. Dimmock³, Robert J. Donovan¹,
David A. Keatley¹, Sarah J. Hardcastle¹, & Martin S. Hagger¹

Curtin University, Australia¹

University of Teacher Education, Switzerland²

University of Western Australia, Australia³

Correspondence concerning this article should be addressed to Derwin K. C. Chan, Health Psychology and Behavioural Medicine Research Group, School of Psychology and Speech Pathology, Faculty of Health Sciences, Curtin University, Perth, Australia. Email: derwin.chan@curtin.ac.uk or kc.derwin@gmail.com

Acknowledgement

This project was funded by the Australian Government Anti-Doping Research Programme (#01-CURTIN-2011-12) awarded to Martin S. Hagger (Curtin University, Australia)

1 **Abstract**

2 We applied the strength-energy model of self-control to understand the relationship
3 between self-control and young athletes' behavioral responses to taking illegal performance-
4 enhancing substances or 'doping'. Measures of trait self-control, attitude and intention toward
5 doping, and doping avoidant intention and behavioral adherence were administered to 410
6 young Australian athletes. Participants also completed a 'lollipop' decision-making protocol
7 which simulated avoidance of unintended doping. Hierarchical linear multiple regression
8 analyses revealed that self-control was negatively associated with doping attitude and
9 intention, and positively associated with the intention and adherence to doping avoidant
10 behaviors. Hierarchical logistic regression analyses showed that self-control was positively
11 linked to the refusal to take or eat the unfamiliar candy offered in the 'lollipop' protocol.
12 Consistent with the strength-energy model, athletes with low self-control were more likely to
13 have heightened attitude and intention toward doping, and reduced intention, behavioral
14 adherence, and awareness of doping avoidance.

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3 Using prohibited performance-enhancing drugs or methods in sport (i.e., “doping”)
4 not only violates the anti-doping rules of the World Anti-Doping Agency (World Anti-
5 Doping Agency, 2009), but is also related to many negative consequences for athletes
6 including bans from participating sport, impaired reputation, sport titles being stripped, and
7 adverse health side effects. Most athletes are aware of these facts but some might still engage
8 in doping behaviors because they are unable to resist the temptations and other social
9 pressures to engage in doping (Lentillon-Kaestner & Carstairs, 2010; Wiefferink, Detmar,
10 Coumans, Vogels, & Paulussen, 2008). Importantly, athletes might also fail to effectively
11 avoid unintentional intake of illegal substances in foods and nutritional supplements, which
12 could lead to a positive test for those substances with similar possible consequences like loss
13 of reputation and bans from competition (Chan, Dimmock, et al., 2015; Chan, Donovan, et
14 al., 2014; Chan, Hardcastle, et al., 2014). Although official figures suggest that the incidence
15 of doping across most elite Olympic sport events is less than 2.0 % (World Anti-Doping
16 Agency, 2012), anti-doping is relevant applicable to all athletes because the potential to
17 engage in unintentional doping through the intake of banned substances in foods and
18 supplements is a very real threat. Avoiding unintentional doping requires considerable
19 vigilance, awareness, conscious effort, and cognitive resources to recognize potential
20 situations where taking such substances may be a risk and undertake behaviors to avoid them
21 (Wiefferink, et al., 2008). The primary aim of the present study was to examine the
22 relationship between athletes’ trait self-regulatory capacity and anti-doping behaviors based
23 on the strength-energy model of self-control (Baumeister, Bratslavsky, Muraven, & Tice,
24 1998; Baumeister, Gailliot, DeWall, & Oaten, 2006).

1 The strength-energy model defines self-control as a limited capacity or resource that
2 enables individuals to regulate their cognitive, emotional, and behavioral effort for achieving
3 desired goals or outcomes (Baumeister, et al., 1998; Ginis & Bray, 2010; Leventhal,
4 Leventhal, & Contrada, 1998; Tangney, Baumeister, & Boone, 2004). This self-regulatory
5 capacity is important because it allows individuals to delay short-term gratification for long-
6 term benefits or goals by effectively overcoming the impulses, temptation, or challenges that
7 could potentially hinder distal goal attainment. However, according to the model, individuals
8 will experience self-regulatory failure when their self-control resources are either insufficient
9 due to limited capacity in a ‘trait’ or individual difference approach (Baumeister, et al., 1998;
10 Baumeister, et al., 2006; Tangney, et al., 2004) or become depleted through excessive
11 exertion over a period of and inadequate opportunity for recovery in a ‘state’ or resource
12 availability approach (Baumeister, et al., 1998). Research has highlighted a number of
13 maladaptive behavioral outcomes associated with low self-control or reduced self-control
14 resources such as poor treatment adherence, inability to regulate eating, relapse during
15 smoking cessation, alcohol consumption, and substance abuse (Hagger, Leaver, et al., 2013;
16 Hagger, Panetta, et al., 2013; Hagger, Wood, Stiff, & Chatzisarantis, 2009, 2010a, 2010b;
17 Vohs & Heatherton, 2000).

18 The strength energy model may also have utility in explaining athletes’ capacity to
19 control and avoid doping in sport (Wolff, Baumgarten, & Brand, 2013) because athletes are
20 constantly involved in consciously and actively engaging in making moral judgments
21 regarding doping, engaging in expectancy-value judgments relating to doping (Chan,
22 Hardcastle, et al., 2015), or making a decisional-balance in the face of doping temptations
23 (Hodge, Hargreaves, Gerrard, & Lonsdale, 2013; Jalleh, Donovan, & Jobling, 2013; Petroczi
24 & Aidman, 2008; Wiefferink, et al., 2008; Zelli, Mallia, & Lucidi, 2010). Similarly, recent
25 research on anti-doping in sport found that even athletes with strong intentions and high

1 commitment to avoiding doping are required to engage in effortful, conscious deliberation in
2 order to avoid doping or prevent of unintended doping (Chan, Dimmock, et al., 2015; Chan,
3 Donovan, et al., 2014; Chan, Hardcastle, et al., 2015; Chan, Hardcastle, et al., 2014).

4 As far as we know, only one study explicitly applied the strength-energy model in the
5 context of performance-enhancing substances. Wolff, Baumgarten, and Brand (2013) recently
6 examined the effect of ego-depletion on individuals' intake of neuro-enhancing food product
7 for performance enhancing purposes. Interestingly, it was found that ego-depleted students
8 were three times less likely to consume neuro-enhancing energy bars than non-ego-depleted
9 students (Wolff, et al., 2013). The authors concluded that the pursuit of neuro-enhancement
10 was more likely a conscious attempt by those with sufficient resources to effectively regulate
11 their behavior than an automatic response to low cognitive resources (Wolff, et al., 2013). It
12 may be that those with sufficient resources wanted to make the most effective use of them, or
13 that they were sufficiently motivated, as a result of their self-control, to engage in
14 enhancement to maximize their potential. However, their study is somewhat removed from
15 the context of the current study as the participants were not athletes and neuro-enhancing
16 substances are neither on the WADA prohibited list nor controlled by law. As a consequence,
17 this context is less relevant to a doping context because the neuro-enhancer is likely to be
18 evaluated as something that is to be approached rather than avoided, and therefore,
19 individuals do not take vigilance and cognitive effort to avoid it. In contrast, the context of
20 unintentional doping is one in which serious consequences await those who transgress the
21 rules, so consuming banned performance-enhancing substances unwittingly in foods and
22 supplements, requires considerable effort to do so and, therefore, is likely to be demanding of
23 self-control resources (Baumeister, et al., 2006; Hagger, in press). The role that availability of
24 self-control resources plays in determining efforts to avoid unintentional doping should be

1 **Trait Self-Control.** The brief version of Tangney et al.'s (2004) scale was used to
2 measure individual differences in self-control capacity. It is a single dimension scale with 13
3 items (e.g., "I am good at resisting temptation") and responses were made on five-point Likert
4 scales ranging from 1 (*not at all*) to 5 (*very much*).

5 **Doping Attitude.** The 17-item Performance Enhancement Attitude Scale (Petroczi &
6 Aidman, 2009) was a single dimension inventory used in the present study for the assessment
7 of doping attitudes. Participants rated to degree to which they agreed with items (e.g.,
8 "Doping is not cheating since everyone does it.") highlighting the typical favorable beliefs for
9 using banned performance-enhancing methods in sport on a six-point Likert-scale ranging
10 from 1 (*strongly agree*) to 6 (*strongly disagree*).

11 **Intention.** We used a three-item measure for evaluating doping intentions (e.g.,
12 "Using banned performance-enhancing substances/methods in sport in the forthcoming month
13 is (something)... I intend to do") and intentions to avoid doping (e.g., "To avoid using banned
14 performance-enhancing substances/methods in sport in the forthcoming month is
15 (something)... I plan to do") following Ajzen's (2002) guidelines. The items were adopted
16 from recent studies about the psychological perspectives doping and anti-doping in sport
17 (Chan, Hardcastle, et al., 2015; Lucidi et al., 2008). Responses were made on a seven-point
18 Likert scale with 1 (*strongly disagree*) to 7 (*strongly agree*) scale anchors.

19 **Doping Avoidance Adherence.** We evaluated the effort (4 items; e.g., "How much
20 effort do you put into avoiding being in a situation where you might unintentionally take
21 banned performance-enhancing substances/methods?") and frequency (3 items; e.g., "How
22 often do you check if your supplements or medications contain banned performance-
23 enhancing substances/methods in sport?") of doping-avoidant behavior (i.e., actively
24 engaging in anti-doping by, for example, raising awareness of doping, learning/updating
25 knowledge about doping, and seeking help on doping) using the doping-avoidant version of

1 the Self-Reported Treatment Adherence Scale (Chan, Dimmock, et al., 2015; Chan, Donovan,
2 et al., 2014). Participants rated effort (1 = *minimum*; 7 = *maximum*) and frequency (1 = *never*;
3 7 = *very often*) items on seven-point scales.

4 **Prevention of Unintended Doping.** We evaluated three types of behaviors related to
5 the prevention of unintended doping based on a protocol of a recent study on young athletes'
6 awareness of doping in everyday life contexts (Chan, Donovan, et al., 2014). Participants
7 were offered a free lollipop at the beginning of the study ostensibly as a reward for doing the
8 study. The lollipops were from a rare brand to simulate a social situation where athletes were
9 given an unfamiliar food or drink. Given that athletes should be constantly vigilant of the
10 potential for unfamiliar foods to contain banned performance-enhancing substances, the
11 lollipop protocol provides an ecologically valid means to test athletes' propensity to avoid
12 unintentional doping. An ingredients table was clearly printed in the package of each lollipop.
13 After completing the questionnaire, participants were asked whether or not they (1) refused to
14 take the lollipop (*not-taking*), (2) decided not to eat the lollipop (*not-eating*), and (3) read the
15 ingredients table (*reading*). To ensure genuine responses, the answers of *not-taking* and *not-*
16 *eating* were cross-checked by the experimenter who delivered the lollipop when participants
17 returned the completed questionnaire.

18 **Analyses**

19 To examine the predictive power of self-control on the doping-related outcomes, we
20 used hierarchical linear multiple regression for the analyses with continuous dependent
21 variables (doping attitude, doping intention, and intention and adherence toward doping
22 avoidance), and hierarchical logistic multiple regression for the analyses with categorical
23 dependent variables (*not-taking*, *not-eating*, and *reading*). In Step 1, age, gender, sport type,
24 and sport level were inserted as control variables consistent with the recommendations of Chan
25 and colleagues (2015). In Step 2, self-control was added as the independent variable such that

1 the parameter estimates would reveal the predictive power of self-control on the behavioral
2 outcome beyond the effects of the control variables.

3 **Results**

4 There were no apparent systematic pattern of missing data (<1%; expectation
5 maximization was used for missing data replacement), non-normality of distribution (Shapiro-
6 Wilk's test $p > .05$), multicollinearity (variance inflation factors (VIF) < 1.34), or low score
7 reliability ($\alpha > .74$) in the data. The descriptive statistics, matrix of intercorrelations, and
8 reliability statistics for the study variables are displayed in Table 1.

9 For continuous outcome variables, hierarchical linear multiple regression models
10 showed that self-control was a statistically significant negative predictor of doping attitudes
11 and doping intention (H1), and it was also shown to be a statistically significant positive
12 predictor of intentions to avoid doping (H3) and actual doping avoidant behavior (H4) (see
13 Table 2 for the model details). For categorical outcome variables, hierarchical logistic
14 regression analysis showed that self-control was a statistically significant positive predictor of
15 participants' not-taking and not-eating the unknown lollipop (H5), but its association with
16 reading the ingredients table was not statistically significant (see Table 3). These significant
17 associations held when statistically controlling for the effects of age, gender, sport type, and
18 sport level on the outcome variables.

19 **Discussion**

20 The present study is the first to examine the central tenet of the strength-energy model
21 of self-regulation (Hagger, et al., 2009, 2010a, 2010b) in the context of athletes' behavioral
22 responses to doping including unintentional doping. The results generally supported our
23 hypotheses based on the proposition that self-control was not only predictive of athletes'
24 doping attitudes and intentions, but also to their intention and behaviors toward doping
25 avoidance and prevention of unintended doping in sport. Such findings are intuitive to the

1 understanding of the self-regulatory process of doping in sport. Doping has been well-
2 regarded as goal-directed and self-regulatory behavior (Gucciardi, Jalleh, & Donovan, 2011;
3 Petroczi & Aidman, 2008), so our findings might supplement the argument by providing
4 initial evidence of the importance of self-control, a finite self-regulatory resource, as a central
5 factor of psychological models of doping and anti-doping behaviors in sport. We see results
6 as paving the way for an experimental study testing whether ego-depletion would moderate
7 the relationship between self-control and behavioral outcomes, in the context of doping
8 (Wolff, et al., 2013).

9 The only discrepancy was that the hypothesized association between self-control and
10 reading the ingredients table of the unknown food was not statistically significant. This
11 finding could be attributed to the possibility that reading the information in the ingredients
12 table was more related to the awareness of doping. Chan, Donovan, and colleagues (2014)
13 found that young athletes with high autonomous motivation toward doping avoidance were
14 more likely to read the ingredients table of an unfamiliar food. Therefore, investigating
15 whether autonomous motivation moderates the relationship between self-control and the
16 awareness of doping information would be an avenue for future research (Hagger, et al.,
17 2010b). It seems reasonable to assume that the availability of resources may moderate the
18 extent to which individuals act on their intentions and motives, and this may be the
19 mechanisms in operation (Hagger, 2013, 2014; Hagger & Chatzisarantis, 2014).

20 A few limitations of the study should be noted. The study only included doping
21 intentions and behaviors with respect to doping avoidance as outcome variables, so we were
22 unable to examine the effects of self-control on athletes' actual doping behavior. It must,
23 however, be stressed, that this is a problem endemic in the vast majority of research in the
24 field of doping behavior, given that accurate, objective measures of doping behavior are very
25 difficult to collect and self-reports are heavily influenced by affirmation bias (Gucciardi,

1 Jalleh, & Donovan, 2010; Petróczi et al., 2010). Also, the size of the effects of self-control on
2 the doping-related outcomes was relatively small, and the correlational design of study could
3 not permit us to infer causality, so we have to interpret our findings in the context of these
4 boundary conditions (Chan, Fung, Xing, & Hagger, 2014; Chan & Hagger, 2012). In addition,
5 measures of the psychological variables (e.g., self-control, doping intention) were self-
6 reported and, therefore, were subject to social desirability and response bias. Moreover, other
7 confounding effects such as participants' prior experience, knowledge, and belief of anti-
8 doping were likely to elevate the error variances of the study. Using lollipops as a behavioral
9 means to evaluate preventive action toward unintended doping (Chan, Donovan, et al., 2014)
10 might also be vulnerable to the influences of socially desirable responses and individual
11 discrepancies in food preference. Future studies may adopt more objective psychological
12 measures (e.g., performance on self-regulatory tasks, implicit association test for implicit
13 doping attitudes) and randomized factorial experiments to test the role of self-control on
14 doping intention, awareness, and behavior.

15 In conclusion, our initial test of the strength-energy model in the context of doping
16 and anti-doping behaviors reveals that young athletes with low trait self-control are likely to
17 have higher attitude and intention toward doping, and increased intention toward, and
18 adherence to, anti-doping behavior.

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Footnote

¹This study utilized a dataset reported in previous studies (Chan, Dimmock, et al., 2015; Chan, Donovan, et al., 2014; Chan, Hardcastle, et al., 2015) based on a convenience sample of athletes that were used to test different hypotheses.

Table 1

Correlation matrix and descriptive statistics

Correlations					
	1	2	3	4	5
1. Self-Control	1				
2. Attitude towards Doping	-.26**	1			
3. Doping Intentions	-.19**	.44**	1		
4. Doping Avoidance Intentions	.17**	-.24**	-.26**	1	
5. Doping Avoidance Adherence	.27**	-0.08	-0.05	0.08	1
Control Variables					
6. Age	-.10*	-.01	-.03	.03	-.02
7. Gender	.03	-.12	-.16**	.05	.13**
8. Sport Type	.04	-.04	-.02	-.06	.04
9. Sport Level	.08	-.05	-.01	.08	.36**
Mean	3.10	2.29	1.33	6.18	3.62
SD	.42	1.13	.90	1.60	1.71
α	.74	.94	.89	.89	.91
Composite Score Reliability	.80	.95	.93	.93	.93
Variance Inflation Factor	1.13	1.33	1.34	1.11	1.23

** $p < .01$ at 2-tailed, * $p < .05$ at 2-tailed.

Table 2

Results of hierarchical linear multiple regression models

Step	Independent Variables	β	(95% CI of B)	F	ΔF	R^2	ΔR^2
<u>Dependent Variable = Doping Attitude</u>							
1	Age	.00	(-.02 to .02)	1.66	N/A	.02	N/A
	Gender	-.11*	(-.49 to .01)				
	Sport Type	-.05	(-.31 to .20)				
	Sport Level	-.04	(-.09 to .17)				
2	Self-Control	-.26**	(-.93 to -.38)	7.07**	28.27**	.08	.06
<u>Dependent Variable = Doping Intention</u>							
1	Age	-.02	(-.02 to .01)	2.80*	N/A	.03	N/A
	Gender	-.16**	(-.43 to -.07)				
	Sport Type	-.00	(-.18 to .19)				
	Sport Level	-.01	(-.09 to .10)				
2	Self-Control	-.18**	(-.57 to -.16)	5.17**	14.26**	.06	.03
<u>Dependent Variable = Doping Avoidance Intention</u>							
1	Age	.02	(-.03 to .04)	.44	N/A	.00	N/A
	Gender	.01	(-.47 to .24)				
	Sport Type	-.05	(-.52 to .22)				
	Sport Level	.02	(-.17 to .19)				
2	Self-Control	.17**	(.27 to 1.09)	2.58*	11.11**	.03	.03
<u>Dependent Variable = Doping Avoidance Adherence</u>							
1	Age	-.04	(-.04 to .03)	18.04**	N/A	.15	N/A
	Gender	.06	(-.27 to .44)				
	Sport Type	.13	(.16 to .89)				
	Sport Level	.38**	(.47 to .84)				
2	Self-Control	.23**	(.50 to 1.31)	20.58**	26.26**	.20	.05

Note. The coding of the control variables was as follows: gender (1 = male, 2 = female), type of sport (1 = individual sport, 2 = team sport), and sport level (1 = sub-elite, 2 = national level, 3 = international level, 4 = world-class). 95% CI of B = 95% confidence interval of unstandardized beta. * $p < .05$, ** $p < .01$

Table 3

Results of hierarchical logistic multiple regression models

Step	Independent Variables	Odd Ratio	(95% CI of <i>EXP(B)</i>)	Wald	χ^2	R ²	ΔR^2
<u>Dependent Variable = Not-Taking</u>							
1	Age	1.00	(.96 to 1.04)	.05	1.26	.01	N/A
	Gender	1.18	(.75 to 1.86)	.51			
	Sport Type	1.19	(.74 to 1.90)	.51			
	Sport Level	.97	(.77 to 1.23)	.05			
2	Self-Control	1.83**	(1.07 to 3.12)	4.91**	4.98**	.06	.05
<u>Dependent Variable = Not-Eating</u>							
1	Age	.98	(.94 to 1.02)	.90	2.05	.01	N/A
	Gender	1.18	(.75 to 1.86)	.52			
	Sport Type	.87	(.54 to 1.39)	.35			
	Sport Level	1.05	(.83 to 1.34)	.19			
2	Self-Control	2.17**	(1.26 to 3.72)	4.40	8.12	.04	.03
<u>Dependent Variable = Reading</u>							
1	Age	1.01	(.95 to 1.06)	.05	6.84	.04	N/A
	Gender	1.98*	(1.04 to 3.78)	4.29			
	Sport Type	1.03	(.55 to 1.92)	.01			
	Sport Level	.74	(.53 to 1.02)	3.44			
2	Self-Control	.89	(.44 to 1.80)	.12	6.96	.04	.00

Note. R² = Nagelkerke R-squared. Not-taking = refusing taking the lollipop (0 = No, 1 = Yes); Not-eating = refusing eating the lollipop (0 = No, 1 = Yes). Reading = reading the ingredients table printed on the lollipop (0 = No, 1 = Yes). 95%CI of *EXP(B)* = 95% confidence interval of the odd ratio. * $p < .05$, ** $p < .01$