Kognitionspsychologie II: Session 4

Emotion: Regulation

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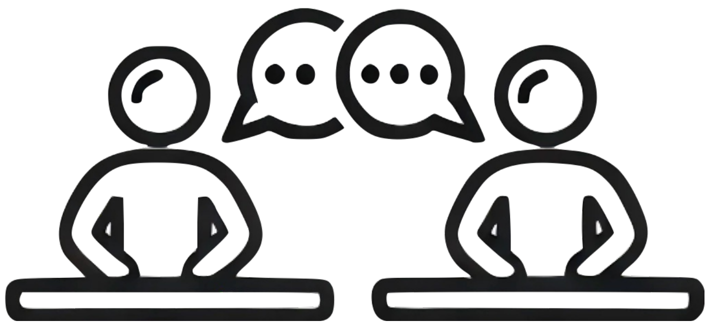
Learning Objectives for this Session

- Explore the definitions and commonalities between self-control and emotion regulation to discuss the construct of **regulation**
- Discuss relevance of regulation for life outcomes
- Become familiar with key developmental aspects of regulation, including the role of genetics and experience
- Become familiar with cognitive and neural models of self-control and emotion regulation
- Discuss implications for our understanding of mental health and regulation interventions

WHEN DID YOU LAST TRY TO REGULATE YOUR EMOTIONS OR EXERT SELF-CONTROL?

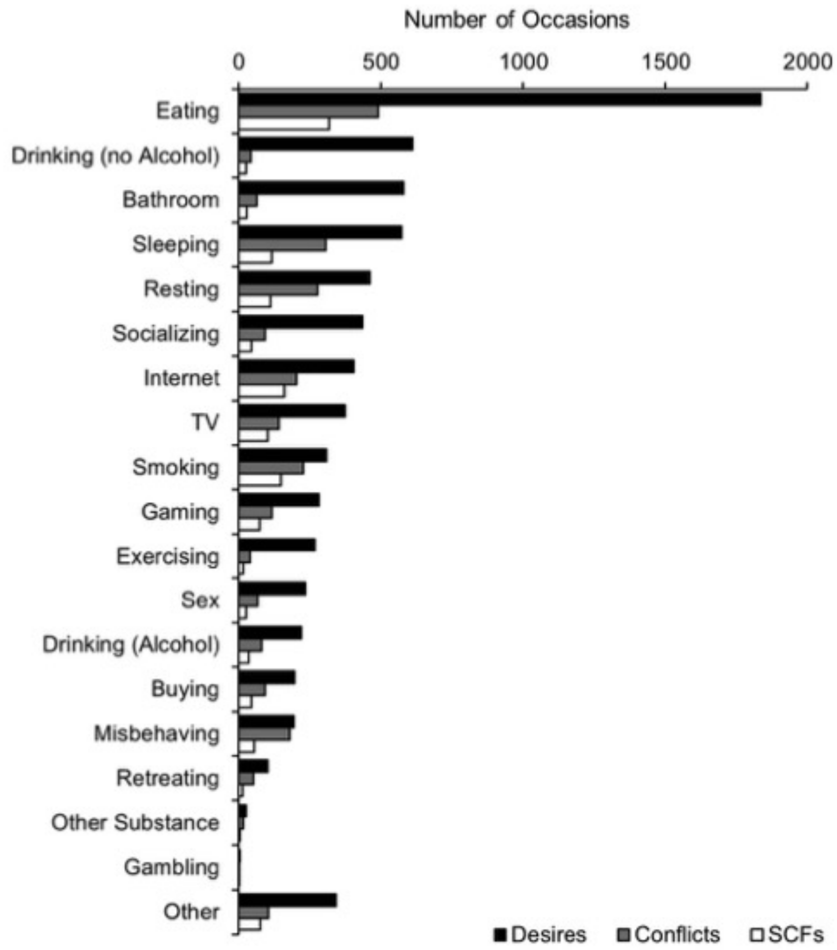
List situations and associated strategies



Regulation in everyday life

240 young adults (146 female; average age 22.2; SD = 1.8)

Experience sampling 8 times daily for 1 week regarding current needs and self-control conflicts



Total numbers of desires, conflicts, and self-control failures (SCFs) reported by the 237 participants for whom experience sampling data were available, by desire type.

Wolff, M., Krönke, K.-M., Venz, J., Kräplin, A., Bühringer, G., Smolka, M. N., & Goschke, T. (2016). Action versus state orientation moderates the impact of executive functioning on real-life self-control. *Journal of Experimental Psychology: General, 145*(12), 1635–1653. https://doi.org/10.1037/xge0000229

Regulation in everyday life

Table 1 Self-control dilemmas described by high school students in Duckworth et al.'s (2016b) study

Self-control dilemma	Academic goal–congruent response	Academic goal–incongruent response
"I had a very important essay due the next day, however there was a huge football game on. I used my self-control to prevent myself from watching the game rather than doing my homework."	Working on an essay	Watching television
"A lot of times it can be difficult for me to concentrate on schoolwork. I was trying to finish an essay before the end of class. It was hard for me to focus because some people had already finished and were talking loudly. I really wanted to talk to them but I needed to finish to improve my grade."	Finishing an essay before the end of class	Talking to classmates
"I wanted to finish an essay but I also wanted to watch Netflix and I was at a great part in [a show called] *The Office* so *The Office* was more important at that time, but I eventually did the essay."	Working on an essay	Watching Netflix
"I use self-control on a daily basis when doing my homework. A specific scenario that has happened more than once is when I am sitting at my desk attempting to study and do homework and I can hear the television blasting my favorite show downstairs."	Doing homework	Watching television
"I once was working on a project with a group of people, and the others did no work on the project. Thus, leaving me to do all the work. I became very angry about this, however I did not lash out on the students I simply told my teacher."	Working on a group project with classmates who are not contributing their share	Lashing out at other students
"One day, I was not able to focus studying because I was Snapchatting and texting constantly. I exercised self-control by turning off my iPhone so I could focus on studying for my bio test."	Studying	Snapchatting and texting
"Once, my sixth grade teacher made it clear that we needed to pay attention to get directions for a test. I told myself that I needed to pay attention. Even though she made the importance of paying attention very clear, I still chose to daydream. When it was time to start the test, I had no idea what I was supposed to do."	Paying attention to directions for a test	Daydreaming
"A time when I used self-control was when I was in elementary school and other kids in my school thought it was cool if you skipped class. However, I did not skip class so I could look cool, instead I ignored what the kids thought and stayed in class."	Attending class	Skipping class to look cool

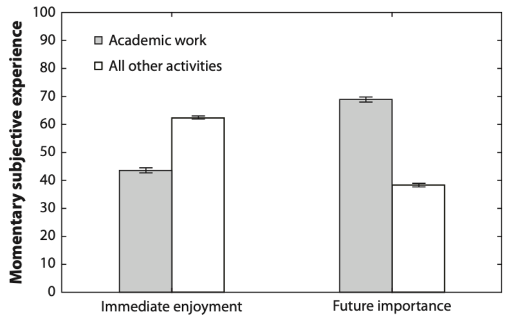


Figure 2

Experience sampling data from a national sample of adolescents show that academic work (e.g., taking a test or quiz, doing homework) is experienced as less enjoyable than other daily activities (e.g., socializing with friends or family, playing sports or doing hobbies, watching television, resting) but simultaneously more important to future goals. Error bars are +/−1 standard deviation of the mean. Data were taken from the Sloan Study of Youth and Social Development (SSYSD; Schneider 2013). The **Supplemental Materials** provide details about the SSYSD and a full reporting of the results of this analysis.

Duckworth, A. L., Taxer, J. L., Eskreis-Winkler, L., Galla, B. M., & Gross, J. J. (2019). Self-control and academic achievement. *Annual Review of Psychology, 70*(1), 373–399. https://doi.org/10.1146/annurev-psych-010418-103230

Predicting Success

"Univariate analyses revealed that demographic and psychosocial contextual factors generated, at best, small correlations with GPA. Medium-sized correlations were observed for high school GPA, SAT, ACT, and A level scores. Three non-intellective constructs also showed medium-sized correlations with GPA: academic self-efficacy, grade goal, and **effort regulation**. A large correlation was observed for performance self-efficacy, which was the strongest correlate (of 50 measures) followed by high school GPA, ACT, and grade goal."

									CV, 80%		Trim and fill procedure	
Measure	N	k	r^{+}	CI_{r+} 95%	I^2	Q	ρ	SD	L	H	k^{a}	r^{+b}
Demographic correlates												
Socioeconomic status	75,000	21	0.11	[0.08, 0.15]	92.53%	221.26^{**}	0.15	0.00	0.08	0.22	0	n.a.
Sex[c]	6,176	21	0.09	[0.04, 0.15]	80.43%	121.90^{***}	0.04	0.01	0.11	−0.19	5	0.05
Age	42,989	17	0.08	[0.03, 0.13]	91.85%	353.49^{**}	0.03	0.01	−0.08	0.14	2	0.09
Traditional correlates												
High school GPA	34,724	46	0.40	[0.35, 0.45]	96.19%	1368.25^{**}	0.41	0.03	0.20	0.63	9	0.45
SAT	22,289	29	0.29	[0.25, 0.33]	85.15%	258.59^{**}	0.33	0.01	0.21	0.45	1	0.30
ACT	31,971	21	0.40	[0.33, 0.46]	97.67%	314.49^{***}	0.40	0.01	0.30	0.49	7	0.50
A level points	933	4	0.25	[0.12, 0.38]	73.63%	12.07^{**}	0.31	0.01	0.19	0.43	0	n.a.
Intelligence	7,820	35	0.20	[0.16, 0.24]	71.78%	117.94^{**}	0.21	0.01	0.08	0.34	5	0.22
Personality traits												
Conscientiousness	27,875	69	0.19	[0.17, 0.22]	65.25%	165.12^{**}	0.23	0.00	0.16	0.30	3	0.19
Procrastination	1,866	10	−0.22	[−0.27, −0.18]	5.04%	13.77 *ns*	−0.25	0.00	−0.33	−0.17	0	n.a.
Openness	23,096	52	0.09	[0.06, 0.12]	61.76%	118.60^{**}	0.09	0.00	0.01	0.17	8	0.07
Neuroticism	23,659	58	−0.01	[−0.04, 0.01]	68.81%	163.70^{**}	0.01	0.01	−0.09	0.11	0	n.a.
Agreeableness	21,734	47	0.07	[0.04, 0.09]	60.16%	103.05^{**}	0.06	0.00	−0.02	0.13	6	0.05
Extraversion	23,730	58	−0.04	[−0.07, −0.02]	66.09%	137.35^{**}	−0.03	0.00	−0.12	0.05	2	−0.05
Need for cognition	1,418	5	0.19	[0.04, 0.33	86.43%	22.08^{**}	0.17	0.01	0.03	0.31	0	n.a.
Emotional intelligence	5,024	14	0.14	[0.10, 0.18]	32.53%	21.37 *ns*	0.17	0.00	0.10	0.23	0	n.a.
Motivation factors												
Locus of control[d]	2,126	13	0.13	[0.04, 0.22]	77.81%	44.85^{**}	0.15	0.02	−0.02	0.32	0	n.a.
Pessimistic attributional style	1,026	8	0.01	[−0.12, 0.13]	73.71%	26.89^{**}	−0.01	0.03	−0.22	0.20	0	n.a.
Optimism	1,364	6	0.11	[0.04, 0.17]	32.51%	7.46 *ns*	0.13	0.00	0.06	0.20	2	0.14
Academic self-efficacy	46,570	67	0.31	[0.28, 0.34]	90.94%	497.07^{**}	0.28	0.01	0.14	0.41	0	n.a
Performance self-efficacy	1,348	4	0.59	[0.49, 0.67]	70.91%	10.63^{*}	0.67	0.00	0.61	0.74	2	0.64
Self-esteem	4,795	21	0.09	[0.05, 0.13]	47.06%	40.54^{**}	0.12	0.01	0.04	0.20	4	0.11
Academic intrinsic motivation	7,414	22	0.17	[0.12, 0.23]	83.30%	137.81^{*}	0.16	0.02	−0.03	0.35	2	0.15
Academic extrinsic motivation	2,339	10	0.01	[−0.06, 0.08]	59.05%	21.91^{*}	0.00	0.01	−0.11	0.11	3	0.05
Learning goal orientation	18,315	60	0.10	[0.09, 0.14]	48.08%	114.25^{*}	0.12	0.00	0.03	0.21	12	0.08
Performance goal orientation	18,366	60	0.09	[0.06, 0.12]	72.49%	184.97^{**}	0.14	0.01	0.02	0.26	1	0.09
Performance avoidance goal orientation	10,713	31	−0.14	[−0.18, −0.09]	79.20%	113.73^{**}	−0.14	0.01	−0.29	0.01	4	0.11
Grade goal	2,670	13	0.35	[0.28, 0.42]	74.39%	37.75^{**}	0.49	0.01	0.36	0.62	2	0.38
Self-regulatory learning strategies												
Test anxiety	13,497	29	−0.24	[−0.29, −0.20]	79.33%	93.40^{**}	−0.21	0.01	−0.31	−0.11	0	n.a
Rehearsal	3,204	11	0.01	[−0.07, 0.10]	81.43%	45.57^{**}	0.05	0.02	−0.12	0.22	0	n.a
Organization	5,410	6	0.04	[−0.06, 0.15]	69.45%	18.38^{**}	0.20	0.00	0.09	0.20	0	n.a
Elaboration	8,006	12	0.18	[0.11, 0.24]	83.54%	58.00^{**}	0.14	0.01	0.03	0.25	0	n.a
Critical thinking	3,824	9	0.15	[0.11, 0.18]	0.00%	5.39 *ns*	0.16	0.00	0.16	0.16	0	n.a
Metacognition	6,205	9	0.18	[0.10, 0.26]	76.60%	30.18^{**}	0.14	0.00	0.05	0.22	3	0.12
Effort regulation	8,862	19	0.32	[0.29, 0.35]	22.81%	21.20 *ns*	0.35	0.00	0.31	0.39	0	n.a
Help seeking	2,057	8	0.15	[0.08, 0.21]	56.62%	15.71^{*}	0.17	0.01	0.07	0.28	0	n.a
Peer learning	1,137	4	0.13	[−0.06, 0.31]	90.16%	28.60^{**}	0.20	0.02	0.01	0.39	0	n.a
Time/study management	5,847	7	0.22	[0.14, 0.29]	68.80%	17.10^{**}	0.20	0.00	0.15	0.25	0	n.a
Concentration	6,798	12	0.16	[0.14, 0.19]	0.01%	12.77 *ns*	0.18	0.00	0.17	0.20	1	0.17
Students' approach to learning												
Deep approach to learning	5,211	23	0.14	[0.09, 0.18]	60.24%	54.82^{**}	0.03	0.00	−0.03	0.10	0	n.a
Surface approach to learning	4,838	22	−0.18	[−0.25, −0.10]	86.31%	190.31^{*}	−0.19	0.07	−0.52	0.14	4	−0.13
Strategic approach to learning	2,774	15	0.23	[0.17, 0.30]	69.61%	50.09^{**}	0.31	0.02	0.11	0.50	0	n.a
Psychosocial contextual influences												
Social integration	19,028	15	0.04	[−0.02, 0.10]	92.53%	111.98^{**}	0.03	0.01	−0.07	0.13	0	n.a
Academic integration	13,755	11	0.07	[−0.00, 0.14]	93.10%	134.96^{**}	0.13	0.01	0.00	0.26	3	0.11
Institutional integration	19,773	18	0.04	[0.01, 0.08]	72.00%	51.42^{**}	0.03	0.00	−0.03	0.09	7	0.01
Goal commitment	13,098	10	0.15	[0.07, 0.22]	92.01%	53.03^{**}	0.12	0.00	0.06	0.17	0	n.a
Social support	5,840	14	0.08	[0.03, 0.12]	60.39%	36.26^{**}	0.09	0.00	0.03	0.14	3	0.07
Stress (in general)	1,736	8	−0.13	[−0.19, −0.06]	41.21%	12.03 *ns*	−0.14	0.00	−0.21	−0.08	1	−0.14
Academic stress	941	4	−0.12	[−0.21, −0.02]	47.74%	5.89 *ns*	−0.11	0.00	−0.18	−0.04	0	n.a
Depression	6,335	17	−0.10	[−0.17, 0.02]	84.41%	92.91^{**}	0.03	0.01	−0.07	0.13	4	−0.05

Richardson, M., Abraham, C. & Bond, R. (2012). Psychological correlates of university students' academic performance: A systematic review and meta-analysis. ***Psychological Bulletin, 138***, 353-387.

Self-control and emotion regulation

Self-control is the capacity to regulate attention, emotions, and behaviors in the face of temptations or distractions in order to achieve (long-term) goals.

Emotion regulation refers to the processes by which individuals influence which emotions they have, when they have them, and how they experience and express them. It includes strategies that can be used before or after an emotion is fully generated.

Both self-control and emotion regulation can be understood as forms of **regulation** because they involve efforts to manage psychological processes in the service of adaptive functioning and goal pursuit.

Duckworth, A. L., Taxer, J. L., Eskreis-Winkler, L., Galla, B. M., & Gross, J. J. (2019). Self-control and academic achievement. *Annual Review of Psychology, 70*(1), 373–399. https://doi.org/10.1146/annurev-psych-010418-103230

Gross, J. J. (2015). Emotion regulation: Current status and future prospects. *Psychological Inquiry, 26*(1), 1–26. https://doi.org/10.1080/1047840X.2014.940781

The Bing Nursery Study

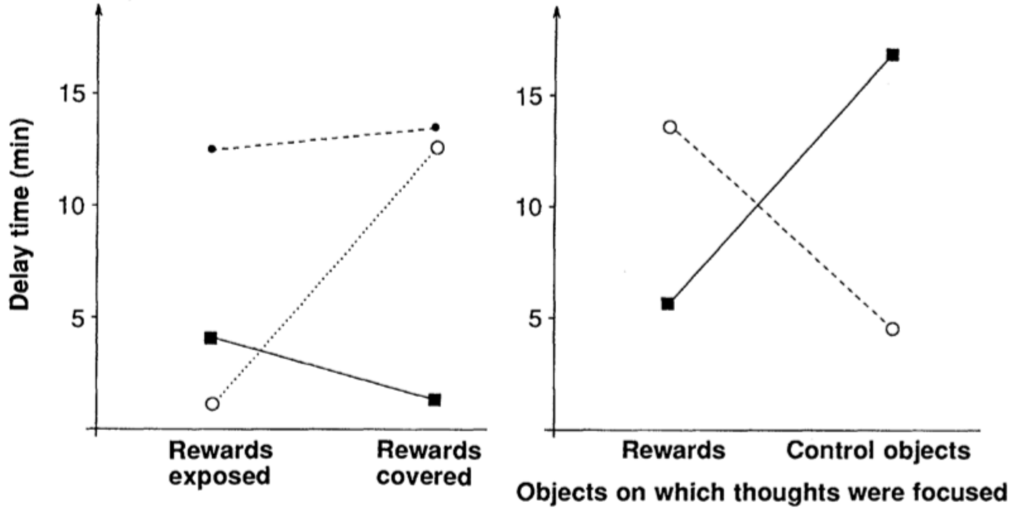


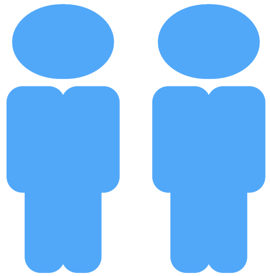
Fig. 1. (**Left**) Average delay time shown by 52 Stanford preschoolers when different types of thoughts were suggested (●, fun thoughts; ■, thoughts about the rewards; ○, no thoughts suggested) and the rewards were exposed or covered [based on figure 4 in (*20*)]. **Fig. 2.** (**Right**) Delay time as a function of objects on which thoughts were focused (rewards versus comparable control objects) and type of cognitive representation in thoughts [arousing (■) versus abstract (○)]. All 48 Stanford preschool children were facing the exposed rewards [data are from table 1 in (*30*)].

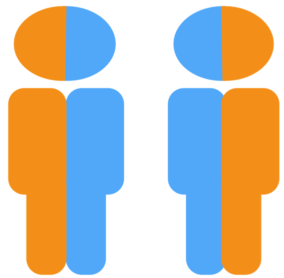
The experiment took place at the Bing Nursery School located at Stanford University, using children age four to six as subjects. The children were led into a room, empty of distractions, where a treat of their choice (Oreo cookie, marshmallow, or pretzel stick) was placed on a table.The children could eat the marshmallow, the researchers said, but if they waited for fifteen minutes without giving in to the temptation, they would be rewarded with a second marshmallow. In over 600 children who took part in the experiment, a minority ate the marshmallow immediately. Of those who attempted to delay, one third deferred gratification long enough to get the second marshmallow.

Mischel, W., Shoda, Y., & Rodriguez, M. L. (1989). Delay of gratification in children. ***Science, 244***(4907), 933–938. http://doi.org/10.2307/1704494?ref=no-x-route:282d9b4150c356d1eb92ad582d930537

Mischel, W., & Ebbesen, E. B. (1970). Attention in delay of gratification. ***Journal of Personality and Social Psychology, 16(2)***, 329–337. http://doi.org/10.1037/h0029815

Genetics





MZ: ***monozygotic*** ("identical twins"), develop from one zygote that splits to form two embryos with identical genetic material (**100%** shared genetic material)

DZ: ***dizygotic*** ("fraternal twins"), develop from two different eggs, each fertilized by separate sperm cells, share half of their genetic material like any siblings (**50%** shared genetic material).

$r_{MZ} = .58$

$r_{DZ} = .28$

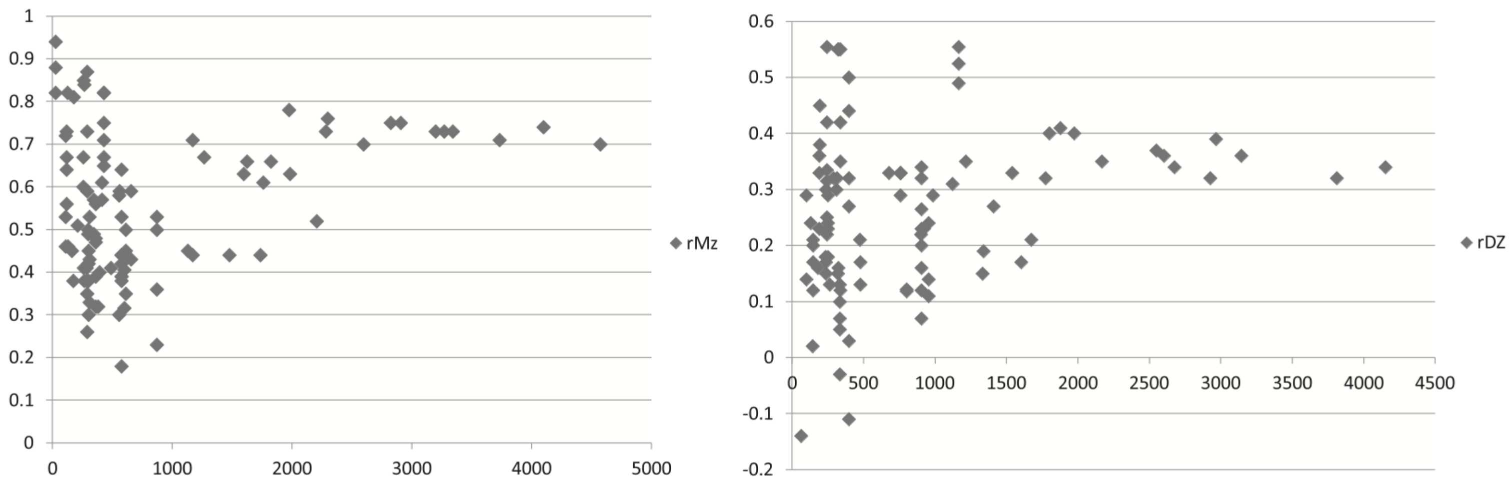


Fig. 2. MZ correlations (on the left, rMZ) and DZ correlations (on the right, rDZ) per sample size.

Willems, Y. E., Boesen, N., Li, J., Finkenauer, C., & Bartels, M. (2019). The heritability of self-control: A meta-analysis. *Neuroscience & Biobehavioral Reviews*, *100*, 324–334. https://doi.org/10.1016/j.neubiorev.2019.02.012

Genetics

"Applying Falconer's formula to calculate the heritability based on the meta- analytic MZ and DZ correlations results in an overall heritability of 60%. In other words, 60% of individual differences in self-control were due to genetic differences between people. The MZ correlation was twice as large as the DZ correlation, indicating little to no evidence for shared environmental effects. Rather, these results suggest that environmental effects on self-control, that explain 40% of the variance, are unique to individuals."

$A = 2\,(r_{MZ} - r_{DZ})$

Falconer's formula

MZs and DZs differ by half a genome, consequently the difference in the similarities between MZs (quantified by r_{mz}) and DZs (quantified by r_{dz}) that is determined by genetics is half a genome. In numbers: half of a genome explains $\frac{1}{2} A = .58 - .28 = .30$ of the variance, and, therefore, a whole genome explains, $A = 2 \times .30 =$ **.60** of the variance.

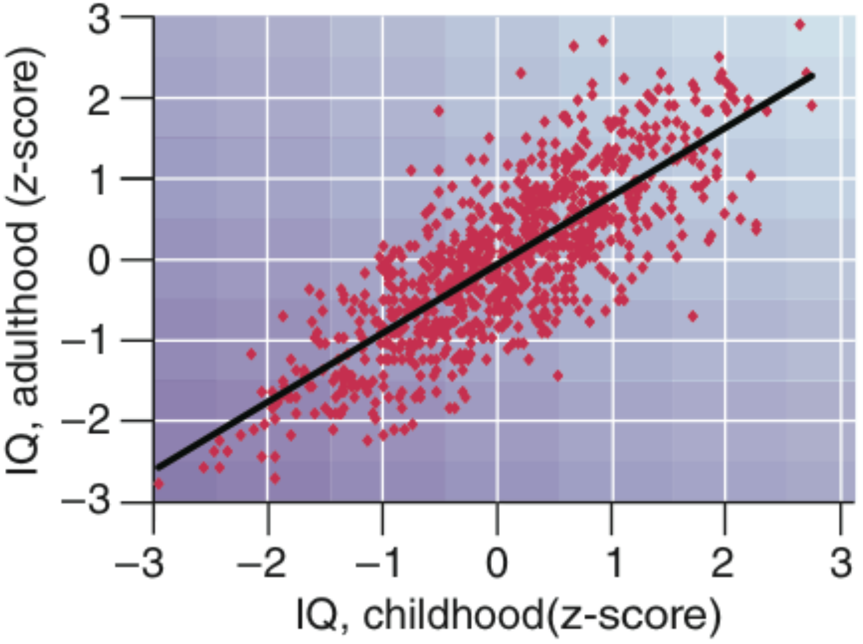
Willems, Y. E., Boesen, N., Li, J., Finkenauer, C., & Bartels, M. (2019). The heritability of self-control: A meta-analysis. *Neuroscience & Biobehavioral Reviews, 100*, 324–334. https://doi.org/10.1016/j.neubiorev.2019.02.012

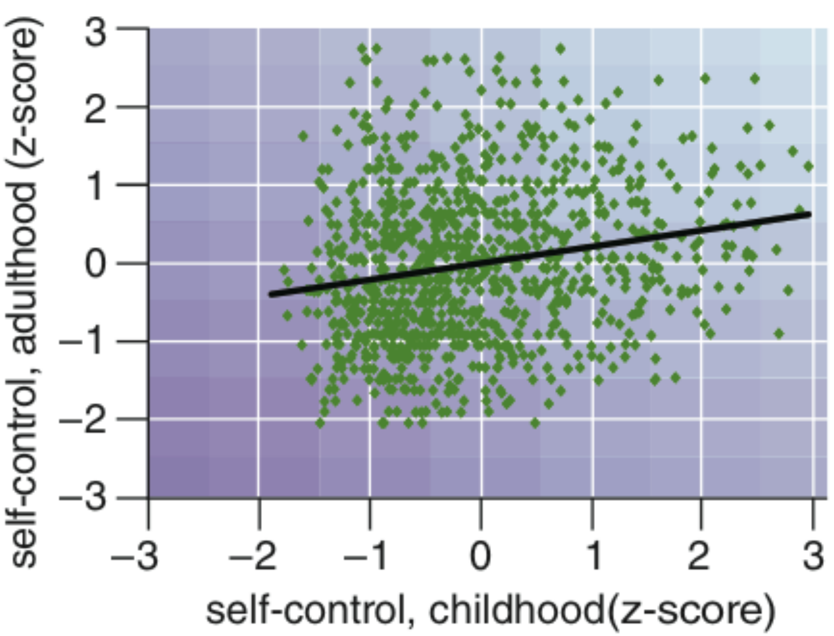
The Dunedin Study

The Dunedin Study is a longitudinal research effort that has followed more than 1,000 people from birth to middle age, collecting information on their physical health and social well-being.

Moffitt, T., Poulton, R., & Caspi, A. (2013). Lifelong impact of early self-control childhood self-discipline predicts adult quality of life. *American Scientist*. http://doi.org/10.1511/2013.104.352

The Dunedin Study

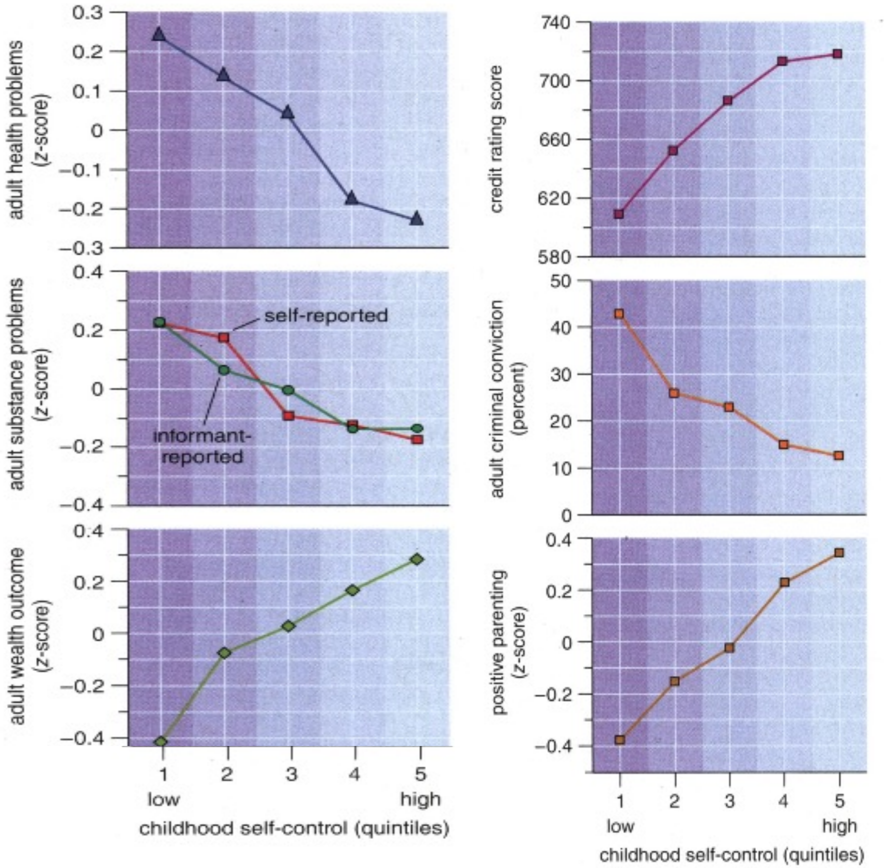


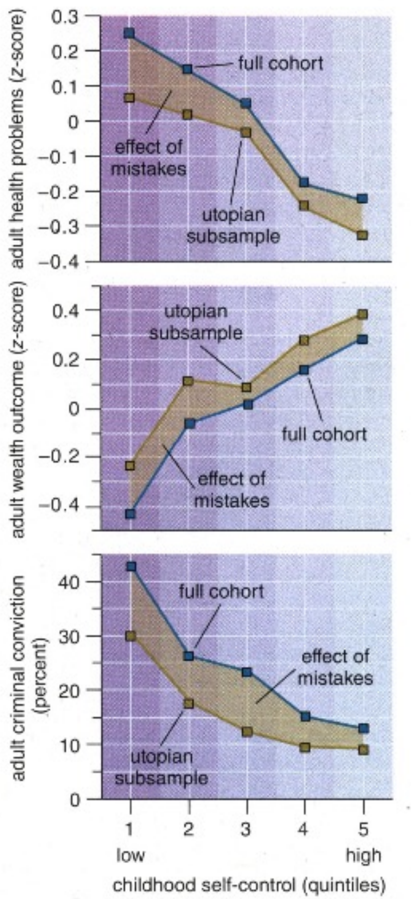


"Childhood IQ is tightly correlated with adult IQ; in contrast, childhood self-control is significantly correlated with adult self-control but shows much more room for change. The fact that a child with low self-control can still become an adult with high self-control indicates that self-control may be a more malleable and teachable characteristic than IQ."

Moffitt, T., Poulton, R., & Caspi, A. (2013). Lifelong impact of early self-control childhood self-discipline predicts adult quality of life. *American Scientist*. http://doi.org/10.1511/2013.104.352

The Dunedin Study





Children who avoided mistakes in adolescence (e.g., dropping out of school, teen parenthood), grew up to be adults with better health, greater wealth, and lower crime conviction than those with similar self-control levels who did not avoid these pitfalls. This finding indicates that preventing such adolescent mistakes could have lifelong benefits.

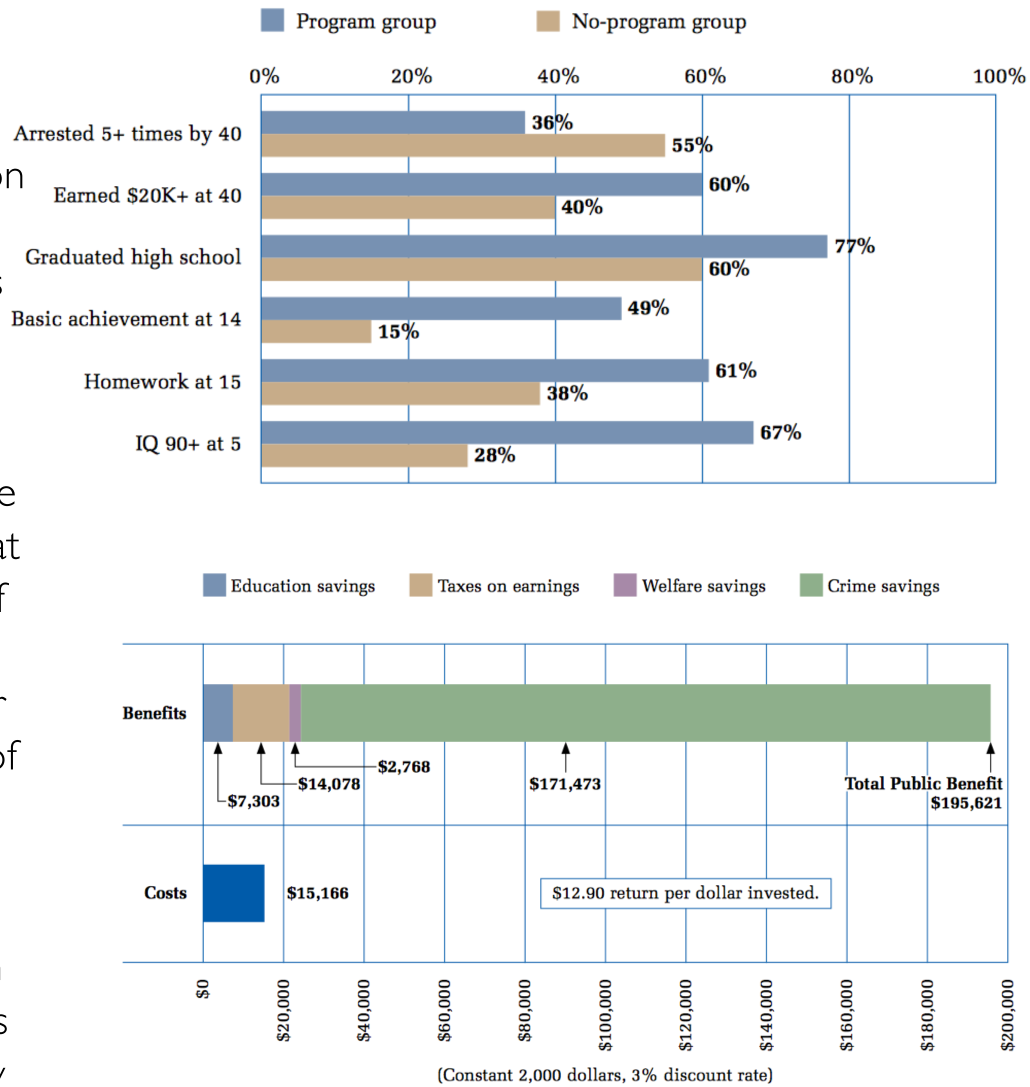
Children who showed early difficulty with self-control grew up to have poorer health, greater substance abuse, more financial difficulties, higher crime conviction rates, and lower parenting skill, even after controlling for the effects of IQ, social class, and sex. Health and substance abuse were both standardized into z-scores: negative scores are below average, and positive scores are above average.

Moffitt, T., Poulton, R., & Caspi, A. (2013). Lifelong impact of early self-control childhood self-discipline predicts adult quality of life. *American Scientist*. http://doi.org/10.1511/2013.104.352

The Perry Preschool Project

The High/Scope Perry Preschool study is a scientific experiment that has identified both the short- and long-term effects of a high- quality preschool education program for young children living in poverty. From 1962 through 1967, David Weikart and his colleagues in the Ypsilanti, Michigan, school district operated the High/Scope Perry Preschool Program for young children to help them avoid school failure and related problems. They identified a sample of 123 low-income African-American children who were assessed to be at high risk of school failure and randomly assigned 58 of them to a program group that received a high-quality preschool program at ages 3 and 4 and 65 to another group that received no preschool program. Because of the random assignment strategy, children's preschool experience remains the best explanation for subsequent group differences in their performance over the years. Project staff collected data annually on both groups from ages 3 through 11 and again at ages 14, 15, 19, 27, and 40, with a missing data rate of only 6% across all measures.

Figure 1
Major Findings: High/Scope Perry Preschool Study at 40



Schweinhart, L. J., Montie, J., Xiang, Z., & Barnett, W. S. (2005). Lifetime effects: the High/Scope Perry Preschool study through age 40.

The Perry Preschool Project

"Cognitive skills are important, but noncognitive skills such as motivation, perseverance, and tenacity are also important for success in life. (…). Consider the Perry Preschool Program, a 2-year experimental intervention for disadvantaged African-American children initially ages 3 to 4 that involved morning programs at school and afternoon visits by the teacher to the child's home. The Perry intervention group had IQ scores no higher than the control group by age 10. Yet, the Perry treatment children had higher achievement test scores than the control children because they were more motivated to learn. In follow-ups to age 40, the treated group had higher rates of high school graduation, higher salaries, higher percentages of home ownership, lower rates of receipt of welfare assistance as adults, fewer out-of-wedlock births, and fewer arrests than the controls."

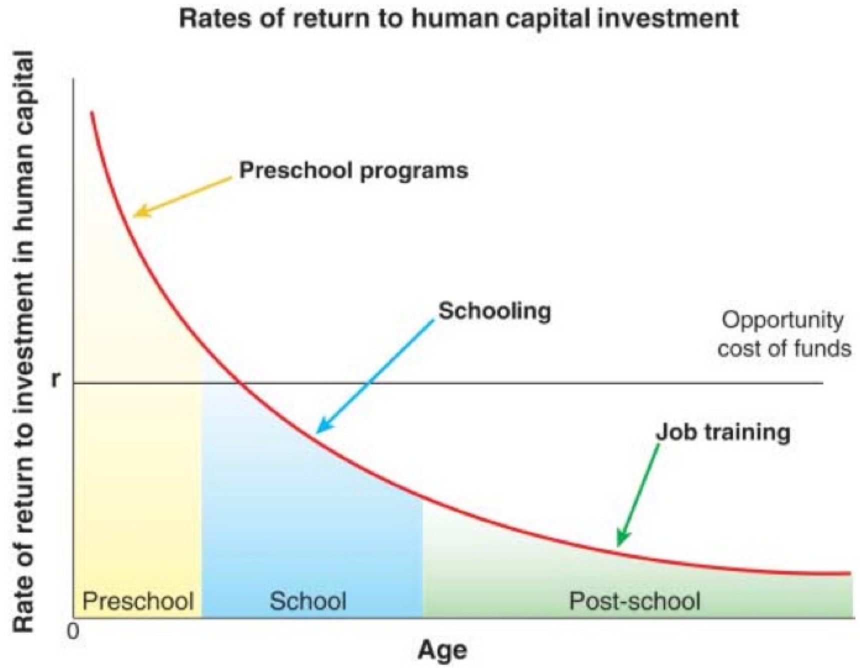
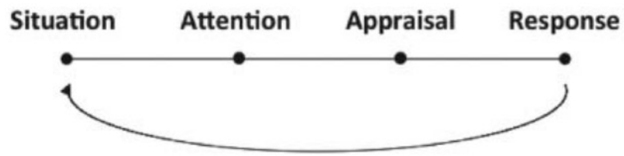


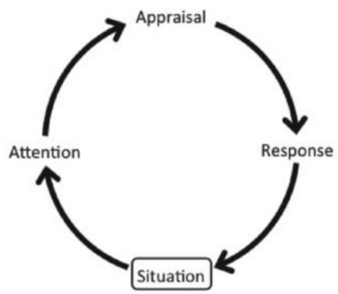
Fig. 2. Rates of return to human capital investment in disadvantaged children. The declining figure plots the payout per year per dollar invested in human capital programs at different stages of the life cycle for the marginal participant at current levels of spending. The opportunity cost of funds (*r*) is the payout per year if the dollar is invested in financial assets (e.g., passbook savings) instead. An optimal investment program from the point of view of economic efficiency equates returns across all stages of the life cycle to the opportunity cost. The figure shows that, at current levels of funding, we overinvest in most schooling and post-schooling programs and underinvest in preschool programs for disadvantaged persons. Adapted from (*3*) with permission from MIT Press.

Heckman, J. J. (2006). Skill formation and the economics of investing in disadvantaged children. ***Science, 312***(5782), 1900–1902. http://doi.org/10.1126/science.1128898

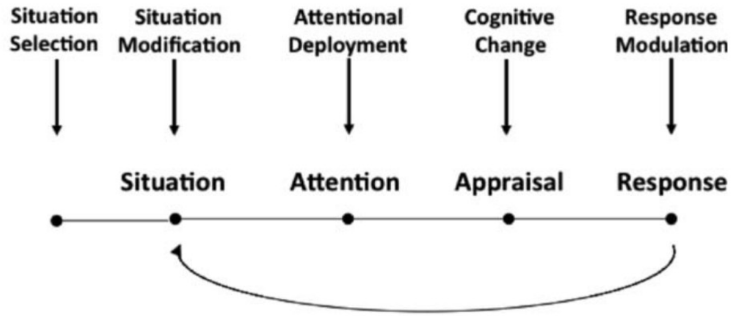
Emotion regulation models

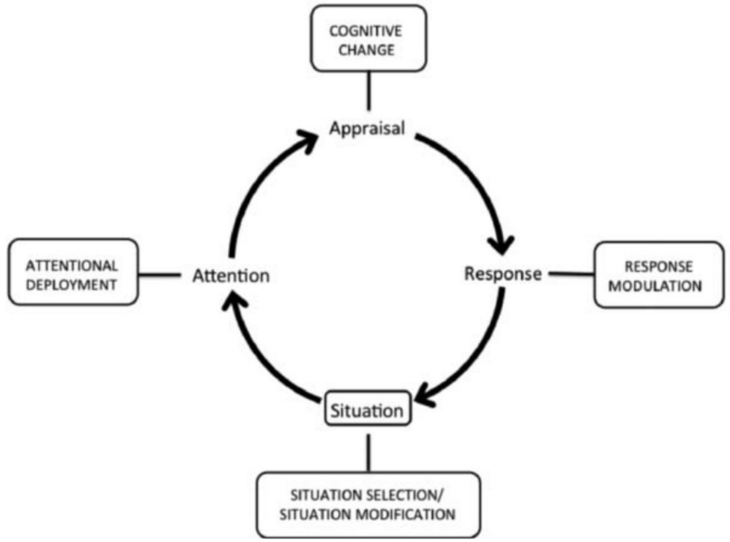
Emotion generation





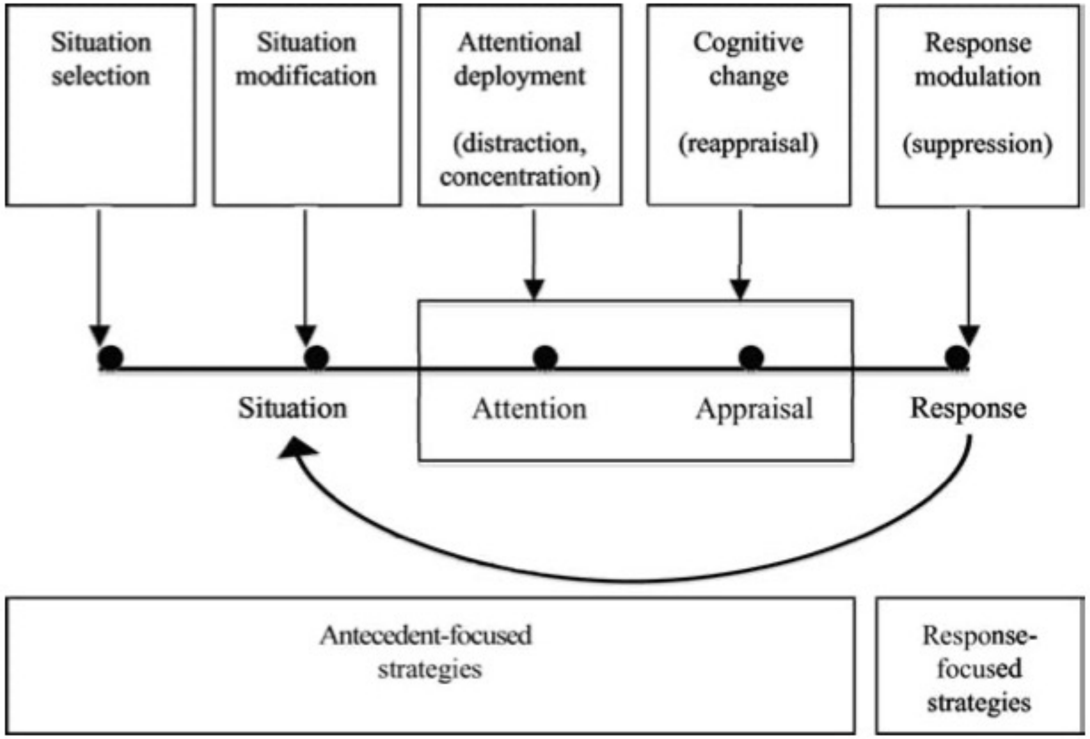
Emotion regulation





Gross, J. J. (2015). Emotion regulation: Current status and future prospects. *Psychological Inquiry, 26*(1), 1–26. https://doi.org/10.1080/1047840X.2014.940781

Emotion regulation models and strategies



	Overall			
			95% CI	
Strategy	*d*	*k*	*LL*, *UL*	χ^2
Attentional deployment	0.00	215	−0.07, 0.07	313*
Distraction: active positive (D1)	0.47	6	0.11, 0.84	2
Distraction: passive positive (D2)	0.18	10	−0.14, 0.50	7
Distraction: active neutral (D3)	0.38	20	0.21, 0.56	20
Distraction: passive neutral (D4)	0.23	66	0.12, 0.35	82
Distraction: overall	0.27	102	0.18, 0.36	119
Concentrate: feelings (C1)	−0.14	42	−0.28, −0.00	51
Concentrate: implications (C2)	−0.34	33	−0.48, −0.20	30
Concentrate: mixed (C3)	−0.36	38	−0.51, −0.21	31
Concentrate: overall	−0.26	113	−0.34, −0.18	120
Cognitive change	0.36	99	0.27, 0.45	131*
Reappraise: response (R1)	0.23	31	0.12, 0.33	29
Reappraise: stimulus (R2)	0.36	26	0.21, 0.51	28
Reappraise: perspective (R3)	0.45	36	0.30, 0.62	54*
Reappraise: mixed (R4)	0.89	6	0.24, 1.54	9
Response modulation	0.16	102	0.09, 0.24	137*
Suppress: expression (S1)	0.32	56	0.27, 0.42	69
Suppress: experience (S2)	−0.04	12	−0.21, 0.14	7
Suppress: thoughts (S3)	−0.12	20	−0.26, 0.01	17
Suppress: mixed (S4)	0.11	14	−0.05, 0.27	8

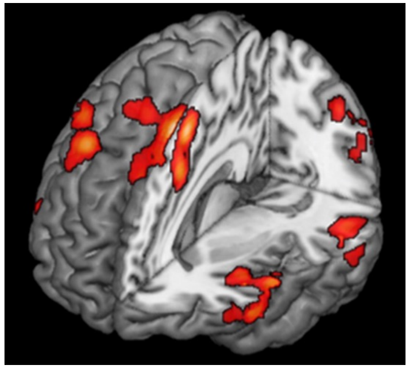
In general, antecedent-focused (some forms of attentional deployment, such as distraction, or cognitive change strategies, such as reappraisal) tend to be more effective than response-focused strategies (suppression). There is overall less work on situation selection and modification but there is some work suggesting overall positive effects (cf. Duckworth, Milkman, & Laibson, 2018).

Webb, T. L., Miles, E., & Sheeran, P. (2012). Dealing with feeling: A meta-analysis of the effectiveness of strategies derived from the process model of emotion regulation. *Psychological Bulletin, 138*(4), 775–808. https://doi.org/10.1037/a0027600

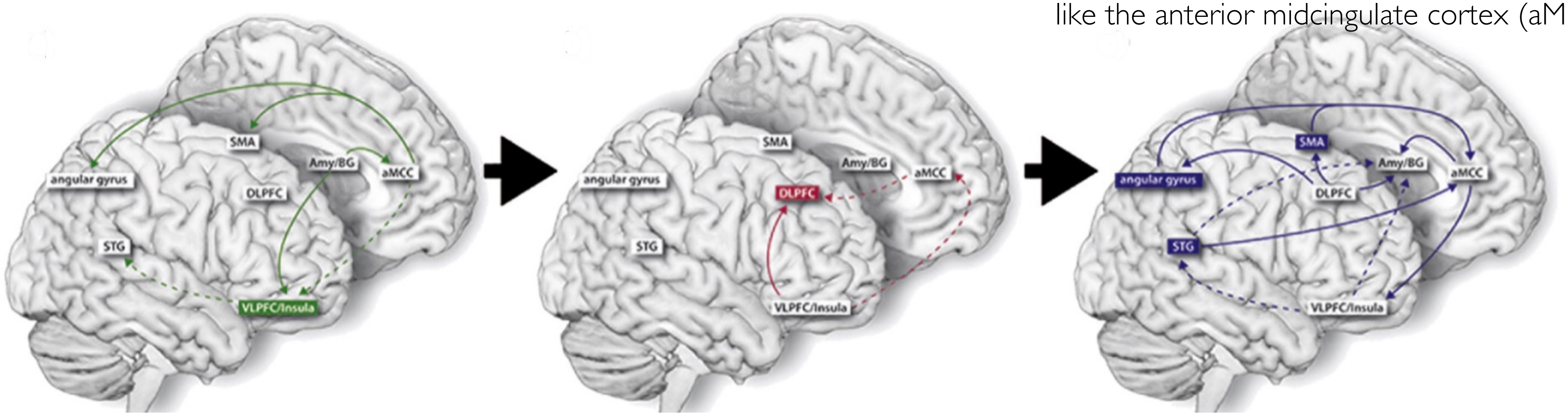
The neural bases of emotion regulation: Meta-analytic evidence

Example data

Authors	Number of subjects	Gender ratio (f/m)	Stimulus material	Contrasts
Campbell-Sills et al. (2011)	26	22/4	IAPS, negative	Reduce > baseline
Delgado et al. (2008)	12	6/6	Fear conditioning paradigm with instruction	Decrease > attend
Domes et al. (2010)	33	17/16	IAPS, negative	Decrease > maintain Increase > maintain
Eippert et al. (2007)	24	24/0	IAPS, neutral and negative (fear)	Decrease > view Increase > view
Goldin et al. (2008)	17	17/0	Disgust-inducing and neutral film clips	Reappraise > watch negative (early, middle, late) Suppress > watch negative (early, middle, late)
Harenski et Hamann (2006)	10	10/0	IAPS and popular media, moral vs non-moral, social unpleasant scenes	Decrease moral > odd–even baseline Decrease non-moral > odd–even baseline Decrease moral > watch moral Decrease non-moral > watch non-moral
Hayes et al. (2010)	25	11/14	IAPS and in-house pictures, negative	Reappraise > view Suppress > view



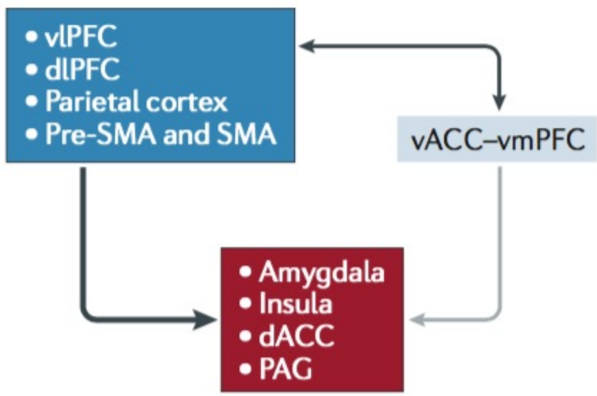
Affective arousal is processed in subcortical regions such as the amygdala, which project to cortical regions including the VLPFC → Activity in the VLPFC is associated with the valuation of emotional stimuli and engagement of regulatory processes, including recruitment of the DLPFC. → The DLPFC is involved in implementing regulation strategies (e.g., reappraisal), and modulates activity in subcortical regions—including the amygdala and basal ganglia—either directly or via intermediary structures like the anterior midcingulate cortex (aMCC)

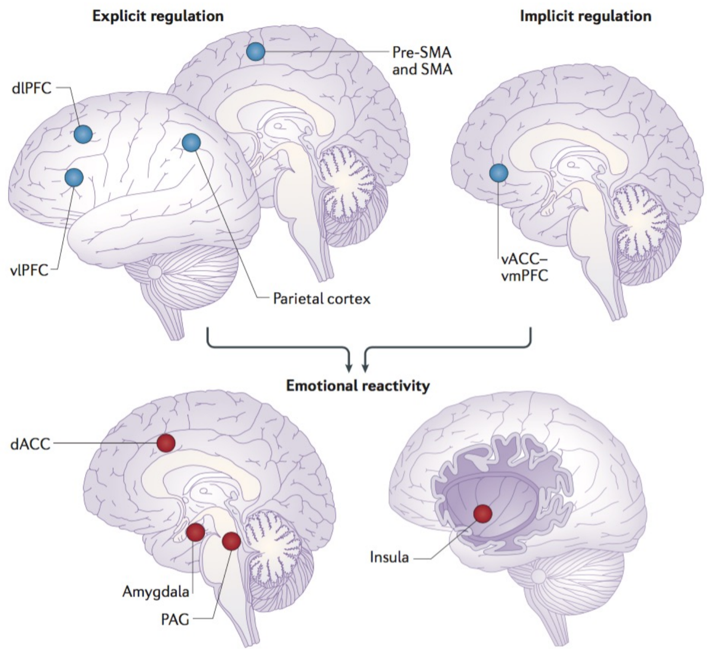


Kohn, N., Eickhoff, S. B., Scheller, M., Laird, A. R., Fox, P. T., & Habel, U. (2014). Neural network of cognitive emotion regulation: An ALE meta-analysis and MACM analysis. ***NeuroImage, 87***(C), 345–355.

The neural bases of emotion regulation: A general model

This schematic and figure illustrate a general model and key brain regions thought to be implicated in the regulation of emotional responses. Prefrontal areas—including the ventrolateral prefrontal cortex (vlPFC), dorsolateral prefrontal cortex (dlPFC), parietal cortex, and supplementary motor areas (Pre-SMA and SMA)—are involved in generating regulatory signals and implementing control strategies. The ventral anterior cingulate cortex (vACC) and ventromedial prefrontal cortex (vmPFC) contribute to evaluating the emotional significance of stimuli and integrating affective information to guide behavior. These regulatory regions influence emotion-generating areas, including the amygdala, insula, dorsal anterior cingulate cortex (dACC), and periaqueductal gray (PAG), which are associated with emotional reactivity, interoception, salience detection, and autonomic responses. Arrows represent pathways of influence, highlighting how regulatory systems modulate affective processing across distributed neural networks.





Etkin, A., Büchel, C., & Gross, J. J. (2015). The neural bases of emotion regulation. *Nature Reviews Neuroscience 16*, 693.

Implications: Understanding of psychopathology

Table 1 The extended process model of emotion regulation and psychopathology[1]

Regulatory stages and dynamics	Regulatory element	Clinical condition and description
Identification	Perception	**Panic attacks:** overrepresenting subtle signs of current emotional states **Disengagement bias in anxiety:** overrepresenting threatening information for an extended time **Alexithymia:** underrepresenting emotional states
	Valuation	**Experiential avoidance:** overvaluating the costs of emotional states **Clinging behavior in dependent personality disorder:** undervaluating the benefits of intrinsic regulation
	Action	**Learned helplessness in depression:** failing to translate a general regulatory goal into action
Selection	Perception	**Escape from self in binge eating and suicide behavior:** overrepresenting maladaptive regulatory options
	Valuation	**Nonsuicidal self-injury and substance abuse:** positively valuing general maladaptive regulatory categories
	Action	**Cognitive change in autism:** impaired ability to activate general adaptive regulatory categories
Implementation	Perception	**Long-term tactics in ADHD:** underrepresenting adaptive regulatory tactics
	Valuation	**Worry in GAD:** positively valuing maladaptive regulatory tactics
	Action	**Positive distraction in major depression:** impaired ability to activate adaptive regulatory tactics
Monitoring	Stopping	**Rumination in depression:** stopping a maladaptive regulatory tactic too late **Low regulatory self-efficacy in SAD:** stopping an adaptive regulatory tactic too early
	Switching	**Depression, anxiety, and OCPD:** switching from an inefficient implemented tactic too late **Manic states in bipolar disorder:** switching between regulatory categories too early

[1]A summary of clinical conditions that represent potential impairments in specific elements of regulatory stages according to the extended process model of emotion regulation. Examples of clinical conditions are not necessarily characterized by difficulties at a single emotion-regulation stage. Rather, each clinical condition may involve failures at multiple stages (see text for details). Abbreviations: ADHD, attention-deficit/hyperactivity disorder; GAD, generalized anxiety disorder; OCPD, obsessive-compulsive personality disorder; SAD, social anxiety disorder.

"Importantly, clinical conditions are not necessarily characterized by difficulties at a single emotion-regulation stage. Rather, a clinical condition may involve failures at multiple stages. At the same time, a clinical condition that is associated with difficulties in one emotion-regulation stage may not be related to difficulties in another regulation stage."

Sheppes, G., Suri, G., & Gross, J. J. (2015). Emotion regulation and psychopathology. *Annual Review of Clinical Psychology, 11*(1), 379–405. https://doi.org/10.1146/annurev-clinpsy-032814-112739

Implications: Multiple interventions

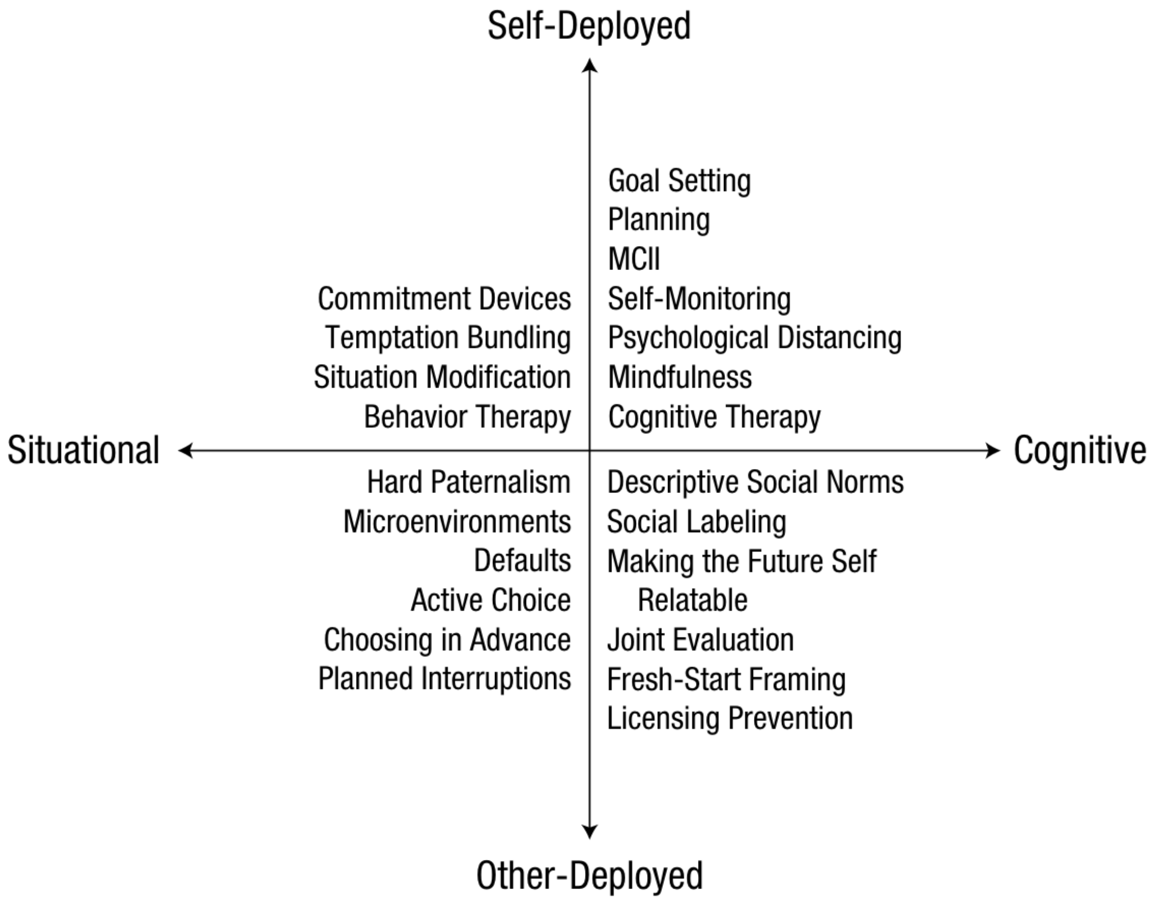


Fig. 2. Illustrative examples of approaches aimed at reducing self-control failures. Approaches are classified as situational versus cognitive and self-deployed versus other-deployed. MCII = mental contrasting/implementation intentions.

Duckworth, A. L., Milkman, K. L., & Laibson, D. (2018). Beyond willpower: Strategies for reducing failures of self-control. *Psychological Science in the Public Interest, 19*(3), 102–129. https://doi.org/10.1177/1529100618821893

Summary

- **Regulation** is important. Self-control and emotion regulation are key psychological functions. They help manage daily challenges and influence academic, social, and health outcomes.
- **Developmental continuity and change:** Self-control is partly genetically determined (ca. 60% heritability) but also shaped by idiosyncratic (unique) experiential factors. Longitudinal studies (e.g., Dunedin, Bing, Perry) show early self-control predicts long-term success but that self-control is malleable and can perhaps be taught.
- **Cognitive and neural models** suggest several forms of regulation and associated strategies. Neural models suggest an interplay between valuation systems and top-down control, including prefrontal brain regions and emotion-generating areas (e.g., amygdala, insula).
- **Implications:** Deficits in regulation are linked to various mental disorders but different conditions may show heterogenous patterns of regulation deficits. Interventions can target different points of action—from environment design, to attention shifting, and reframing.
- **Methodology**: large variety in approaches, with studies using self-reports (surveys, experience sampling), informant ratings, but also lab experiments, longitudinal designs, and randomized controlled trials (RCTs) to measure and test regulation processes.