Trait self-control, exercise and exercise ambition: Evidence from a healthy, adult population

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ABSTRACT
This study explores if self-control predicts exercise ambition and actual exercise, and if exercise ambition predicts actual exercise. Members and guests at a not-for-profit sports club were invited to participate. 264 individuals completed a self-reported (Self-Control Scale) measure of self-control, and responded to questions about actual exercise as well as exercise ambition prior to their workout. Main Outcome Measures are exercise ambition, actual exercise, and the difference between them. We find that trait self-control predicts both actual exercise and exercise ambition. Exercise ambition also predicts actual exercise. The results suggest a path from self-control, via exercise ambition, to actual exercise. Individuals with relatively low self-control might benefit from some aid in setting goals for their workouts and committing to exercise.

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Introduction
Exercise is important to both physical health and mental wellbeing (Miller et al., 2016; Penedo & Dahn, 2005; Warburton, Nicol, & Bredin, 2006). The risk of several diseases is reduced through exercise, including diabetes type 2, stroke, osteoporosis, cardiovascular heart disease, some forms of cancer, and depression (Miller et al., 2016). Many individuals, however, fail to get enough exercise. Previous research has indicated a link between self-control and exercise (Crescioni et al., 2011; Kinnunen, Suihko, Hankonen, Absetz, & Jallinoja, 2012; Stork, Graham, Bray, & Ginis, 2016). It is, however, yet unclear if it is indeed differences in self-control that drive differences in exercise. In a meta-analysis it is concluded that the effect of self-control on behaviour may be through habit formation (rather than impulse control), with self-control being necessary or at least conducive to forming new, better, habits (De Ridder, Lensvelt-Mulders, Finkenauer, Stok, & Baumeister, 2012).\textsuperscript{1} This is also in line with the results in Gillebaart and Adriaanse (2017). They find no significant direct effect of self-control on exercise frequency (only on minutes of exercise), but an indirect effect via habit strength. In a theoretical review, Hagger, Wood, Stiff, and Chatzisarantis (2010) argue that self-control may predict both intention and behaviour. This would suggest that the path
from self-control to habit formation might be through ambition or setting of goals. While habits refer to previous behaviour, intentions and ambition are both forward-looking. This forward-looking aspect is our main focus.

This study explores if self-control predicts exercise ambition, in addition to actual exercise. To complete the picture, we also explore if exercise ambition predicts actual exercise. If self-control does predict exercise ambition, and exercise ambition predicts actual exercise, it is an indication that failing to get enough exercise to maintain good health may not only be due to individuals failing to obtain their exercise goals, but also a failure to even set those goals (at an adequate level). We implicitly argue that exercise ambition is a prerequisite to intention to exercise. This could have policy implications. In particular, it might imply that motivational campaigns could be important.

**Materials and methods**

**Procedure**

To recruit participants (N = 264; 30.62 per cent male; mean age 33.5 years) to this study, we collaborated with Friskis & Svettis Uppsala, Sweden. This is a not-for-profit sports club, with classes and gyms. At the time they had facilities at three locations in Uppsala (in December 2015 they opened at a fourth location), and approximately 28,000 members (at year end 2014). During two weeks in September 2015, a questionnaire was distributed to individuals who came to work out at any of the three facilities, both current members and guests. The only inclusion criterion was to come to the sports club with the intention to exercise.

Under Swedish law, ethical approval is not required for this study, since no personal information was collected, and since there was no risk of harm to any participant. Responding to the questionnaire was completely voluntary, and doing so was understood as giving consent to participate in this study. Questionnaires were anonymous.

**Measurements**

All our measures are self-reported by the participants in a questionnaire on paper.

**Trait self-control**

We use the Self-Control Scale (SCS) Brief form from Tangney, Baumeister, and Boone (2004) to assess trait self-control. This measure of trait self-control is widely used in previous studies (see for example Crescioni et al., 2011; Gillebaart & Adriaanse, 2017; Stork et al., 2016). According to Tangney et al. (2004) the internal consistency estimates (alpha) were 0.83 and 0.85, and the test-retest reliability estimate over a three-week interval was 0.87. Later research has confirmed relatively high reliability and test-retest stability in other samples (Malouf et al., 2014), and using other translations of the test (Brevers, Foucart, Verbanck, & Turel, 2017; Nebioglu, Eroglu, & Konuk, 2012; Unger, Bi, Xiao, & Ybarra, 2016). This brief form consists of thirteen questions, such as: ‘I am good at resisting temptation.’ Responses are given on a scale from one (not at all) to five (very much). A higher score reflects more self-control. Internal consistency in our sample was acceptable (Cronbach’s alpha = 0.74).
Exercise: exercise ambition, actual exercise, and the difference between them

Survey-based measures of physical exercise habits are widely used to monitor developments in physical activity and its impact on public health (see for example Bauman, 2004). Survey instruments such as the International Physical Activity Questionnaire (see Lee, Macfarlane, Lam, & Stewart, 2011) have been mostly used to measure general physical activity, while we wanted to have an instrument more tailored to the gym environment at which we recruited our sample. We also needed a questionnaire tailored to capturing exercise ambition. Although, the use of survey-based measures have been found to have questionable validity for light to moderate exercise behaviour, for more vigorous physical activity, akin to our health-club context, the validity of survey instruments have been found to be more acceptable (Lee et al., 2011).

Actual exercise is respondents’ self-reported average exercise per week the past month, while exercise ambition is their desired exercise per week. The difference is exercise ambition minus actual exercise. Responses are discrete: zero or less than once, twice to three times, four to five, or six times or more per week. (Once per week is missing in the possible responses due to our mistake.) The midpoints of the responses are used (0, 2.5, 3.5, and 6.5 respectively). For practical purposes a maximum of seven times per week is assumed, yielding the last of the midpoints. How the exercise ambition question was perceived may vary across individuals, and in another question, we ask why they do not exercise in accordance with their ambition. 8.71 per cent of the respondents stated they lack motivation to go to the gym, while a vast majority gave a response indicating that short-term time constraints were decisive. Further, as will become clear below, the difference between ambition and actual exercise is moderate, which gives us reason to believe it is a realistic ambition rather than wishful thinking.

Additional questions on health and exercise habits

We also asked questions concerning their health, both objective, such as height and weight, and subjective assessment about their health status. Moreover, we asked whether participants know how to exercise and eat to obtain/reach good health. We also asked respondents for their main purpose with exercising. They choose among the following, pre-defined responses: improve my overall level of energy; become stronger/build muscles; lose weight; improve my health; or perform better at a competition. There is also a possibility to choose ‘other’ (open).

Descriptive statistics and statistical analyses

Table 1 gives descriptive statistics of the survey measures collected in our study. Out of the 301 participants we recruited, our measure of self-control (SCS) is missing for 37, leaving us with a main sample of 264 observations. Mean self-control is 44.13 (standard deviation (SD) = 7.16). Not all previous studies report the mean for self-control in their samples, but at least Stork et al. (2016) do, and for their small student sample the mean is 43.00 and the standard deviation 9.51, so our sample does not seem extreme.

Mean exercise ambition is 3.35 workouts per week (SD = 1.21) and mean actual exercise is 2.61 workouts per week (SD = 1.38). The difference between exercise ambition and self-reported actual exercise is on average 0.74 workouts per week (SD = 1.11). This mean includes four responses that result in a negative difference,
i.e. respondents who claim they aim to exercise fewer times per week than they report they have the past month. These respondents may – but not necessarily – have made a mistake when entering their responses. Excluding these possible mistakes, the average is 0.77 (SD = 1.08), and the number of observations is then 260. As these are all self-reported, it seems reasonable to assume that the difference between actual exercise and exercise ambition is at any rate not overestimated.

Concerning the demographics of our sample, 30.62 per cent are men and the mean age is 33.5 years (SD = 14.9). As respondents were asked to fill in their height and weight, we can calculate their Body Mass Index (BMI). Six respondents did not know, or chose not to give this information, leaving us with 258 observations for the BMI variable. Average BMI is 23.36 (SD = 3.20). A large majority of the respondents have normal weight (180 persons; 69.77 per cent), while 55 respondents (21.32 per cent) are overweight, and an additional ten (3.88 per cent) are obese. Average BMI by gender is 23.00 for females (SD = 3.37), and 24.36 for males (SD = 2.81). That is, both mean and variation are higher for women. 6.51 per cent of the respondents are not born in Sweden; this is lower than the population average of fifteen per cent for Uppsala County (SCB Statistikdatabas).

A large majority of the respondents feel they know how they should exercise (81.82 per cent) and eat (88.59 per cent) to maintain/reach good health. Many of the respondents state they are in good (51.14 per cent) or excellent (30.30 per cent) health. Not surprising, perhaps, as these persons are about to work out at a sports club. Concerning their stated purpose of exercising, the most frequently given response is

| VARIABLE                                      | Average | Min | Max | SD  | n =  |
|-----------------------------------------------|---------|-----|-----|-----|------|
| Self-control                                  | 44.13   | 21  | 61  | 7.16| 264  |
| Ambition                                      | 3.35    | 0   | 6.5 | 1.21| 264  |
| Actual exercise                               | 2.61    | 0   | 6.5 | 1.38| 264  |
| Difference ambition-actual                   | 0.74    | −2.5| 4   | 1.11| 264  |
| Difference, no negative values                | 0.77    | 0   | 4   | 1.08| 260  |
| Age                                           | 33.5    | 12  | 73  | 14.9| 257  |
| BMI                                           | 23.4    | 15.0| 35.1| 3.2 | 258  |
| BMI by gender                                 |         |     |     |     |      |
| BMI females                                   | 23.0    | 15.0| 35.1| 3.3 | 178  |
| BMI males                                     | 24.4    | 19.0| 34.7| 2.8 | 75   |
| Share                                         |         |     |     |     |      |
| Share normal weight                           | 69.77%  | 258 |
| Share overweight & obese                      | 25.40%  | 258 |
| Male                                          | 30.62%  | 258 |
| Born in Sweden                                | 93.49%  | 261 |

### Purpose is to:
- Improve overall level of energy: 23.95% (263)
- Become stronger: 17.11% (263)
- Lose weight: 8.37% (263)
- Improve health: 33.46% (263)
- Perform better at competition: 4.18% (263)
- Other: 12.93% (263)

### Knows how they should:
- Eat to maintain/reach good health: 88.59% (263)
- Exercise to maintain/reach good health: 81.82% (264)

### State they are:
- In good or excellent health: 81.44% (264)
improve my health’ (33.46 per cent) followed by ‘improve my overall level of energy’ (23.95 per cent). ‘Become stronger/build muscles’ comes in third with 17.11 per cent. Weight loss comes in fifth (8.37 per cent), after ‘other’ (12.93 per cent). ‘Perform better at a competition’ comes in last (4.18 per cent).

Statistical relationships are tested with correlation tests and regression analysis. Normality of the variables is first tested with a numerical skewness/kurtosis test. We can reject the hypothesis that exercise ambition, actual exercise and the difference between them are normally distributed. We cannot reject that self-control is normally distributed. Hence, we use Spearman correlations, in addition to the regular Pearson correlations, when assessing the correlations between self-control and the exercise variables.

We include self-control as an independent variable in the OLS regression analysis. Dependent variables tested are exercise ambition, actual exercise, and the difference between exercise ambition and actual exercise, respectively. We run a separate regression excluding the four observations with a negative difference between ambition and actual exercise, as mentioned above. We also run OLS regressions including age and gender as controls, since previous research has found that self-control varies systematically with age and gender (Crescioni et al., 2011; De Ridder et al., 2012). Finally, we run regressions with actual exercise as the dependent variable including initially only exercise ambition, and then exercise ambition as well as self-control as independent variables.

All statistical analyses are carried out in STATA 15.

Results

Correlation coefficients and p-values for Spearman and Pearson correlations between self-control and exercise ambition, actual exercise and the difference (exercise ambition minus actual exercise), respectively, are listed in Table 2. In the last row, four negative values of the difference are excluded. These four negative values are possibly, but not necessarily, due to mistakes or misreading by the respondents. Hence, excluding them can be regarded as a robustness check. The two different tests yield correlation coefficients of roughly the same magnitude. The significance levels for the correlations vary more, but all correlations are significant at least at the ten per cent level. Since exercise ambition, actual exercise and the difference all failed the test for normality, we should probably pay more attention to the significance levels from the Spearman tests. The correlation between self-control and actual exercise in our data is of the same

| VARIABLE | SPEARMAN | PEARSON |
|----------|----------|---------|
|          | Correlation coefficient | P-value | Correlation coefficient | P-value |
| Exercise ambition | 0.1038 | 0.0923 | 0.1598 | 0.0093 |
| Actual exercise | 0.2161 | 0.0004 | 0.2230 | 0.0003 |
| Difference ambition – actual | −0.1224 | 0.0469 | −0.1030 | 0.0950 |
| Difference ambition – actual with no negative values | −0.1382 | 0.0258 | −0.1146 | 0.0650 |
magnitude as the second measure for exercise behaviour in Stork et al. (2016). The correlation between self-control and exercise ambition is about half (Spearman) or three quarters (Pearson) of that between self-control and actual exercise.

The regression analysis displayed in Table 3 shows that self-control is predictive of both actual exercise and exercise ambition. The two variables are highly correlated with each other. Yet, in the regressions with the difference between exercise ambition and actual exercise the self-control coefficient is borderline significant (it is insignificant when all observations with complete SCS are included, and significant at the ten per cent level when the four negative values of the difference are excluded). When including age and gender, eleven observations are lost due to missing values. These two variables – age and gender – are only statistically significant in relation to exercise ambition. Higher age is associated with a small decrease in average exercise ambition; the coefficient is however so small it is practically insignificant. Being male is associated with a higher average exercise ambition. Neither age nor gender is significantly associated with actual exercise. The coefficients for self-control are not affected in any of the specifications when age and gender are included. In the interest of space, these results are hence not included in the tables.

Further regression analysis, with actual exercise as the dependent variable, is displayed in Table 4. The coefficient estimates indicate that both exercise ambition separately, and along with self-control, are significant predictors of actual exercise. However, the coefficient on exercise ambition is much larger than that on self-control.

### Table 3. Regressions with self-control as independent variable. Dependent variables are:
Exercise ambition (columns 1), actual exercise (column 2), and the difference between ambition and actual (column 3 including all 264 participants who completed the SCS, in column 4 excluding those with a negative difference between ambition and actual exercise).

| VARIABLES       | (1) Ambition | (2) Actual | (3) Difference | (4) Diff. no neg. |
|-----------------|--------------|------------|----------------|------------------|
| Self-control    | 0.0269**     | 0.0428***  | −0.0159        | −0.0172*         |
| Observations    | 264          | 264        | 264            | 260              |
| R-squared       | 0.026        | 0.050      | 0.011          | 0.013            |

Robust standard errors in parentheses
*** p < 0.01, ** p < 0.05, * p < 0.1

### Table 4. Regressions with actual exercise as dependent variable. Independent variables are exercise ambition (column 1) and exercise ambition as well as self-control (column 2).

| VARIABLES       | (1) Actual | (2) Actual |
|-----------------|------------|------------|
| Ambition        | 0.729***   | 0.707***   |
| Self-control    | 0.0238**   | 0.0428***  |
| Observations    | 264        | 264        |
| R-squared       | 0.409      | 0.424      |

Robust standard errors in parentheses
*** p < 0.01, ** p < 0.05, * p < 0.1
Discussion

Our sample consists of relatively active individuals. The participants are about to exercise at a sports club, where a majority (71.21 per cent) are current members. They are mostly of normal weight and comparatively healthy. A large majority are confident they know how they should take care of themselves. Yet, on average they have the ambition to exercise more than they have done the past month.

We find that self-control is an important predictor of actual exercise, but matters also to exercise ambition. Both self-control and exercise ambition are predictors of actual exercise. In our estimations, however, the coefficient on exercise ambition is much larger than that on self-control. This, together with the fact that previous research has indicated that self-control is conducive to habit formation (see for example De Ridder et al., 2012; Galla & Duckworth, 2015; Gillebaart & Adriaanse, 2017; Pfeffer & Strobach, 2018), as well as our empirical finding that even active members at a sports club exercise less than their ambition, leads us to suggest that individuals with relatively low self-control might benefit from some aid in setting goals for their workouts and committing to exercise. The results also indicate that people with higher self-control exercise more for a given exercise ambition. That is, self-control is important to both setting and fulfilling exercise goals.

There are several strengths of the current study. Our sample is larger than in many of the previous studies, Crescioni et al. (2011) and Stork et al. (2016) for example, use samples of only 86 and 30 subjects. One exception is Kinnunen et al. (2012), who conduct their study with 428 male military conscripts. Despite our relatively large sample, the power of the tests is a concern. For our estimated coefficient on the association of self-control with exercise ambition the power is only 0.75, while it is 0.96 for the association with actual exercise.

One improvement of our paper over the previous literature is that we have a more diverse sample. For example, it includes both male and female respondents, in contrast to the sample of males only used in Kinnunen et al. (2012). It is also more varied in other respects, relative to their sample and the student samples that dominate in the rest of the previous literature. Students are typically relatively young, which is reflected in a low mean age in student samples. (For example, the mean age in Stork et al. (2016) is 18 years.) In our sample mean age is 33.5 years. Mean age in the county of Uppsala was 40.2 years in 2015 (SCB Statistikdatabas). This implies that our conclusions are likely to be more generally valid. Still, it should be noted that our study is conducted at a gym facility with individuals about to work out, so the correlations we detect are based on a self-selected sample with individuals with enough motivation to attend the gym. This is a feature our sample shares with the sample (N = 134) used in Gillebaart and Adriaanse (2017).

An important contribution of the current study is to include exercise ambition. With data on both actual exercise and exercise ambition, we can look further into the links to self-control, and assess the predictors of positive health behaviour. A limitation is that exercise ambition is only expressed as desired average workouts per week, not as a plan to work out a specific number of times per week. However, while ambition is not a synonym to intention to exercise, a natural assumption is that exercise ambition is a prerequisite to an intention to exercise. That is, it is reasonable to expect that if there is no ambition to exercise (i.e. desired exercise is zero), there will also be no intention to exercise. Hence, what we have found for ambition is likely to be even stronger for intention. Future work should explore this.
A further limitation is that our measures of self-control and actual exercise are self-reported. Self-reported measures may be subject to social desirability bias (Fisher & Katz, 2000; Tangney et al., 2004). Self-reported measures of self-control are, however, common in the literature, and the fact that self-reported self-control is linked to various beneficial outcomes and behaviours indicates that it is ‘a marker of good adjustment’ (Tangney et al., 2004, p 315, fourth paragraph). De Ridder et al. (2012) offer further support for the validity of self-reported measures; they find no difference in the relationship between self-control and observed vs. self-reported behaviours.

More troubling is self-reported actual exercise. If this measure is inflated, however, it would bias our estimates towards zero. We can also provide some validation of our self-reported measures using our data. Out of the total 264 respondents with complete SCS, 52 are non-members at the gym who get a free work out, because a member brings them. In line with expectations, members have statistically significantly higher exercise ambition (3.47 vs. 3.08). Their self-reported actual exercise is also higher (2.87 vs. 1.99). This may be seen as a validation of the exercise measures, even if non-members could of course exercise at other sports clubs or by themselves. The difference between exercise ambition and actual exercise is significantly lower for members (0.60 vs. 1.09). Interestingly, but perhaps expectedly, members also have statistically significantly higher self-control (44.65 vs. 42.84).

Finally, we should of course bear in mind that the results we present are correlational in nature. Hence, we cannot infer a causal relationship between our measures. There could also be omitted factors confounding our analysis.

Conclusions

Even relatively active individuals fail to exercise in accordance with their exercise ambition. We find that self-control predicts both actual exercise and exercise ambition for this sample. Further, exercise ambition also predicts actual exercise. Together, exercise ambition and self-control explain about 42 per cent of the variation in actual exercise. This suggests a path from self-control, via exercise ambition, to actual exercise. The results also indicate that people with higher self-control exercise more for a given exercise ambition. That is, self-control is important to both setting and fulfilling exercise goals. A practical implication, in line with suggestions by Kinnunen et al. (2012) and Sniehotta, Scholz, and Schwarzer (2005), is that individuals with relatively low self-control might benefit from some aid in setting goals for their workouts and committing to exercise.

Note

1. The meta-analysis is based on 102 studies that relate individual measures of self-control with different behaviours (but not with exercise behaviour as we do).

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