Happiness and Productivity

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PRELIMINARY WORK

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Abstract

Little is known by economists about how emotions affect productivity. To make persuasive progress, some way has to be found to assign people exogenously to different feelings. We design a randomized trial. In it, some subjects have their happiness levels increased, while those in a control group do not. A rise in happiness leads to greater productivity in a paid piece-rate task. The effect is large; it can be replicated; it exists in male and female subsamples; and it is not a reciprocity effect. We discuss the implications for economics.

Introduction

There is a large economics literature on individual and economy-wide productivity. There is also a fast-growing one on the measurement of individuals' mental well-being. Yet economists know little about the interplay between emotions and human productivity. Although people's happiness and effort decisions seem likely to be deeply intertwined, we lack evidence on whether, and how, they are causally connected.

This paper seeks to make two contributions. First, it attempts to alert economists to a psychology literature in which happiness (or more precisely what psychologists describe as positive affect) has been shown to be associated with higher human performance. Here the work of the psychologist Alice Isen has been particularly important. The second contribution of the paper is to design and perform an empirical inquiry that has not been done in the psychology literature. It addresses a question of particular interest to economists (and perhaps to policy-makers). *Does happiness make people more productive in a paid task?* We provide evidence -- in a standardized piece-rate setting with otherwise fairly well-understood properties -- that it does.

Argyle (1989 a,b) points out that little is known about how life satisfaction affects productivity, but that there is some (mixed) evidence that job satisfaction shows 'modestly positive correlations' with measures of worker productivity. Wright and Staw (1999) examine links between worker affect and supervisors' ratings of workers, and, depending on the affect measure, find rather mixed results. In contrast to our paper, Sanna et al (1996) argue that those in a negative mood put forth the most effort. Amabile et al (2005) finds that happiness appears to provoke greater creativity.

We shall not distinguish in any stark way between happiness and 'mood'. We take the distinction, in a short run experiment as ours, to be largely semantic or philosophical. Nor shall we discuss the possibility that other stimuli such as music, alcohol or sheer relaxation time – all mentioned by readers of early drafts – could have the same or equivalent effects.

Theory: A model of work and worrying

Consider the following simple model. Its main result, put intuitively, emerges from internal resource-allocation by the worker. In the model, an initial happiness

shock raises the psychological resources available to a worker. At the margin, this shock frees an overall energy constraint. That in turn allows a worker to devote more effort to solving problems for pay and to switch away from worrying about other distractions.

Let the worker's (randomly distributed) ability be z. This has a density function f(z). Denote u as utility. Denote p as the piece-rate level of pay. Let e be the energy the worker devotes to solving the tasks at work. Let w be the energy the worker devotes to 'worrying' about the job and other things. Assume R is the worker's psychological resources. Hence (e + w) is less than or equal to R.

Let u be the utility from working, and assume it depends on both the worker's earnings and the effort from solving work problems. Let v be the utility from worrying. Worrying can be thought of as generalized concern for issues in the worker's life that need his or her cognitive attention. In a paid-task setting, it might simply be stress about the possibility of failure at the task. But, more broadly, it can also be a general form of distraction from the job at hand. Perhaps it might be realistic to think of a worker as alternating, during the working day, between concentrating on the task and feeling anxious about his or her job and life.

Assume there is an initial happiness shock, h.

People therefore solve the problem: Choose work-energy e to

Maximize $\int u(p,e,h,z)\,f(z)dz + v(w,h)$

subject to $R \geq e + w$.

The first-order condition for a maximum in this problem is

$Eu_e - v_w = 0$. (1)

A comparative-static result of particular interest is the response of productivity, given by work effort e, to a rise in the initial happiness shock, h. It is determined in a standard way: The sign of de*/dh takes the sign of the cross partial of the maximand, so:

Sign *de*/dh* takes the sign of $Eu_{eh} + v_{wh}$. (2)

Without more restrictions, this sign could be positive or negative. The happiness shock could increase or decrease the amount of work done on the maths task.

To get some insight into the likely outcome, consider simple forms of these functions. Assume that workers know their own productivity, so are not subject to the uncertainty, and that R is normalized to unity. Also set z to unity for simplicity.

Assume u and v are both concave functions.

An additively separable case

Assume additive separability. Then, assuming the worker gets the h happiness shock whether or not she subsequently works or worries, the worker solves

Maximize $u(pe) + v(1-e) + 2h$ (3)

and hence at an interior maximum

$u'(pe)\,p - v'(1-e) = 0$. (4)

This is a useful benchmark case. Here, the optimal work effort e* is independent of the happiness shock, h. As h rises or falls, the marginal return to effort is unaffected.

A concavity case

A more plausible form of utility function has the happiness shock operating within a concave form. Here the worker solves

Maximize $u(pe + h) + v(1 - e + h)$

which is the assumption that h is a shift variable inside the utility function itself, rather than an additive part of that function.

Now the first-order condition is

$u'(pe + h)\,p - v'(1 - e + h) = 0$. (5)

In this case, the optimal level of energy devoted to solving work problems, e*, does depend on the level of the happiness shock, h.

The sign of *de*/dh* now takes the sign of $u''(pe + h)\,p - v''(1 - e + h)$.

Its first element is thus negative and its second is positive. By the first-order condition, we can replace the piece rate wage term p by the ratio of the marginal utilities from working and worrying.

Hence, after substitution, the sign of the comparative static response of *work effort, e, with respect to the size of the happiness shock, h, is greater than or equal to zero*

as

$$\frac{u''(.)}{u'(.)} - \frac{v''(.)}{v'(.)} \geq 0. \quad (6)$$

These terms can be viewed as unconventional versions of the degrees of absolute risk aversion in two domains -- the utility from work and the utility from worrying. If the marginal utility of worry declines quickly enough as energy is transferred from working to worrying, then a positive happiness shock will successfully raise the worker's chosen productivity, e*. Intuitively, as the individual become happier, this allows her to divert attention away from background worries, and to put that attention into work tasks.

This approach also provides a way to think about stress in the workplace. This can be conceived of as the (rational) need to devote energy and attention away from the job. Happier workers need to do so less, and thus have higher productivity.

Experimental Design

Here we explain the structure of the experiment. We start with a motivation for the choices made within the design, and then provide a description of the tasks and a time-line for the experiment. The experimental instructions, the GMAT MATH-style test and questionnaires are set out in the appendix.

Overview

The experimental design was built around the desire to understand the productivity x_i of workers engaged in a task for pay. Our focus is the consequences, for their output, of different starting levels of happiness.

We employ the task previously used in a number of existing papers (for example, Niederle and Vesterlund, 2007), which entails asking subjects to add sequences of five 2-digit numbers under timed conditions. This task is comparatively

simple but is taxing under pressure. It might be thought of as representing in a highly stylized way an iconic white-collar job: both intellectual ability and effort are rewarded.

Since we are trying to evaluate the relationship between happiness and productivity, we wish ideally to disentangle the effort component and ability component. To this end, we also included two control variables that we hoped would capture underlying exogenous but heterogeneous ability as opposed to effort -- although we were also open to the possibility that changes in underlying happiness might induce shifts in ability or change the nature of the interaction between ability and effort to alter overall productivity. Our control variables came from (i) requiring our subjects to do a brief GMAT MATH-style test (5 multiple choice questions) along similar lines to that of Gneezy and Rustichini (2000) and (ii) obtaining information in a final questionnaire to allow us to construct a measure of subjects' prior exposure to mathematics. The aim was to allow us to control for heterogeneous ability levels.[1]

A key concern was to examine the consequences that happiness has for productivity (be it through effort or ability). We therefore needed some means of inducing an exogenous rise in happiness. The psychology literature offers evidence that movie clips (through their joint operation as a form of audio and visual stimulus) are a means of doing so. They exogenously alter people's feelings and mood. For example, Westermann et al (1996) provides a nice meta-analysis of the methods available.

We used a 10-minute clip based on composite sketches taken from various comedy routines enacted by a well-known British comedian. In order to ensure that the clip and subjects were well matched, we restricted our laboratory pool to subjects of an English background who had likely been exposed to similar humor before. As explained later, whether subjects enjoyed the clip turned out to be important to the effects on productivity.

In summary, the data collected were on the successful and unsuccessful numerical additions, a brief GMAT MATH-style test and a questionnaire that included questions relating to happiness and intellectual ability.

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[1] We deliberately kept the number of GMAT MATH-style questions low. This was to try to remove any effort component from the task so as to keep it a cleaner measure of raw ability: 5 questions in 5 minutes is a relatively generous amount of time for an IQ-based test, and casual observation indicated that subjects did not have any difficulty completing the GMAT MATH questions, often well within the 5-minute deadline.

Design

We randomly assigned people into two groups:

- Treatment 0: the control group who were not exposed to a comedy clip.
- Treatment 1: the treated group who were exposed to a comedy clip.

The experiment was carried out on four days, with deliberate alteration of the morning and afternoon slots, so as to avoid underlying time-of-day effects, as follows:

- Day 1: session 1 (treatment 0 only), session 2 (treatment 1 only).
- Day 2: session 1 (treatment 0 only), session 2 (treatment 1 only).
- Day 3: session 1 (treatment 1 only), session 2 (treatment 0 only).
- Day 4: session 1 (treatment 1 only), session 2 (treatment 0 only).

Subjects were only allowed to take part on a single day and in a single session.

On arrival in the lab, individuals were randomly allocated an ID, and made immediately aware that the tasks at hand would be completed anonymously. They were told to refrain from communication with each other. Those in treatment 1 (the Happiness Treatment subjects) were asked to watch a 10 minute comedy clip designed to raise happiness or 'positive affect'.[2] Those in the control group came separately from the other group, and were not shown a clip nor asked to wait for 10 minutes. Isen et al (1987) finds that a control clip without positive affect gives the same general outcomes as no clip.

The subjects in both the movie-clip group (treatment 1) and the not-exposed-to-the-clip control group (treatment 0) were given identical basic instructions about the experiment. These included a clear explanation that their final payment would be

[2] The questionnaire clearly indicated that the clip was generally found to be amusing and had a direct impact on reported happiness levels. More on this is in the results section.

a combination of a show-up fee (£5) and a performance-related fee to be determined by the number of correct answers in the tasks ahead. At the recruitment stage it was stated that they would make "… a guaranteed £5, and from £0 to a feasible maximum of around £20 based purely on performance". Technically, subjects received £0.25 per correct answer on the arithmetic task and £0.50 on each correct GMAT MATH answer, and this was rounded up to avoid the need to give them large numbers of coins as payment.

An extra reason to pay subjects more for every correct answer was to emphasize that they would be benefit from higher performance. We wished to avoid the idea that they might be paying back effort -- as in a kind of reciprocity effect -- to the investigators for their show-up fee.

The subjects' first task was thus to answer correctly as many different additions of five 2-digit numbers as possible. The time allowed for this, which was explained beforehand, was 10 minutes. Each subject had a randomly designed sequence of these arithmetical questions. The numerical additions were undertaken directly through a protected Excel spreadsheet, with a typical example as in Legend 1. The spreadsheet necessarily contained more such rows that any subject could hope to add in the ten minutes allowed. The subjects were not allowed to use calculators, and it was explained that any attempt to use a calculator or any outside assistance was deemed to be a disqualification offence, resulting in only a show-up fee being paid. This did not prove to be a problem across the 4 experimental days. The numerical additions were designed to be reasonably simple, if dull and repetitive, and earlier literature has deemed this a good measure of intellectual effort (Niederle and Vesterlund, 2007).

31	56	14	44	87	

Legend 1: Adding 2-digit Numbers

The second task for subjects was to complete a simple 5-question GMAT MATH-style test. These questions were provided on paper, and the answers were inputted into a prepared protected Excel spreadsheet. The exact questions are given in an appendix. This test was designed as a brief and simple check on ability, as used before in the research literature (Gneezy and Rustichini, 2000), to supplement the

questionnaire.

The final task, which was not subject to a performance-related payment (and subjects were made aware of this), was to complete a questionnaire. A copy of this is provided in the appendix. The questionnaire inquired into both the happiness level of subjects (before and after the clip for treatment 1), and their level of mathematical expertise. The wording was designed to be simple to answer; anonymity was once again stressed before it was undertaken; the scale used was a conventional 7-point metric, following the well-being literature.

To summarize the timeline:[3]

1. Subjects enter and are given basic instructions on experimental etiquette.
2. Subjects in treatment 1 are exposed to a comedy clip for 10 minutes, otherwise not.
3. Subjects are given additional instructions, including a statement that their final payment relates to the number of correct answers, and instructed against the use of calculators or similar.
4. Subjects move to their networked consoles and undertake the numerical additions for 10 minutes.
5. Results are saved and a new task is initiated, with subjects undertaking the GMAT MATH-style test for 5 minutes.
6. Results are again saved, and subjects then complete the final questionnaire.
7. After the questionnaire has been completed, subjects receive payment as calculated by the central computer.

Results

A group of 182 subjects drawn from the University of Warwick participated in the experiment, each taking part in only one session. A breakdown of the numbers per day and session follows. As explained in Table 1, the subject pool was made up of 100 males and 73 females. Table 2 summarizes the means and standard deviations of main variables. The first variable is the number of correct additions in the allotted ten minutes. 'Happiness before' is the self reported level of happiness (for the treated

[3] The full instructions provided in the appendix provide a description of the timing.

group before the clip) on a seven point scale. The variable 'happiness after' is the level of happiness after the clip for the treated group; GMAT MATH is the number of correct problem solved; Mathematical qualification is an index calculated from the questionnaire. Enjoyment-of-clip is a measure in a range between 1 and 7 of level of how much they liked the movie clip.

According to the data, the clip is successful in increasing the happiness levels of subjects. As shown in Figure 1, they report an average rise of almost one point (0.98) on the scale of 1 to 7. Comparing the ex-post happiness of the treated subject with that of the non-treated subjects, we observe that the average of the former is higher by 0.85 points. Using a two-sided t-test, this difference is statistically significant (p <0.01). Finally, it is useful to notice that the level of happiness before the clip for the treated group is not statistically significantly different (the difference is just 0.13) from the happiness of the untreated group (p = 0.20 on the difference).

In Figure 2 we display the average productivity in the test. The treated group's mean performance is higher by 1.71 additions than the average performance of the untreated group. This difference is approximately ten percent. It is statistically significantly different from zero (p=0.04).

Interestingly, and perhaps encouragingly, the performance of those 16 subjects in the treated group who did not report an increase in happiness is statistically non different from the performance of the untreated group (p=0.67). Therefore, the increase in the performance seems to be linked to the increase in happiness rather than merely to the fact of watching the clip. The clip did not hamper the performance of subjects who did not declare themselves happier.[4] For them, the effect is zero.

In Figure 3 we show the performances of male and female subjects. Both groups feature a similar increase in their performances (1.9 for male, 1.78 for female).

From the cumulative distributions for the number of correct answers for the treated and untreated group, shown in Figure 4, we see that the treatment increase the performances of low and medium performers, while the high performers are less affected.

We also performed OLS-based regressions to analyze the determinants of the performances.

Table 3 presents the determinants of the number of correct additions; variable

[4] Also, the 17 subjects who did not declare an increase in happiness enjoyed the clip. In a range of values between 1 and 7, the average is 5.41, with a minimum of 5 and a maximum of 7.

Change-in-Happiness is the difference in happiness before and after the clip; Math-qualification is a measure of knowledge in mathematics determined by past studies. Day 2, Day 3 and Day 4 are day dummies. GMAT MATH is a test score that records the subjects' intellectual skills.

Consistent with the result seen in the previous session, the subjects' performances are higher in the session with treatment. As we can see in regression (1), this results hold when we control for subjects' characteristics and periods. In regression (2) we show that the performances are more generally increasing with the increase of elicited happiness (for the case of untreated subjects, by definition, Change-in-Happiness=0). This result is still true when we restrict the analysis to the treated subjects like in regression (3).

As a check, Table 4 re-runs the first two regressions of Table 3 with absolute values rather than log values. The variable 'Treatment' is positive and significant when, as in regression 2, we exclude the outliers (we drop the observations with 2 and 43 correct additions). The variable Change-in-Happiness is significant irrespective of whether or not we keep in the two outliers (regressions 3 and 4).

It seems that positive emotion invigorates people. Yet the mechanism here, so far, is unclear. Does happiness have its effect through greater numbers answered or through greater accuracy of the average answer? The distinction is of interest and might be thought of as one between industry and talent --between the consequences of happiness for pure effort compared to effective skill.

To inquire into this, we estimate different kinds of equations.

Table 5 takes attempted additions (in log terms) as the dependent variable. The results are similar to the ones in Table 3, where we considered the # of correct additions. Then, in Table 6, we run exactly the same regression as in Table 5 but with the different dependent variable. This is an estimated equation for the ratio of correct-answers to attempted-answers. Interestingly, neither the dummy treatment nor Change-in-Happiness is statistically significantly different from zero. Therefore, the treatment acts as an intercept shifter in the attempts equation rather than in extra precision. It is also worth noticing that the precision results are influenced by the underlyling mathematical skill, as measured by the mini GMAT MATH score, and to a lesser extent by mathematical knowledge.

Standing back from the details, there seem to be a number of implications from the experiment. First, economics may need to pay more attention to what

emotions do. In so far as they play a role at all in economics, they have been viewed, as in the happiness literature, as something to be treated as a dependent variable. Second, it seems clear that better bridges should be built between applied psychology and the discipline of economics. Third, if happiness boosts productivity, this raises the possibility of virtual spirals -- that might even operate at the macroeconomic level. Happiness might lead to greater productivity which might in turn lead to greater happiness.

Conclusions

Little is known by economists about how emotions affect productivity. To try to make progress on this, we design a randomized trial, and thus are able exogenously to 'assign' different emotions to different people. Some of our laboratory subjects have their happiness levels increased. Some, in a control group, do not. A rise in happiness seems to lead to greater productivity in a paid piece-rate task. The effect is large, can be replicated, exists in male and female subsamples, and is not plausibly a reciprocity effect.

Figure 1: Reported happiness

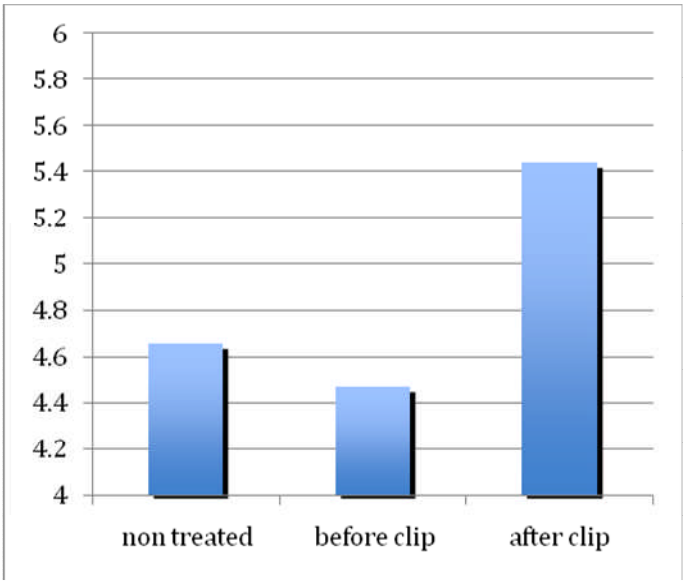

Figure 2: Number of correct additions

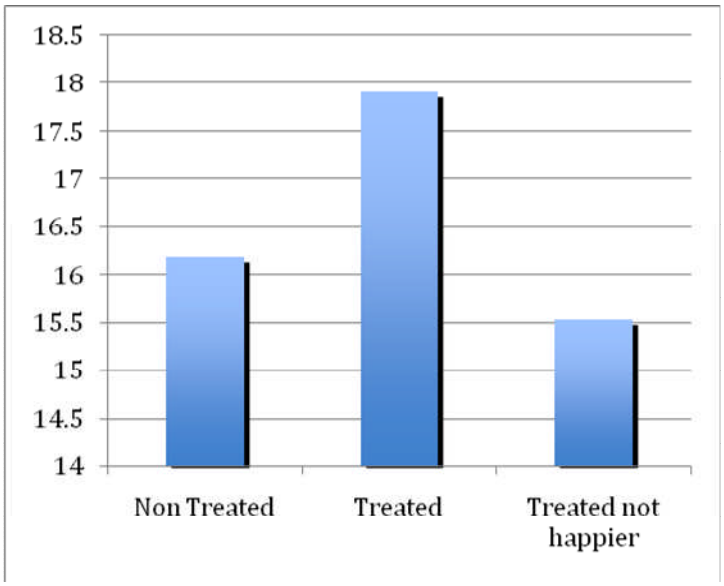

Figure 3: Performance difference between males and females

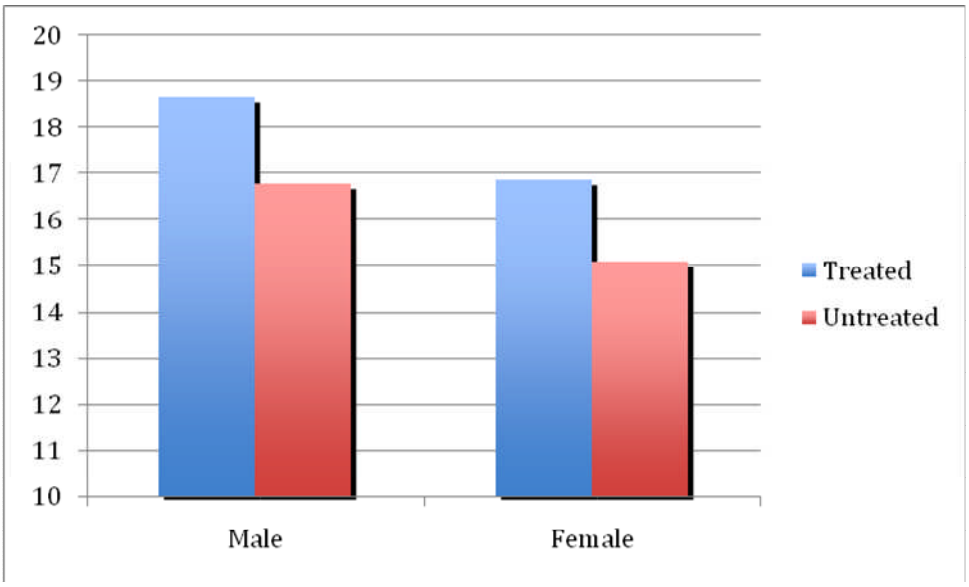

Figure 4: CDF of subjects' performances

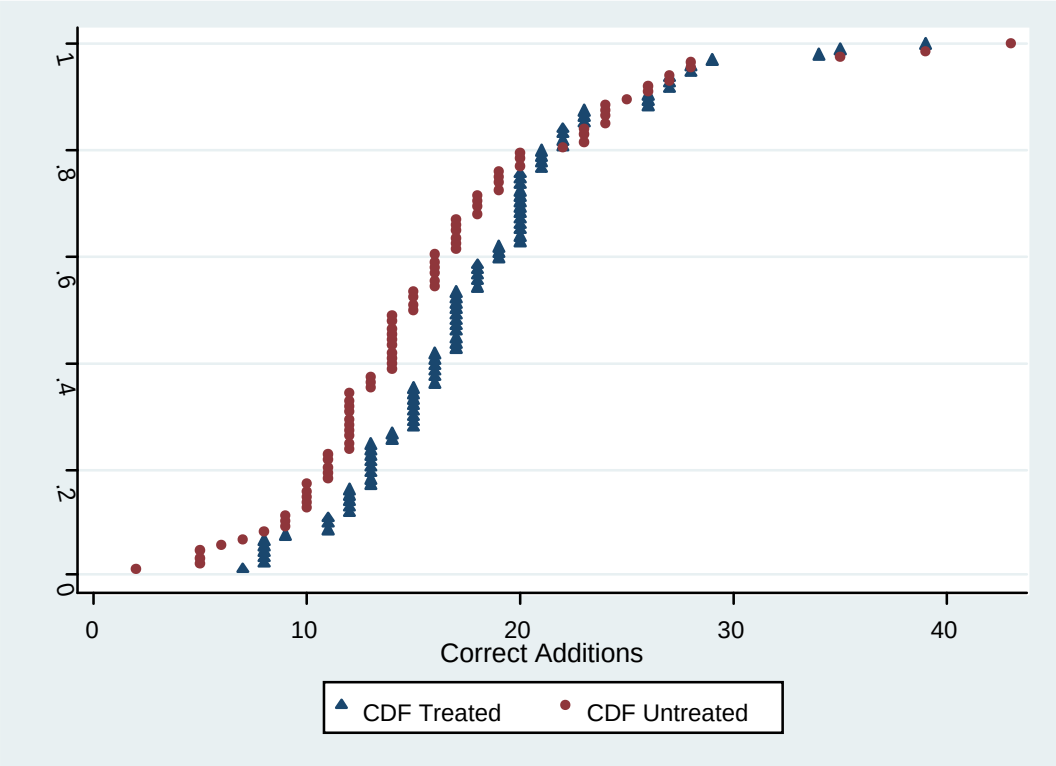

Table 1: Subject numbers for each session and day

Day	Treated	Untreated
1	24	24
2	23	20
3	23	24
4	24	25

Table 2: Data description

Variable	#Observations	Mean	Std Error	Min	Max
#Correct Additions	182	17.09	6.62	2	43
Happiness	182	4.55	1.03	1	7
Happiness after	94	5.45	0.74	3	7
GMAT MATH	182	3.43	1.38	0	5
High School Grades	178	0.49	0.25	0	1
Enjoyment-of-Clip	94	5.93	0.68	5	7

Definitions

The measure called "High School Grades" asks students to consider all of their qualifications and gives a percentage of those qualifications that are at the highest possible grade. It therefore measures their past performance against the highest possible performance. More precisely, on the questionnaire we asked two questions:

"How many school level qualifications have you taken (including GCSEs, A-levels and equivalent)?" (forming the denominator)

"How many of these qualifications were at the best grade possible? (eg A* in GCSE, A is A-level, etc.)" (forming the numerator)

Table 3: Determinants of subjects' performance[5]

	(1)	(2)	(3)
	log(Additions)	log(Additions)	log(Additions)
			Treated only
Treatment	0.118**		
	(0.0548)		
Change-in-Happiness		0.101**	0.0847*
		(0.0405)	(0.0495)
GMAT MATH score	0.104***	0.100***	0.0739***
	(0.0226)	(0.0226)	(0.0273)
High School Grades	0.471***	0.477***	0.428***
	(0.114)	(0.114)	(0.124)
Male	-0.0257	-0.0267	0.00675
	(0.0609)	(0.0606)	(0.0774)
Day 2	-0.0169	0.000901	-0.0170
	(0.0790)	(0.0787)	(0.0905)
Day 3	0.0975	0.106	0.131
	(0.0779)	(0.0776)	(0.0885)
Day 4	0.0118	0.00724	-0.00752
	(0.0762)	(0.0758)	(0.0895)
Constant	2.106***	2.120***	2.244***
	(0.105)	(0.102)	(0.126)
Observations	178	178	93
R-squared	0.273	0.280	0.307

Std errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

[5] Within the table as is standard the notation *** indicates p<0.01, ** p<0.05, * p<0.1, and standard errors are given in parentheses.

Table 4: Determinants of subjects' performance [Non-logged]

	(1) Additions	(2) Additions (no outliers)	(3) Additions	(4) Additions (no outliers)
Treatment	1.336	1.572**		
	(0.889)	(0.825)		
Change-in-Happiness			1.316**	1.407**
			(0.657)	(0.608)
GMAT MATH score	1.286***	1.291***	1.243***	1.244***
	(0.367)	(0.343)	(0.366)	(0.342)
High School Grades	8.284***	8.349***	8.355***	8.429***
	(1.854)	(1.710)	(1.844)	(1.701)
Male	0.824	0.606	0.828	0.607
	(0.988)	(0.919)	(0.982)	(0.914)
Day 2	0.472	-0.325	0.693	-0.0707
	(1.281)	(1.193)	(1.276)	(1.187)
Day 3	2.105*	2.330**	2.212*	2.455**
	(1.264)	(1.173)	(1.258)	(1.167)
Day 4	0.868	0.809	0.814	0.749
	(1.236)	(1.140)	(1.230)	(1.134)
Constant	6.603***	6.602***	6.680***	6.763***
	(1.697)	(1.575)	(1.657)	(1.535)
Observations	178	176	178	176
R-squared	0.245	0.283	0.253	0.290
Std errors in parentheses *** p<0.01, ** p<0.05, * p<0.1				

Table 5: Determinants of attempts

	(1) Log(Attempt)	(2) Log(Attempts)
Treatment	0.0911**	
	(0.0417)	
Change-in-Happiness		0.0812***
		(0.0308)
GMAT MATH score	0.0758***	0.0733***
	(0.0172)	(0.0171)
High School Grades	0.372***	0.377***
	(0.0869)	(0.0863)
Male	-0.0165	-0.0170
	(0.0463)	(0.0460)
Day 2	0.0198	0.0340
	(0.0600)	(0.0597)
Day 3	0.133**	0.140**
	(0.0592)	(0.0589)
Day 4	0.0767	0.0732
	(0.0579)	(0.0576)
Constant	2.432***	2.441***
	(0.0795)	(0.0776)
Observations	178	178
R-squared	0.279	0.288

*** p<0.01, ** p<0.05, * p<0.1 Std errors in parentheses

Table 6: Determinants of the precision (ie. ratio of correct answers)

	(1) Correct/ Attempt	(2) Correct/ Attempt
Treatment	0.0128	
	(0.0185)	
Change-in-Happiness		0.0102
		(0.0138)
GMAT MATH score	0.0165**	0.0162**
	(0.00765)	(0.00767)
High School Grades	0.0656*	0.0663*
	(0.0386)	(0.0386)
Male	0.00152	0.00134
	(0.0206)	(0.0206)
Day 2	-0.0268	-0.0249
	(0.0267)	(0.0267)
Day 3	-0.0201	-0.0192
	(0.0263)	(0.0263)
Day 4	-0.0507*	-0.0512**
	(0.0258)	(0.0257)
Constant	0.753***	0.755***
	(0.0354)	(0.0347)
Observations	178	178
R-squared	0.095	0.096

Std. errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

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APPENDIX FOR PARIS TALK

Replication of findings

The experiment was carried out on four separate days, as follows:

Session	Treatment	Date	Time
1	Treatment 0	21 May 2008	2.30-3.30pm
1	Treatment 1	21 May 2008	4.00-5.00pm
2	Treatment 0	18 June 2008	2.30-3.30pm
2	Treatment 1	18 June 2008	4.00-5.00pm
3	Treatment 1	10 October 2008	2.30-3.30pm
3	Treatment 0	10 October 2008	4.00-5.00pm
4	Treatment 1	15 October 2008	2.30-3.30pm
4	Treatment 0	15 October 2008	4.00-5.00pm

Table 1: Treatment Dates

Recall that treatment 0 is the treatment without a video clip and treatment 1 includes a video clip. Sessions 1 and 2 were undertaken in term 3 of the University of Warwick academic year 2007-8, while sessions 3 and 4 were undertaken in term 1 of the 2008-9 academic year. Since they are separated by a gap of approximately 4 months, we might wish to check for significant changes across the time between sessions 1-2 and sessions 3-4. The key aggregate variables results broken down by session are as follows:

Session	addscore	log addscore	Addscore Male	Addscore Female	happy before	happy after	enjoy clip
1 Treatment 0	15.38**	1.17	14.88**	16.83	4.54	na	na
1 Treatment 1	18.21**	1.23	18.26**	18	4.54	5.63	5.96
2 Treatment 0	16.85	1.18	19.41	13*	4.45	na	na
2 Treatment 1	16.48	1.19	16.36	16.58*	4.43	5.22	5.74
3 Treatment 0	16.26*	1.16	15.75*	17.14	4.79	na	na
3 Treatment 1	19.52*	1.27	20.42*	18.11	4.48	5.39	5.83
4 Treatment 0	16.04	1.15	18.07	14.36	4.92	na	na
4 Treatment 1	17.72	1.22	19.6	15.92	4.36	5.44	6.21

Table 2: Summary Statistics by Treatment

The key column is perhaps *log addscore* (log correct additions) which smoothes for outliers in the number of correctly answered numerical additions within 10 minutes. As can be seen from the table, the data for sessions 1-2 are very similar to those from sessions 3-4. In particular the happiness levels are similar, and the clip seems to have induced similar increase across all sessions. Most importantly, the pattern of results seems consistent across all four sessions. The only exception comes in session 2 where the raw number of additions does not rise moving from treatment 0 to treatment 1. This is entirely down to one outlier who performed extremely well in treatment 0, and using logs to mute the impact of outliers brings

the results into alignment with the other sessions.[6]

Note that we put an asterisk when the difference between treated and untreated groups are statistically significant, using a simple ttest. In particular we have that for session 1 (21 May 2008) and 3 (10 October 2008) the difference for the entire pool is already statistically significant with a p-values 0.047 and 0.052 respectively. When we split the group in male and female we note that they are already statistically significant in 3 out of 8 subcases. Of course summing all four the significance rises as indicated in the main text.

Alternatively we also regressed the key variables for all four sessions individually as below:

VARIABLES	(1) ladd	(2) ladd	(3) ladd	(4) ladd	(5) ladd	(6) ladd	(7) ladd	(8) ladd
treatment	0.129		0.0931		0.184		0.0979	
	(0.0889)		(0.124)		(0.127)		(0.118)	
gmatscore	0.0799*	0.0859*	0.115**	0.110**	0.139***	0.135***	0.0739	0.0722
	(0.0472)	(0.0453)	(0.0507)	(0.0510)	(0.0434)	(0.0448)	(0.0473)	(0.0469)
qualifs	0.482**	0.486**	0.398	0.386	0.277	0.332	0.657***	0.652***
	(0.198)	(0.192)	(0.261)	(0.266)	(0.262)	(0.262)	(0.239)	(0.236)
male	-0.0729	-0.0373	0.113	0.0985	-0.153	-0.150	-0.0258	-0.0350
	(0.111)	(0.110)	(0.127)	(0.126)	(0.134)	(0.136)	(0.136)	(0.133)
dhappy		0.126**		0.0256		0.0993		0.0980
		(0.0585)		(0.112)		(0.102)		(0.0792)
Constant	2.220***	2.165***	2.022***	2.093***	2.219***	2.256***	2.122***	2.128***
	(0.187)	(0.185)	(0.218)	(0.198)	(0.184)	(0.184)	(0.170)	(0.163)
Observations	48	48	40	40	41	41	49	49
R-squared	0.286	0.323	0.288	0.278	0.336	0.315	0.264	0.278

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses

Table 3: Session regressions

Regression (1) considers *log addscore* from session 1 regressed on treatment, with (2) instead using *dhappy*. Dhappy is in general a better measure of the impact of happiness since it controls for those subjects who did not gain in happiness from watching the clip. (3) and (4) are the respective regressions for session 2, (5) and (6) forsession 3 and (7) and (8) for session 4. We might also consider merging sessions 1 and 2, and merging sessions 3 and 4 as below.

VARIABLES	(1) ladd	(2) ladd	(3) ladd	(4) ladd
treatment	0.0989		0.139	
	(0.0712)		(0.0848)	
gmatscore	0.100***	0.0987***	0.111***	0.108***
	(0.0333)	(0.0330)	(0.0316)	(0.0318)
qualifs	0.458***	0.462***	0.468***	0.479***
	(0.157)	(0.155)	(0.169)	(0.169)
male	0.0299	0.0309	-0.0658	-0.0720
	(0.0797)	(0.0789)	(0.0918)	(0.0916)
dhappy		0.0990*		0.0982
		(0.0535)		(0.0617)
Constant	2.091***	2.096***	2.147***	2.174***
	(0.135)	(0.130)	(0.122)	(0.118)
Observations	88	88	90	90
R-squared	0.268	0.281	0.274	0.273

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses

Table 4: Grouped session regressions

[6] [6] Without the outlier who performed 43 exact additions, the average is 16.47 in treated and 16.47 in the untreated group.

In table 4 regression (1) and (2) group sessions 1 and 2, while regression (3) and (4) group sessions 3 and 4. As in table 3, the first regression in each pair considers *treatment* while the

Appendix

The appendix includes a full set of subject instructions (Appendix A), a copy of the GMAT MATH-style test (Appendix B) and the questionnaire (Appendix C).

Appendix A: Instructions

[**bold** = only for the clip treatment, X talks directly with subjects, Y, Z, etc. are assistants. Parts in square brackets are not to read out.]

[X invites subjects to enter room **while Y sets up the video clip]**

Welcome to the session. My name is X, and working with me today are Y, Z, etc. Many thanks for attending today. You will be asked to perform a small number of very minor tasks and will be paid both a show-up fee and an amount based on how you perform, **but first we would like to ask you to watch a video clip.** Please do not talk to each other at any stage in the session. If you have any questions please raise your hands, but avoid distracting the others in the room.

Z will now guide you to the seats at the front of the room directly in front of the projector, while Y prepares the video clip. Please make yourselves comfortable: the clip will last about 10 minutes and I will have more instructions for you afterwards.

[10 minutes: video clip]

Thanks for watching. Z will now distribute ID cards to you and you are asked to sit at the computer corresponding to the ID number. Everything is done anonymously – your performance will simply be recorded based on the ID card, and not your names. You will find some paper and a pen next to your computer – use them if you wish, and raise your hand if you wish to request additional paper. Please do not use calculators or attempt to do anything other than answer the questions through mental arithmetic. If we observe any form of cheating it will invalidate your answers and you will be disqualified, and therefore receive only the show-up fee.

For the first task you will have 10 minutes to add a sequence of numbers together and enter your answers in the column labelled “answer”. To remind you, you will be paid based on the number of correct answers that you produce. When the ten minutes are over I will ask you to stop what you are doing and your results will be saved.

Next look at your screens: you will find that a file called “Numberadditions.xls” is open but minimized on your screen. Please now maximize the file by clicking on the tab. You have ten minutes starting now.

[10 minutes: number additions]

Please stop what you are doing, your answers will now be saved. Y and Z will now visit your computers and place a sheet faced down next to your keyboards. Please do not turn over the sheet until I ask.

[Y and Z move to terminals, placing question sheets faced down]

For the second task we would like you answer a small number of questions. You can maximise the file on your computer labelled "GMAT MATH.xls" and you will once again see a column labelled answers. In this column you will have to enter a letter from (a) to (e), corresponding to a multiple-choice answer to the sheet which is faced-down in front of you. Once again, I remind you that you will be paid based on the number of correct answers. You have 5 minutes to attempt these questions, please turn over the sheets and begin.

[5 minutes: GMAT MATH-style test]

Please stop what you are doing, your answers will now be saved. You should next open the final document: a questionnaire that you are asked to complete. You will be given 10 minutes to complete this, though if you need additional time we can extend this deadline indefinitely. Please answer as truthfully as you can and feel free to raise your hands if anything is unclear. To stress, where you are asked to input a number from 1 to 7, "7" is the high number and "1" is the low one.

[10 minutes: questionnaire]

Hopefully you have all had a chance to complete the questionnaire. If you need more time, then please raise your hand. Otherwise we will save your questionnaire replies.

The central computer has calculated your payments. Please remain at your computer for the time being. I will ask you to approach the front in order of your ID numbers and you will need to sign a receipt for your payments and to hand in both your ID cards and the test document before receiving payment. Many thanks for taking part in today's session.

[Test documents destroyed, ID cards collected, receipts signed and payments handed out]

Appendix B: GMAT MATH-style Test

Questions

Please answer these by inserting the multiple choice answer a, b, c, d or e into the GMAT MATH spreadsheet on your computer.

1. Harriet wants to put up fencing around three sides of her rectangular yard and leave a side of 20 feet unfenced. If the yard has an area of 680 square feet, how many feet of fencing does she need?

a) 34
b) 40
c) 68
d) 88
e) 102

2. If $x + 5y = 16$ and $x = -3y$, then $y =$

a) -24
b) -8
c) -2
d) 2
e) 8

3. If "basis points" are defined so that 1 percent is equal to 100 basis points, then 82.5 percent is how many basis points greater than 62.5 percent?

a) .02
b) .2
c) 20
d) 200
e) 2,000

4. Which of the following best completes the passage below?

In a survey of job applicants, two-fifths admitted to being at least a little dishonest. However, the survey may underestimate the proportion of job applicants who are dishonest, because——.

a) some dishonest people taking the survey might have claimed on the survey to be honest.

b) some generally honest people taking the survey might have claimed on the survey to be dishonest.

c) some people who claimed on the survey to be at least a little dishonest may be very dishonest.

d) some people who claimed on the survey to be dishonest may have been answering honestly.

e) some people who are not job applicants are probably at least a little dishonest.

5.People buy prestige when they buy a premium product. They want to be associated with something special. Mass-marketing techniques and price-reduction strategies should not be used because ——.

a) affluent purchasers currently represent a shrinking portion of the population of all purchasers.

b) continued sales depend directly on the maintenance of an aura of exclusivity.

c) purchasers of premium products are concerned with the quality as well as with the price of the products.

d) expansion of the market niche to include a broader spectrum of consumers will increase profits.

e) manufacturing a premium brand is not necessarily more costly than manufacturing a standard brand of the same product.

Appendix C: Questionnaire

Questionnaire for Treatment 1.

Questionnaire

Please insert your answers into the shaded boxes to the right

Details

What is your age?

Are you a 1st year, 2nd year, 3rd year, graduate student, or other? (1/2/3/G/O)

What is your gender? (M/F)

The Clip

How much did you enjoy the clip shown at the beginning? (1-7)

Note: 1 is completely disliked, 2 very disliked, 3 is fairly disliked, 4 is neither enjoyed nor disliked, 5 is fairly enjoyed, 6 is very enjoyed, 7 is completely enjoyed

Happiness

How would you rate your happiness before seeing the clip? (1-7)

Note: 1 is completely sad, 2 is very sad, 3 is fairly sad, 4 is neither happy nor sad, 5 is fairly happy, 6 is very happy, 7 is completely happy

Did the clip shown at the beginning make you feel happier? (yes/no)

IF SO:

How would you rate your happiness after seeing the clip (1-7)?

Note: 1 is completely sad, 2 is very sad, 3 is fairly sad, 4 is neither happy nor sad, 5 is fairly happy, 6 is very happy, 7 is completely happy

School Record

Have you taken GSCE or equivalent in maths? (yes/no)

IF SO:

What was the highest grade possible for this course? (A/A*/etc.)

What was your grade?

Give a percentage if you know it

Have you taken A-level or equivalent in maths? (yes/no)

IF SO:

What was the highest grade possible for this course?

What was your grade?	
Give a percentage if you know it	
How many school level qualifications have you taken (including GCSEs, A-levels and equivalent)?	
How many of these qualifications were at the best grade possible? (eg A* in GCSE, A is A-level, etc.)	
University Record	
Are you currently or have you ever been a student (yes/no)	
If yes, which degree course(s)?	
IF you are a second or third year student what class best describes your overall performance to date? (1/2.1/2.2/3/Fail)	

Questionnaire for Treatment 0.

Questionnaire

Please insert your answers into the shaded boxes to the right

Details

What is your age?

Are you a 1st year, 2nd year, 3rd year, graduate student, or other? (1/2/3/G/O)

What is your gender? (M/F)

Happiness

How would you rate your happiness at the moment? (1-7)

Note: 1 is completely sad, 2 is very sad, 3 is fairly sad, 4 is neither happy nor sad, 5 is fairly happy, 6 is very happy, 7 is completely happy

School Record

Have you taken GSCE or equivalent in maths? (yes/no)

IF SO:

What was the highest grade possible for this course? (A/A*/etc.)

What was your grade?

Give a percentage if you know it

Have you taken A-level or equivalent in maths? (yes/no)

IF SO:

What was the highest grade possible for this course?

What was your grade?

Give a percentage if you know it

How many school level qualifications have you taken (including GCSEs, A-levels and equivalent)?

How many of these qualifications were at the best grade possible? (eg A* in GCSE, A is A-level, etc.)

University Record

Are you currently or have you ever been a student (yes/no)

If yes, which degree course(s)?

IF you are a second or third year student what class best describes your overall performance to date? (1/2.1/2.2/3/Fail)