Nudging the student for study success:

A long-term experiment in a Dutch University of Applied Sciences

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Introduction

Evidence on the application of nudges to increase study success is scarce. Yet, the application of nudges in educational contexts could be a promising, low cost method to improve study success.

Background

Nudges are consciously chosen, subtle interventions that seduce people unconsciously, while retaining their freedom of choice, to show behaviour that improves their lives. Nudge theory is an important branch of behavioural economics, a branch of economics that applies insights from psychology and sociology to economics. A nudge is defined by Thaler and Sunstein (2008) as 'any aspect of the choice architecture that alters people's behaviour in a predictable way without forbidding any options or significantly changing their economic incentives.' Nudges must be easy, cheap to avoid and are not mandates. In their book Nudge (2008) Thaler and Sunstein suggest policy recommendations in the areas of finance, health, the environment, marriage and schools. The latter context has as of yet only little nudging research.

Nudges in education have been applied to promote study persistence (Castleman & Page, 2014), to improve academic outcomes by sending text messages (Castleman & Meyer, 2016) and to promote the filling out of commitment forms (Himmler et al., in progress). All mentioned studies pointed out positive effects of nudging. A few studies have focused on the effects of nudges in the form of feedback on students' performance in relation to peers, i.e. comparative descriptive feedback: your position in comparison with a particular reference group. These studies report conflicting results. In a high-school environment Goulas and Megalokonomou (2015) have found that this kind of (competitive) feedback improves high achieving students' performance and creates a drop for low achieving students. In a college experiment Azmat, Bagues, Cabrales and Iriberri (2016) have concluded that providing feedback to college students on their position in the grade distribution decreases their educational performance, as measured by their accumulated GPA and number of exams passed. However, in an experiment by Tran and Zeckhauser (2012), Vietnamese students enrolled in an English course performed better when they were told their rankings on practice tests.

By adding injunctive elements that communicate approved or disapproved behaviour (social norms), undesirable behaviour such as reducing performance by high performing students, can be prevented (Schultz et al., 2007; Cialdini, 2008; Allcott, 2011; Dolan et al., 2010; Sunstein, 2014, Nudging Short Guide). Preliminary results of a study on the effect of injunctive comparative feedback carried out by the Max Planck Institute (Himmler, in progress) show that academic outcomes of students above the median and below the 80th percentile improve while for others no effect is found. In an experiment in higher education in which students' grades were presented in traffic light colours students expressed the expectancy that this injunctive element would motivate them to attain higher grades (De Wild et al., 2013). The present research will build upon the studies that have focused on the use of nudges in the form of feedback on students' performance, to find out how positive effects can be reached and the, also previously found, negative effects can be avoided. Educational research on feedback in higher education usually refers to summative and formative feedback on students' performance, not so much on feedback in the form of *rewards* for high performance. The word *feedback* thus has a different meaning in nudging versus educational research. The present focus is on the addition of feedback in the 'nudging' way in the context of higher education.

From educational research we have learnt that intrinsic motivation in students leads to higher performance than extrinsic feedback. As the nudges as described above are a form of extrinsic motivation, we could question whether this will have positive effects on performance. Yet, Martin (2006) has found that extrinsic

motivation *next to* intrinsic motivation can be very useful. Also a competitive element may give a student the energy to work hard(er) (either competition with others or with yourself). Still there is pretty strong evidence of negative effects when students mainly compare their performance to peers instead of to their own previous performance (fixed mindset versus growth mindset, Dweck, 2006). The most optimal mindset for learning is the "growth mindset" because it means that students seek out for help, are willing to try again and to put in extra effort.

If success is not expected by students (Hattie (2012); de Jong (2001), and when students do not have an internal locus of control (Martin, 2006; Pol, 2014), they are less likely to be successful students. These are issues that we have taken mind when designing the nudges in our experiment. We did not give 'punishments' for low results, because that could lower students self-confidence and thus their success expectation. On the other hand we know that students aged 17-23 are still developing their brains, especially their executive and control functions like planning, estimating long term consequences (Jolles et al. 2006). Students need help on these functions, support in developing these skills. Therefore, some external warnings about risks for study delay or drop-out may be in place too.

Research goal

The focus of our study is on using injunctive feedback (normative information on what's good or bad) as a nudge to improve study success. The objective is to come to an optimal technical provision of feedback on study results that promotes study success.

Our study is carried out in a Dutch university for applied sciences, NHTV Breda, with about 8000 students. Its strategy is to promote ambitious student behaviour, and motivate students to attain high levels of study success. In this light Nudge theory appears a promising, low cost method to improve study success. How such nudges should be designed exactly however, remains unclear. That's why we will work with four different treatment groups, representing non-competitive, competitive, little and intensive nudging.

NHTV recently introduced a student application for smartphones: *MyNHTVapp*. This app is produced by StuComm. The functions of the app are a Timetable, News, StudyProgress and Study Results. Together with StuComm we designed nudging elements within the functions of StudyProgress and Study Results.
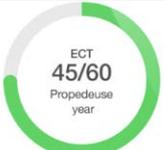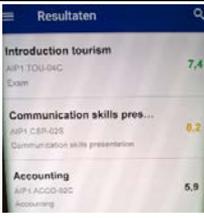
Research question

Is there an effect of personal and comparative study results-related injunctive feedback on study success in higher education?

Method

Design

The quasi-experimental design consists of four different treatment conditions, each containing a different combination of nudges. The four conditions, operationalized in four versions of the *MyNHTV-app*, are shown in Table 1. All NHTV-students that downloaded MyNHTVapp were randomly assigned to one of these nudge combinations. This design allows us to assess the effectiveness of different nudges, i.g.: (1) the effects of a progress 'filling circle' as *personal* feedback on study success, (2) the effect of colours and injunctive text elements as *personal feedback* on study success (2) the effects of smileys and injunctive text elements as *comparative feedback* on study success.

Table 1 Overview of four nudge treatment conditions

App function and screen ↓	I Basic treatment	II Basic + personal injunctive feedback	III Basic + comparative injunctive feedback	IV Full treatment
Study progress screen	ECT 45/60 Propedeuse year	ECT 45/60 Propedeuse year	ECT 45/60 Propedeuse year	ECT 45/60 Propedeuse year
Results overview screen	Grey	Colour	Grey	Colour
Results detail screen	Grey, no smileys	Colour, no smileys	No colour, smileys	Colour and smileys
Results explanation screen				

A nudge that is present in every treatment is a ring that displays personal feedback on study progress expresses in attained ECTS (relative to 60 ECTS for students in their first year and 180 ECTS for students at a higher level). This is referred to as a *reference point nudge*. It is visible on the Study progress screen.

Personal injunctive feedback is designed by means of coloured grades that indicate the level of study success relative to fixed norms. Colours used are *red* for grades below 5.5, *black* for grades higher than 5.5 and lower

than 7, *green* for grades higher than 7 and lower than 8 and *gold* for grade 8 and above. The colour red signals an alert to attain these ECTS and put in effort. The colour black indicates sufficiency, being out of the red. The colour green signals safety, just as in a traffic light. The colour gold signals *cum laude*. This colour scheme aims to promote higher average grades and indirectly study progress measured in attained ECTS. The coloured grades are visible in the Results overview screen and the Results detail screen.

The colours go with injunctive text elements, as follows:

- Gold (8 or higher): Great result, excellent!
- Green (7 – 8): Good result, well done!
- Black (5.5 to 7): Sufficient result, passed!
- Red (0 – 5.5): Insufficient result, pity.

The text elements, and again the coloured grade, are visible in the Results detail screen.

Comparative injunctive feedback is designed by means of smileys that indicate the level of study success in comparison with all students that took part in the same test and whose grades are reported in the app. One yellow smiley is awarded for grades above the average of this reference group. Two yellow smileys are awarded for students in the top 20% of this reference group. If none, or one smiley(s) are in place, the student sees the other one (or two) as light grey smileys, only just visible like a watermark. The smileys are visible in the Results detail screen.

Just as the colour scheme, this smiley scheme aims to promote higher average grades and indirectly study progress measured in attained ECTS. This nudge contains an element of competition. The average grade itself is also presented in this condition because a pilot test demonstrated that students become annoyed with this condition when this number is missing. It is expected that students will communicate among themselves about this average grade, also to students not exposed to this condition, which will create a spill over effect.

At last, there are explaining screens that become visible when students tick the coloured grade or the smiley(s) in the Result detail screen.

Participants

In December 2016 NHTV had 8107 students. Of this group 3640 students downloaded the (new version) of MyNHTVapp. Each of those 3640 students was assigned to a treatment group at random by the system. This resulted in the following distribution of subjects:

Treatment Groups - Frequency

	1	908
	2	955
	3	828
	4	949
	Total	3640
Missing	System	4467
Total	8107	

Note: Not all of the 3640 students used the app-functionalities containing nudges. Some only used the Timetable.

Measurements

The dependent variable of the experiment is study success. In our research we operationalized it with two measures:

- Change in General Point Average (GPA)
- Change in ECTS attained

To measure the level of exposure to the screens with nudges we counted the number of times students had a look at each of the nudged screens.

For the present paper we were able to analyse results for a period of four months (Dec 21th 2016 – May 2nd 2017).

Procedure

At the start of the experimental period (December 2016) students received a request to update their version of the *MyNHTV-app*. Upon installation students received the next message:

 'NHTV will be testing different versions of MyNHTV-app. That is why you may notice differences between features in your MyNHTV app and that of your fellow students. You will be asked to give user feedback at several moments. During the academic year 2017-2018 the optimal features will become available for all students'.

Analysis

In the analyses, we included only those students that had at least looked three times at the relevant screens for the present research.

We've conducted mixed Anova's to find out whether the different treatments worked out differently on the change in GPA and/or ECTS credit points (repeated measures).

We've also calculated correlations between the number of clicks on the Study progress screen and the difference-scores of ECTS credit points in May minus December.

Results

Not all of the 3640 students used the app-functions containing nudges. Table 2 presents the number of clicks on all MyNHTVapp functions.

Table 2   The total number of 'clicks' by all students using
MyNHTV app between December 2016 – May 2017

MyNHTV app functions	Frequency
Dashboard	22.236
Email feedback	9
FAQ	124
News	3.445
Rate	13
Settings	3.036
Share	5
Staff members absence	1
StuComm	6
StuComm Logo	12
StudyProgress	19.745
Study Result Badge Card	563
StudyResultsOverview	51.831
StudyResults Score Car	107
StudyResultsDetail	23.686
Timetable	320.004
Unknown class: HelpBut	1
Total	444.824

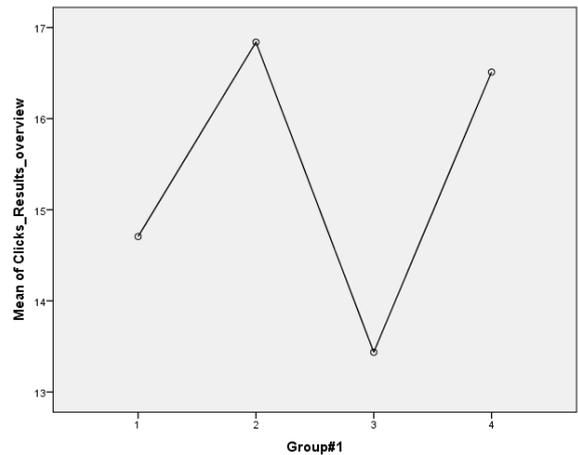**Differences in the number of clicks at the nudged screens**

First, we have checked if students from the four treatment groups differed in the number of times they looked at 'nudged' screens. There were no significant differences as to the 'Study progress circle' (as expected), but there were significant differences concerning the use of the 'Results overview screen' and the 'Results detail screen' (see table 3). Table 4 shows that student of groups 2 and 4 (both with coloured grades) looked at the Results overview screen about 16 to 17 times on average, whereas group 1 looked about 13 times, and group 3 about 15 times (both with grey grades). Table 5 shows that the same groups, 2 and 4 (colours without smileys, respective colours with smileys) looked at the Result detail screen more often (10 to 11 times) as compared to groups 1 (only grey) and 3 (grey with smileys) who looked at the detail screen about 7 times.

Table 3   ANOVA results on the difference between the four treatment groups
concerning the number of "clicks" on three nudged screens

		Sum of Squares	df	Mean Square	F	Sig.
	Between Groups	20,854	3	6,951	,054	,983
Clicks_Studyprogress	Within Groups	308192,926	2413	127,722		
	Total	308213,780	2416			
	Between Groups	6147,302	3	2049,101	6,047	,000
Clicks_Results_overview	Within Groups	1118622,276	3301	338,874		
	Total	1124769,578	3304			
	Between Groups	8783,823	3	2927,941	29,546	,000
Clicks_Results_detail	Within Groups	263503,323	2659	99,099		
	Total	272287,145	2662			

Table 4   Mean scores of treatment groups as to number of "clicks" on the Results overview screen

	Treatment group	N	Subset for alpha = 0.05	
			1	2
	3	749	13,44	
	1	816	14,71	14,71
Tukey HSD[a,b]	4	872		16,51
	2	868		16,84
	Sig.		,500	,087

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 823,136.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

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Table 5   Mean scores of treatment groups as to number of "clicks" on the Results detail screen

	Treatment group	N	Subset for alpha = 0.05	
			1	2
Tukey HSD[a,b]	1	634	6,63	
	3	545	7,15	
	2	756		10,17
	4	728		10,80
	Sig.		,784	,660

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 654,822.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.
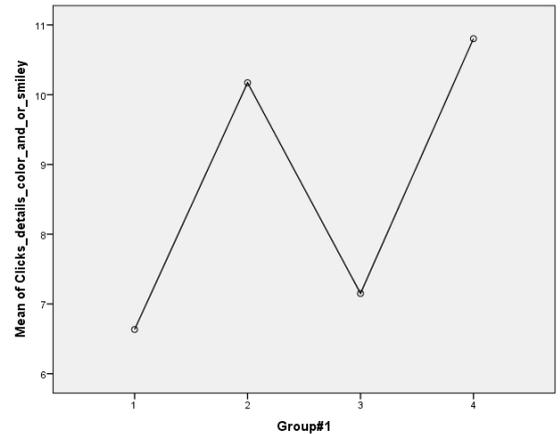
Effects of nudges on study success

In the analyses below, we included only those students that had at least looked three times at the relevant screens for that analysis.

There were no significant interaction effects between the four treatment groups and the change in GPA nor in ECTS credit points F (3, 1412) = .46, p= .987. The main research question is therefore answered negative. Table 6 presents the results for the dependent variable ECTS.

Table 6   Mixed ANOVA results on the treatment effects on growth in ECTS (Dec-May)
(Selected: students that looked at the Nudge "Study Progress" at least 3 times)

Greenhouse-Geisser; Measure: ECTS

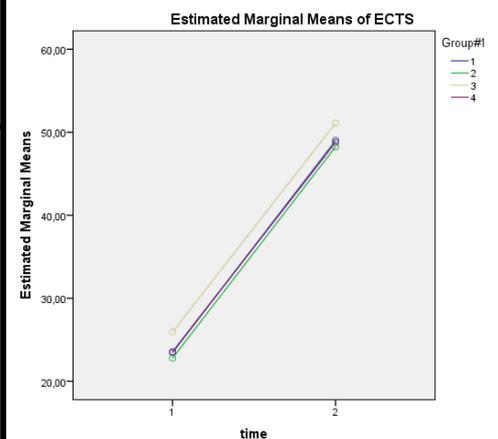| Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Time	450309,111	1,000	450309,111	3315,059	,000	,701
Time * Group	18,848	3,000	6,283	,046	,987	,000
Error (Time)	191802,469	1412,000	135,837			

Table 7 shows there was no significant effect on change in GPA of coloured grades versus grey grades F (1, 2128) = .071, p = .790. This was tested by means of a mixed ANOVA comparing two combined treatments: (1) nudged with coloured grades: treatment II and IV, (2) not nudged with colour, but grey grades.

Table 7   Mixed ANOVA results for the coloured versus grey grades,
visible in Results overview screen, on change in GPA

Greenhouse-Geisser; Measure: GPA_change

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Time	,165	1,000	,165	1,493	,222	,001
Time * Group_colour	,008	1,000	,008	,071	,790	,000
Error (Time)	234,832	2128,000	,110			

Table 8 shows there was no significant effect on change in GPA of non-competitive vs. competitive feedback (visible in Results Detail screen) F (1, 1469) = .2,251, p = .134.). This was tested by means of a mixed ANOVA comparing two combined treatments: (1) nudged with competitive feedback: treatment III and IV, (2) not nudged with competitive feedback: treatment I and II.

Table 8   Mixed ANOVA results for the non-competitive versus competitive feedback,
visible in Results overview screen, on change in GPA

Greenhouse-Geisser; Measure: GPA_change

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Time	,134	1,000	,134	1,177	,278	,001
Time * Group competitive	,256	1,000	,256	2,251	,134	,002
Error (time)	166,874	1469,000	,114			

Table 9   Mean scores of change in GPA over time for non-competitive versus competitive feedback groups

Groups	Time (1=Dec- 2=May)	Mean GPA	N	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
I and II: non-competitive	1	6,945	749	,023	6,900	6,990
	2	6,950		,017	6,916	6,984
III and IV: competitive	1	6,974	749	,023	6,928	7,020
	2	6,942		,018	6,907	6,976

Estimated Marginal Means of MEASURE_1
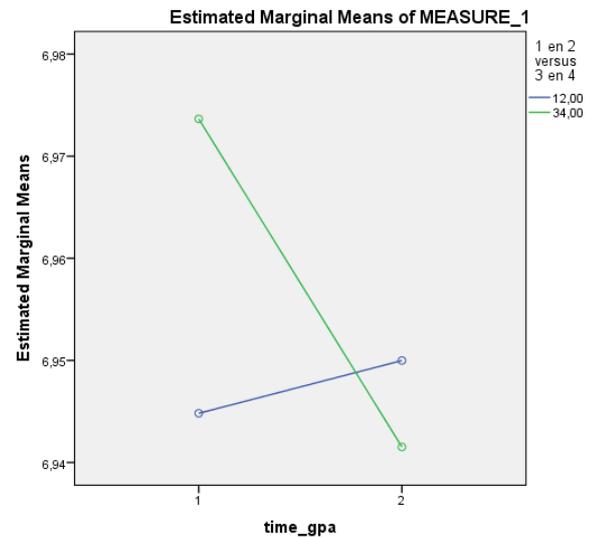
All analyses have been based on differences between groups. The treatment group, however, may be too rough a way to analyse the differences. That is, the level of exposure to the treatment depends on how many times the student looks at the screens that contain nudges.

Therefore, we've also conducted correlations between the number of views at the nudged screens, and the difference-scores on study results. There were no significant results in any of these analyses.

Conclusions

During a period of four months students were exposed to injunctive feedback on their study results by means of the use of colours and or smileys in the 'Results' functionality in MyNHTVapp. There were no significant interaction effects between the treatments and the change in GPA nor ECTS credit points.

The only effect that was found was that there were more views on the coloured results screen, then on the grey results screen. This could indicate that the colours make it more attractive to have a look at the results, and thus may make students more aware of their study success. However, during the four months that passed so far, there were no effects on the results.

The use of MyNHTV app, especially the functions that were nudged, is still low. Much more students could use these functions. A period of four months (ending before the main exams at the end of the year) may also have a limiting influence on the finding of effects. We may need more time to find out more certain if there are any effects.

We intend to prolong the experiment, and to promote the use of the functions in the next half year to see how this changes the results of our research.

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