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Seeking Risk or Answering Smart? Framing in Elementary Schools in Germany

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[PRELIMINARY DRAFT—DO NOT CITE]

Abstract

This paper investigates how loss and gain framing affects the quantity and quality of decision in a multiple-choice test. In a field experiment in elementary schools, 1.377 pupils are randomly assigned to one of three experimental conditions: (i) earning points is framed as a gain (Control Group), (ii) earning points is framed as a loss (Loss Treatment) and (iii) earning points is framed as a gain but pupils are endowed with negative points (Negative Treatment). On average, pupils in both treatment groups answer significantly more questions correctly compared to the "traditional grading". This increase is driven by two different mechanisms. While pupils in the Loss Treatment increase significantly the quantity of answered questions—seek more risk—pupils in the Negative Treatment seem to increase the quality of answers—answer more accurately. Moreover, differentiating pupils by their initial ability shows that the Negative Treatment is superior to the Loss Treatment. High-performers increase performance in both treatment groups but motivation is significantly crowded out for low-performers in the Loss Treatment.

Keywords Behavioral decision making, quantity and quality of decisions, framing, loss aversion, field experiment, motivation, education

JEL codes: D03, D80, I20, C93

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1 Introduction

Effort is an important prerequisite to achieve externally driven goals. A manager may set a goal for productivity in the workplace, the doctor advises his patient how much weight to lose or parents emphasize which GPA their child should achieve in the academic year. However, individuals' intrinsic motivation is often not high enough to achieve these external goals. An economist's obvious solution would be the provision of adequate extrinsic financial incentives. While financial incentives can be costly and may have mixed effects on motivation [Gneezy and Rustichini, 2000, Bénabou and Tirole, 2006] there is growing evidence in behavioral economics that non-monetary (recognition) incentives represent an appropriate alternative [Neckermann et al., 2014, Ashraf et al., 2014, Bradler et al., 2013, Kube et al., 2012].[1] Moreover, inducing loss aversion to change peoples' behavior has been shown to be effective and hence framing extrinsic rewards as a loss has been increasingly applied to some field settings in recent years [Hong et al., 2015, Armantier and Boly, 2015, List and Samek, 2015, Roland G. Fryer et al., 2012, Hossain and List, 2012]. These studies demonstrate that the provision of effort is sensitive to incentives framing. However, it is important to know for whom loss framing works and to understand the underlying mechanisms of effort provision if outcomes depend on multiple inputs i.e. the quality and quantity of decisions.

An ideal setting to test the impact of framing effects on the quality and quantity of decisions is within the educational sector using multiple-choice tests. This testing format creates an environment where decisions have to be taken under uncertainty and performance is dependent on the quality and quantity of answers.[2] It also allows to analyze heterogeneous framing effects on effort as pupils within a classroom can be differentiated by their initial ability. Moreover, there are not many studies which test the effect of loss framing on performance and motivation in the educational system. Enhancing pupils' motivation is important as it is a key input to excel in the educational system and pupils often invest too little in their own education although there are large returns to education [Hanushek et al., 2015, Card and Krueger, 1992, Card, 1999].[3] To test framing effects is therefore promising as it represents a potential cost-effective and easy to implement method to motivate pupils. In particular, testing framing effects on elementary pupils in their last school years in Germany seems to be valuable because the German school system tracks pupils into three different school types—and locks them in tracks throughout middle school—at an early age (at age 10).[4] Therefore, enhancing pupils' attitude towards school (i) might be more effective in younger ages due to complementarities of skill formation at different stages of the education production function [Cunha and Heckman, 2007] and (ii) might influence the tracking decision and thus pupils' future income.[5]

Elementary pupils represent the general population and based on their midterm grades, can be differentiated into high-, middle- and low-performers. While high-performers are likely to be allocated to the academic track and low-performers to the lower track (preparing for blue color occupations), middle-ability pupils might the most at risk of being misallocated. Therefore, it is worthwhile to analyze whether framing can change (educational) behavior of different ability groups. Nevertheless, educators might dislike loss framing because pupils could incur psychological or emotional costs.[6] Hence, it is also important to identify

[1] Wagner and Riener [2015], Springer et al. [2015], Jalava et al. [2015], Levitt et al. [Forthcoming] analyze the effectiveness of non-monetary incentives in educational settings.

[2] Performance in multiple-choice tests can be enhanced by answering more questions (quantity) if the expected number of points when guessing is non negative or by answering questions more accurately (quality).

[3] See Lavecchia et al. [2014] and Koch et al. [2014] for an overview on behavioral economics of education.

[4] A more detailed description of the German tracking system is given in Wagner and Riener [2015].

[5] Results by Dustmann et al. [Forthcoming] suggest that pupils in the highest track have 23 percent higher wages than medium track pupils and completing the medium versus the low track is associated with a 16 percent wage differential.

[6] Although some teachers may dislike loss framing, some elementary teacher already use some kind of loss framing in the way they assign "stars and stickers" to pupils. While some teachers give stars for good behavior and reward pupils in case they

alternative ways to increase the motivation of pupils. Loss framing is potentially a cost-effective method to boost performance in school and therefore might be appealing for policy-makers to implement which is why it is important to inform policy-makers and educators about potential drawbacks of loss framing, in particular whether it works for all pupils of the ability distribution and which domain—risk seeking or accuracy—is mainly affected.

This paper tests whether manipulating the grading scheme, e.g. loss framing, improves pupils' performance in a ten item multiple-choice test and compares pupils' performance under three different frames: (1) gain frame, (2) loss frame and (3) gain frame with negative endowment. Moreover, a special focus is on analyzing the effectiveness of framing effects for different ability levels (high- and low-performing pupils). To the best of my knowledge this has not been studied previously and it represents a major contribution of this paper. Furthermore, the multiple-choice testing format allows to analyze the impact of framing effects on pupils' risk-seeking behavior and level of accuracy.[7]

The experiment was conducted in 20 elementary schools in Germany among 1377 pupils of grades three and four. The setting of elementary schools allows to analyze framing effects for heterogeneous ability groups as elementary children are not yet tracked into vocational or academic school types and represent the general population. Pupils were randomized into the *Control Group*, the *Loss Treatment* and the *Negative Treatment*. In the Control Group and Negative Treatment earning points was framed as a gain. Pupils received +4 points for a correct answer, +2 points for skipping an answer and 0 points for an incorrect answer.[8] The difference between these two treatments is that pupils were endowed upfront either with 0 points or -20 points. Hence, pupils could earn between 0 to 40 points in the Control Group and -20 to +20 in the Negative Treatment. The intention to endow pupils with a negative amount of points was to make the "passing threshold" more salient. In most exams pupils need at least half of the points to "pass" the exam or to get a respective grade that signals "pass".[9] In the Loss Treatment earning points was framed as a loss and pupils started with the maximum score (+40 points) but lost -4 points for an incorrect answer, -2 points for a skipped question and 0 points for a correct answer.

On average, pupils in the Loss and Negative Treatment give significantly more correct answers compared to pupils in the Control Group. These results seem to be driven by two different mechanisms. While pupils in the Loss Treatment become more risk-seeking, pupils in the Negative Treatment tend to give more accurate answers. The number of answered questions increases significantly in the Loss Treatment while the share of correctly answered questions does not change. In contrast, the quantity of answers in the Negative Treatment does not significantly differ from the Control Group while the accuracy of answers significantly increases.[10] Moreover, I find heterogeneous framing effects for pupils of different ability levels. While high-ability pupils increase the number of correct answers as well as total points in both treatments, low-ability pupils significantly perform worse under the Loss Treatment compared to low-ability pupils in the Negative Treatment and pupils in the Control Group. These results are important especially for policy-makers who plan to introduce new incentive or grading schemes in schools. Although loss framing might be cost-effective and appears appealing to implement in elementary and secondary schools, the experimental results suggest that

achieve a predefined amount of stars, other teachers let pupils start with the maximum number of stars but take them away for disruptive behavior. Hence, some teachers already use some kind of loss framing but instead of framing stars as losses, *earning points* is framed as a loss in this study. This information was given by some teachers in the run-up of the experiment.

[7] As skipping an answer usually gives a sure (non negative) number of points, answering a question without certainly knowing the answer is a risky decision. In this study a risk-neutral individual which does not know the answer is indifferent between answering and skipping a question if the probability of success is 50%.

[8] An incorrect answer is usually punished in multiple-choice tests by deducting points. However, it was important in this experiment that pupils could either only lose or only gain points in order to implement loss and gain framing.

[9] This information was informally given by teachers.

[10] Overall, the coefficient for the number of *total points* in the test is positive but statistical insignificant for both treatments.

low-performers—often the main target audience of policy interventions—would be made worse off. Notably, all differences between the treatment groups and the Control Group are driven by a change in (cognitive) effort. The specific grading scheme was explained to pupils shortly before pupils had to take the test. Thus, pupils had no time to study between learning about the grading scheme and the start of the test. This allows to separate the effort effect from the learning effect. Finally, in contrast to Apostolova-Mihaylova et al. [2015], I find no heterogeneous gender effects of loss framing.[11]

The remainder of the paper is structured as follows. The next section gives an overview about the related literature. The experimental design and expiration is described in Section 3 and Section 4 derives hypotheses of potential treatment effects. The data and descriptive statistics are reported in Section 5. Section 6 presents the results which are discussed in Section 7. Section 8 summarizes and concludes.

2 Literature Review

This paper is related to the strand of behavioral literature focusing on loss framing and to the education (economics) literature on grading schemes. Non-monetary incentives to motivate students have received increasing attention by researcher as—compared to financial incentives—this kind of rewards are more likely to be accepted by teachers, parents and policy makers. Levitt et al. [Forthcoming] show that non-monetary incentives (a trophy) work for younger but not for older kids and that the incentive effect diminishes if payment of the rewards is delayed. Jalava et al. [2015] find that girls respond to symbolic rewards but that motivation tends to be crowded out for low-skilled students. Wagner and Riener [2015] test a set of public recognition incentives and show that self-selected rewards tend to work better than predetermined ones.

On grading schemes Jalava et al. [2015] test the effectiveness of a "traditional" criterion-based grading (pupils get grade on a A-F scale according to predetermined thresholds) and a rank-based grading. In the latter, only the top three performers of a class received an A. The authors find that rank-based grading increases performance of boys and girls and that rank-based grading also tends to crowd out intrinsic motivation of low-skilled students.[12] Czibor et al. [2014] investigate the effectiveness of absolute grading and grading on a curve in a high-stake test environment among university students. The authors hypothesize that grading on a curve induces male students to increase their performance compared to an absolute grading. They find weak support for this hypothesize and mainly an increase in performance for the more (intrinsically) motivated male students—female students were unaffected by the grading system. However, there is evidence that rank-based grading might be problematic if ranks are made public. Bursztyn and Jensen [2015] find a decrease in performance if top performers are revealed to the rest of the class. Moreover, educators might dislike to introduce rank based competition between pupils as they are not interested in pupils' relative performance but are more concerned about the individual learning progress of their students.

Although there is ample evidence on extrinsic rewards and grading schemes, only a few empirical studies have analyzed the effectiveness of framing effects in educational settings. Roland G. Fryer et al. [2012] analyze whether framing teachers' bonus payments as losses increases the performance of their students. Teachers in the loss frame were paid in advance (lump sum payment at the beginning of the school year) but had to return the bonus if their students did not meet the performance target. The authors find large and statistically significant gains in math test scores for students whose teachers were paid according to the loss frame.[13]

[11] The different findings to Apostolova-Mihaylova et al. [2015] could be due to differences in the subjects' age—university students vs. elementary pupils.

[12] see also the literature on grading standards mentioned in Jalava et al. [2015]

[13] The size of gains was equivalent to increasing teacher quality by more than one standard deviation.

Apostolova-Mihaylova et al. [2015] test whether framing grades of university students as a loss or as a gain effects the course grade at the end of the semester. Students in the treatment group started with the highest possible grade and lost points as the semester progressed while students in the control group started with zero points and could gain points throughout the semester.[14] After each completed exam or assignment, the students' grades were updated, so that students had the opportunity to follow their increasing or decreasing grades. The authors find no overall effect of loss framing on the final course grade but they find heterogeneous gender effects. The final course grade of male students increased while female students got lower grades in case of loss framing.

There is little evidence on framing effects on school aged children in the economics literature. In the educational psychology literature, Kishor and Godfrey [1999] analyze how framing instructions effects academic task completion of third and fourth graders. Pupils were asked to finish an academic task and teachers added information on which consequences—individual or group—students' behavior has. Those consequences were either framed as a gain (*"If you finish these questions ..., there is a 100% chance that your group will receive ..."*) or as a loss *("If you do not finish these questions ..., there is a 100% chance that you will lose..."*). The authors show that task completion rates were significantly higher under all framed instruction conditions.

Closest to my study is the experiment by Levitt et al. [Forthcoming] which is the only study—to the best of my knowledge—testing loss framing of extrinsic rewards among school-aged children. The authors provide elementary and high school students in Chicago with financial ($10 or $20) and non-financial (a trophy) incentives for a self-improvement in a low stakes test. These incentives were announced immediately before the test and were presented either as a loss or a gain. In the loss treatment students received the incentive at the beginning of the test and kept the incentives at their desk throughout the test.[15] Levitt et al. [Forthcoming] find that immediate paid high financial and non-financial rewards improve performance, and that younger students are more responsive to non-financial rewards. However, they find only suggestive evidence that loss framing improves performance—effects are positive but statistical not significant. My study differs in several ways to Levitt et al. [Forthcoming]: (i) I apply loss framing on *points in a test* and not on an *extrinsic* reward[16], (ii) loss framing is not only tested against the traditional grading scheme but *additionally* to endowing pupils with negative points, (iii) loss framing is analyzed for different ability groups and (iv) the underlying mechanisms of loss framing—impact on quantity and quality of decisions—are examined.

3 Experimental Design

The study was conducted in 20 elementary schools with a total of 71 school classes in the federal state of North Rhine-Westphalia (NRW), Germany. During May and November 2015, 1377 pupils in grades three and four participated. Elementary school in Germany runs from grade one at the age of 6 to grade four at the age of 9 or 10. With the semester report in grade four, parents receive a transition recommendation to which school type—academic or vocational track—to send their child. This recommendation is given by the elementary school teacher and is based on i) talent and performance, ii) social skills and social behavior and iii) motivation and learning virtues [Anders et al., 2010]. However, parents in NRW have the choice to which type of secondary school they want to send their children, regardless of the school recommendation. Nevertheless,

[14] Students had to complete i) daily quizzes and assignments, ii) one group project and iii) three exams including the final exams, each worth 100 points.

[15] Students had to sign a sheet confirming receipt of the reward and were asked to return it in case of missing improvement.

[16] Framing points as gain or loss should help to maintain a "natural" testing environment as pupils usually do not get extrinsic rewards for performance in a test.

depending on their capacity, secondary schools can decline applications.[17] Hence, policy interventions to boost pupils' performance in grades three and four might have long-lasting effects for pupils as these grades are important stages for the recommendation decision and promotion within the German school system.

3.1 Selection of Schools and Choice of Testing Format

Selection of Schools In total, 221 elementary schools in the cities of Bonn, Cologne and Düsseldorf, which represents about 7.7% of all elementary schools in NRW were contacted based on a list that is publicly available from the Ministry of Education of NRW. The first contact was established via Email on April 7, 2015 and a second mailing followed on August 3, 2015 (at the end of the summer holidays). About 19% of all contacted schools responded, and 50% (21 schools) of these schools replied positively and agreed to a preparatory talk.[18] In the preparatory talks, the experimental design was explained to at least one teacher and lasted about 20-30 minutes. Finally, 20 schools totaling 71 classes agreed to participate in the experiment. One school initially agreed to participate and received all experimental instructions and testing material but did not carry out the experiment in the end. The reasons are unknown as the school did not respond to any mailing afterwards. Additionally, one teacher of another school did not manage to write the test in time.

Multiple-Choice Test I received permission to use old questions from a mathematics competition test "*Känguru-Wettbewerb*" which is administered once a year throughout Germany and in over 50 other countries. The mathematical test in this experiment consisted of 10 multiple-choice pen-and-paper questions and represented a compilation of old age appropriate questions of the *Känguru-Wettbewerb*.[19] Pupils had 30 minutes to answer all the questions so that the test could be taken in a regularly scheduled teaching hour.[20] The problems and the answer options were presented on three question sheets and points could be earned according to the treatment specifications (see Table 1). There were five answering possibilities with only one correct answer per question, and pupils had to mark their answers on the same sheet. To minimize cheating [see Armantier and Boly, 2013, Behrman et al., 2015, Jensen et al., 2002], the order of questions was changed within the class.

To fulfill privacy and data protection requirements, each test and questionnaire received a test identification number, so that pupils did not have to write down their names. This procedure is similar to the one of evaluations of learning processes which are regularly carried out in various subjects. Furthermore, parents had to sign a consent form.

3.2 Treatments

The following three treatments were designed to analyze the effectiveness of different grading schemes on pupils' performance: the Control Group (Control), the Loss Treatment (Loss), and the Negative Treatment (Negative). The test was announced one week in advance in all treatments and the preparatory material for pupils was distributed in the same lesson. During the preparation week, teachers were not allowed to

[17] Criteria for the admission decisions that may be used by the school principal are the number of siblings already attending the school, balanced ratios of girls and boys, distance to school and/or a lottery procedure (see http://www.schulministerium.nrw.de/docs/Recht/Schulrecht/APOen/HS-RS-GE-GY-SekI/APO_SI-Stand_-1_07_2013.pdf).

[18] Non-participating schools which replied to the request declined participation due to a number of other requests of researchers or limited time capacities.

[19] The *Känguru-Wettbewerb* consists of 24 items and working time is 75 minutes. Hence, 10 questions were chosen in the experiment to adjust for the shorter testing time of 30 minutes.

[20] A regular teaching hour in Germany lasts for 45 minutes.

actively prepare pupils for the test.[21] The grading scheme differed across treatments and was announced to pupils on the testing day shortly before the test started. Hence, this design allows to differentiate between a learning and effort effect because pupils had no time to study after the grading scheme was revealed.[22] Any treatment effects can therefore be attributed to pupils exerting more effort during the test and not to a learning effect—e.g. pupils spending more time on test preparation.

Control Group Pupils in the Control Group started the test with 0 points which is the "traditional" system in Germany. For each correct answer pupils earned +4 points, 0 points for a wrong answer and +2 points in case they skipped a question. Hence, pupils could never lose a point in the Control Group and consequently could earn between 0 and +40 points. Note that a sure gain of +2 points for skipped answers increases the cost of guessing under uncertainty. Risk-neutral individuals who maximize the expected number of points but do not know the correct answer and cannot exclude a wrong answering choice, are indifferent between answering and skipping the question if the probability of finding the right answer is 50 percent.

Loss Treatment To implement loss aversion, pupils were endowed with the maximum score of +40 points upfront but subsequently could only lose points. Pupils earned -4 points for a wrong answer, -2 points for skipping a question and 0 for a correct answer. Likewise pupils in the Control Group, pupils could earn between 0 and +40 points.

Negative Treatment In the Negative Treatment, earning points was framed in the same manner as in the Control Group. Pupils earned +4 points for a correct answer, 0 points for a wrong answer and +2 points for skipping a question. The only difference between the Negative Treatment and the Control Group was that pupils started the test with -20 points.[23] Thus, pupils could earn between -20 and +20 points. Usually pupils have to score at least half of the points to "pass" the exam. Hence, this treatment intended to make the threshold of passing more salient.

Notice that pupils in in the Control Group and Loss Treatment who give the same number of correct answers and skip the same number of questions earn the same amount of total points in the test. This is also true for pupils in the Negative Treatment if the negative endowment of -20 points is taken into account. Table 1 gives an overview of the treatment conditions. In particular, the number of points earned for correct, skipped and wrong answers, the number of starting points as well as the minimum and maximum number of total points.

[21] Teachers answered questions concerning the preparatory exercises only if pupils asked on their own initiative.
[22] See also the experimental design by Levitt et al. [Forthcoming] for isolating the effort effect from the learning effect.
[23] Pupils in grades three and four already learned addition and subtraction with numbers up to 100.

Table 1: Treatment Overview

	Starting Points	*Correct Answer*	*Skipped Answer*	*Wrong Answer*	*Minimum Points*	*Maximum Points*
Treatments						
Control	0	+4	+2	0	0	+40
Loss	+40	0	−2	−4	0	+40
Negative	−20	+4	+2	0	−20	+20

Note: This table displays the number of points pupils received for a correct, wrong or skipped answer as well as the amount of starting points and the minimum and maximum number of total points separately for each treatment.

Randomization

Randomization was performed using a block-randomized design.[24] All pupils within the same class were randomized into the same treatment and blocked on grade level within schools, classes were randomized into the Control Group, Loss Treatment or Negative Treatment. The randomization procedure ensured that the Control Group and either the Loss or the Negative Treatment were implemented within each grade level of a school participating in the experiment with two classes.[25] The Loss and Negative Treatment were implemented simultaneously for schools participating with more than two classes within a grade level.

Table 6 in Appendix A.1 shows the randomization of treatments and reports the number of participants, average number of correct answers and average points by treatment group i) for the full sample and ii) separately for boys and girls. Table 7 in Appendix A.1 reports the randomization checks adjusting for multiple hypothesis testing [see List et al., 2016]. On average, the variables do not differ from the Control Group at conventional levels of statistical significance. This indicates that the randomization procedure was successful. However, teachers seem to be less experienced on average in the Negative Treatment. Having less experienced teachers could have a negative effects on pupils' performance and therefore would underestimate positive treatment effects. Nevertheless, differences in teachers' experience are taken into account in the statistical analysis.

Participants are on average 9.10 years old and have 0.79 older siblings. 48.80% of the pupils are female and 78.44% speak German at home. The average midterm grade in mathematics is 2.46 on a scale from 1 to 6, where 1 is the highest and 6 is the lowest grade.

3.3 Implementation

Researchers were never present in the classroom to maintain a natural exam situation within the classroom. Therefore, teachers got detailed instructions in the run-up of the experiment (see Appendix C.1). Each school was visited once during the preliminary stage of the experiment. In this meeting, the exact schedule and expiration of the experiment was described and teachers' questions were answered.[26] Each teacher received the instructions again in written form close to the start of the experiment. In total, two envelopes were subsequently sent to the teacher. The first envelope was distributed at the beginning of the experiment—the moment a school agreed to participate—and contained instructions regarding the announcement of the test, preparatory material for pupils and consent forms for parents.[27] In the first instruction letter teachers

[24] See Duflo et al. [2007], Bruhn and McKenzie [2009] regarding the rationale for the use of randomization.
[25] There were only two schools in which one class participated.
[26] The implementation of the experiment is similar to Wagner and Riener [2015].
[27] See Appendix C.3 for the consent form and Appendix C.1 for the teacher instructions.

learned about the treatment group of their class but were not yet allowed to communicate it to pupils. It was necessary to tell teachers their treatment in advance to give them the opportunity to ask questions about the treatment expiration. Two to three days before the test date, teachers received the second envelope containing the tests, detailed instructions for implementations on the test day and a list in which teachers were asked to enter pupils' midterm grades and the corresponding test-id numbers.[28] It was important to send the tests in a timely manner in order to reduce the risk of intentional or unintentional preparation of pupils by teachers. Tests were corrected by the researchers and graded by teachers. Teachers and pupils answered a questionnaire at the close of the experiment.

It was common to all treatments that teachers were asked to choose a suitable testing week in which no other class test was scheduled for which pupils had to study. Teachers announced the test one week in advance and distributed the preparatory questions with attached solutions as well as the consent forms to be signed by parents.[29] The teachers clarified that pupils' performance will be evaluated and that pupils will get a grade but that this grade does not count for the school report. They did so in the framework of an evaluation of pupils' achievements which demonstrates their skills during a school year. Pupils had 30 minutes to answer all the test questions and filled out a questionnaire that was attached to the end of the test. The tests were corrected centrally by the researcher, and pupils received their result shortly after.

It was not possible to implement the experiment in a high stakes testing environment—test score counts for pupils' overall grade—due to the institutional setting and teachers resistance.[30] Hence, the multiple-choice test is a low stakes test which is also the case for PISA and other standardized comparative tests (i.e. VERA, IGLU, TIMSS). However, the experimental design is superior to these standardized comparative tests as the experiment is conducted in pupils' natural learning environment and pupils get a grade and feedback about their test performance the latest after one week. Thus, there are several reasons why pupils should be motivated to put effort into the test. First, grades (and ranks) themselves have an incentive effect [see Koch et al., 2014, Lavecchia et al., 2014, and the literature mentioned therein]. Second, pupils might want to signal good performance to parents or the teacher [see Wagner and Riener, 2015] and third, giving grades and feedback on performance allows for social comparison within the classroom [Bursztyn and Jensen, 2015].[31] Furthermore, there is mixed evidence that performance changes if the test counts towards the course grade. While Baumert and Demmrich [2001] find no differences between high and low stakes testing with respect to intended and invested effort, Grove and Wasserman [2006] find that grade incentives boosted the exam performance of freshmen but not for older students.[32] Therefore, analyzing grading manipulation in a low stake testing environment can shed light on how framing might change behavior in a high stake testing environment. Nevertheless, it would be interesting to analyze framing effects for high stakes tests in future research. However, in a first step it was easier to convince teachers to participate in a low stakes study.

At the testing day, teachers explained in detail how pupils could earn points shortly before the test started and the introductory text at the top of the tests varied by treatment:

Control:

[28] Due to data privacy reasons, each pupil got a test-id number so that researchers could not infer pupils' identity.

[29] Strategic attrition was not possible as all treatments got the same consent form. In Subsection 5.1 attrition is discussed in detail.

[30] Teachers did not agree that the test performance counts for the final grade—because contrary to regular exams—the multiple-choice test of the experiment does not test recently learned curricular content.

[31] Bursztyn and Jensen [2015] show that pupils' investment decision into education differs based on which peers they are sitting with and thus to whom their decision would be revealed.

[32] Camerer and Hogarth [1999] review the literature on experiments in which the level of financial incentives was varied. They find mixed results of incentives on performance and that the effectiveness of incentives seems to be task dependent.

"1. Please do not write your name on the test. For each task, there are 4 wrong and 1 correct answers. Please write your answers in the boxes.

2. The highest possible score is 40, the lowest 0.

3. You start with 0 points. If a correct answer is written, you get +4 points. You get +2 points if no answer is given and 0 points if an incorrect answer is written."

Loss:

"1. Please do not write your name on the test. For each task, there are 4 wrong and 1 correct answers. Please write your answers in the boxes.

2. The highest possible score is 40, the lowest 0.

3. You start with the maximum number of points. This means you have 40 points at this point. However, you lose 4 points if an incorrect answers is written and you lose 2 points if no answers is given. If a correct answer is written, you lose no points."

Negative:

1. Please do not write your name on the test. For each task, there are 4 wrong and 1 correct answers. Please write your answers in the boxes.

2. The highest possible score is +20, the lowest -20.

3. You start with the minimum number of points. This means you have -20 points at this point. However, if a correct answer is written, you get +4 points. You get +2 points if no answer is given and 0 points if an incorrect answer is written."

4 Hypothesis

One objective of this paper is to test whether loss framing increases test performance of elementary children. According to prospect theory Kahneman and Tversky [1979], individuals evaluate a loss approximately twice as much as an equal gain if they are loss averse and therefore choose more often a risky gamble than a sure outcome. In a multiple-choice test pupils also have the choice between a risky gamble (answering a question) and a sure outcome (omitting a question) if they do not know the answer with certainty. Therefore, if pupils are loss averse, start with the maximum number of points and can only lose points, they should give more answers in the Loss Treatment in order to avoid losing points with certainty. The underlying assumption is that pupils' reference point is their current asset (+40 points) and due to loss aversion change their behavior compared to the Control Group. However, if pupils are not loss averse or their reference point does not change to the new endowment, there should be no difference between the Control Group and the Loss Treatment. Nevertheless, informed by previous research, I hypothesize that pupils are loss averse, adjust their reference point to the new endowment and therefore choose more often the risky option, i.e. increase the quantity of answers.

Hypothesis 1 *The number of answered questions in Loss Treatment is higher than in the Control Group.*

The Negative Treatment and the Control Group differ only with respect to their initial endowment of points. Pupils in the Negative Treatment start the test with -20 points whereas pupils in the Control Group are endowed with 0 points. Thus, the point scale is shifted downwards which could—according to prospect theory—effect pupils' performance in two ways: First, they adjust to the incurred loss of -20 points and accept this endowment as their new reference point. In this case, earning points is in the domain of gains and performance should not differ from the Control Group. Second, pupils do not immediately adjusted to the new endowment and their reference point is at 0 points—the "traditional" starting point. In this case, pupils would face a negative discrepancy between the reference point and their current endowment. Hence, they could code their situation as a loss which could result in an increase in their performance. If this would be indeed the case, pupils' behavior should be changed by the same mechanism (loss aversion) as in the Loss Treatment, This means pupils would chose more often the gamble. However, pupils in the Negative Treatment might also increase their performance if they adjust their reference point to the new endowment. The Negative Treatment increase the salience of the "passing" threshold and therefore sets an intermediate goal at 0 points whereas in the Control Group pupils' goal is at +40 points. Hence, pupils in the Negative Treatment are closer to their (intermediate) goal and due to diminishing sensitivity of the value function increase their test performance. This increase can be reached by answering more questions, answering questions more accurately or a mixture of both. Moreover, pupils could also adjust to the incurred loss and simply have more pessimistic beliefs about the grade they would get if they score negatively. I expect that pupils in the Negative Treatment perform better in the test than pupils in the Control Group.[33]

Hypothesis 2 *Pupils in the Negative Treatment perform better in the test compared to pupils in the Control Group.*

It is of crucial importance to inform policy makers and educators about heterogeneous framing effects to know for whom loss framing potentially works (negatively). There is evidence that pupils who differ in their cognitive ability also differ in risk preferences, i.e. that cognitive ability and risk aversion are negatively related [Benjamin et al., 2013, Dohmen et al., 2010, Burks et al., 2009] and Frederick [2005] show that individuals who score high on a cognitive reflection test (CRT) are more risk-seeking in gain domains and less risk-seeking in loss domains than individuals scoring low in the CRT.[34] Low-ability pupils could therefore be more sensitive to losses than high-ability pupils and the Loss Treatment could lead—as loss aversion is assumed to be the mechanism boosting performance—to larger differences in performance for low ability-pupils [see also Imas et al., 2016, on sensitivity to loss averion].

Hypothesis 3 *Low-ability pupils are more sensitive to losses which leads to larger differences in performance compared to high-ability pupils.*

5 Data and Descriptive Statistics

Data on pupil and teacher level are questionnaire based and compared to data in NRW. The most important control variable is pupils' last midterm grade in math to be able to control for pupils' baseline performance.

[33] Whether the Negative Treatment has long run effects on pupils performance cannot be answered in this study. It might be that the negative endowment of points results only in short run effects if pupils learn to adjust their reference points to the incurred loss in repeated interventions. However, short run interventions can give valuable insights on how long run studies might work. If the Negative Treatment does not motivate pupils in the short run then it is also unlikely that motivation would increase in repeated interactions.

[34] Andersson et al. [2016] report evidence that the negative relation of cognitive ability and risk aversion may be spurious as they find suggestive evidence that cognitive ability is related to random decision making rather than to risk preferences.

Midterm grades have the advantage that they are reported by teachers and can be treated as exogenous in the analysis because they were given to pupils before teachers learned about the experiment. Midterm grades in Germany combine the written and verbal performance of pupils wherein the written part has a larger influence on the final course grade and should be correlated with pupils' true ability; thus, these grades are a good—also not perfect—measure of mathematical ability. Further control variables on pupil level I will use to derive my results in Section 6 are gender, parents' education and a dummy whether pupils are in grade three or four. The latter variable controls for pupils' age and educational level simultaneously. Parents' educational level is captured by the number of books at home (see Woessmann [2005], Fuchs and Woessmann [2008] for an application in PISA studies).

Control variables at the classroom-level are teachers' working experience, the number of days between the test and the next holidays, and an indicator whether the test was written before or after the summer holidays. It seems that there is a common understanding in the literature that unobserved teacher characteristics may be more important than observed characteristics. However, among the observable teacher characteristics, many studies find a positive effect of teachers' experience on pupils' achievement [Harris and Sass, 2011, Mueller, 2013]. The number of days until the next holidays is included as pupils' academic motivation could decline as the semester progresses [Corpus et al., 2009, Pajares and Graham, 1999]. Pupils who write the test close to the start of the holidays could be less motivated to exert effort than pupils who write the test at the beginning of the semester.[35] It was also necessary to include a dummy controlling whether the test was written before or after the summer break as the summer break marks the beginning of the new school year. Controlling only for the school grade would neglect the fact that pupils in grade four before the summer break are one year ahead in the teaching material than pupils in grade four after the summer break.

Table 2 compares the descriptive statistics to the actual data in NRW. Although representativeness of the sample for the school population in NRW cannot be claimed, the data are consistent with key school indicators. 1.333 observations were included in the final analysis; 44 observations were dropped because of missing values.[36]

Table 2: Comparison of characteristics: Experiment vs. North Rhine-Westphalia (in %)

	Experimental Data	*North Rhine-Westphalia*
Proportion Female	48.80	49.19
Proportion Pupil German	62.89	56.40
Class Size	24.85	23.20
Proportion Teacher Female	94.29	91.27

Note: This table compares characteristics of the pupils in the experiment with the same indicators in NRW. Cell entries represent percentages of key school indicators. NRW school data are taken from the official statistical report of the ministry of education for the school year 2014/2015 (see https://www.schulministerium.nrw.de/docs/bp/Ministerium/Service/Schulstatistik/Amtliche-Schuldaten/StatTelegramm2014.pdf).

[35] In total there were two holidays during the experiment (summer and autumn).

[36] Missing values were the result of incomplete pupil questionnaires. There are 3 missing values for the last midterm grade and 41 for pupils' gender.

5.1 Attrition

Parents had to give their consent that their child are allowed to participate in the experiment and that teachers are allowed to pass on pupils' test and past midterm grade to the researcher.[37] Hence, before comparing the performance of pupils in the two treatment groups to the Control Group, concerns related to non-random attrition need to be alleviated. If attrition is associated with the outcomes of interest, then the results could lead to biased conclusions. Nevertheless, biased outcomes are unlikely if response probabilities are uncorrelated with treatment status [Angrist, 1997].

There are several reasons for attrition: (i) pupils are sick at the testing day, (ii) pupils have lost or forgotten the signed consent form, (iii) parents forgot to timely sign the consent form but actually agreed or (iv) parents intentionally did not give their consent. It is impossible to disentangle the reasons for attrition because the data set contains information only about those pupils who participated in the test and handed in the consent form in time. Nevertheless, the experimental design excludes the possibility of strategic attrition as all parents got the same information about the experiment and the same consent forms in all treatments. Therefore, parents did not get to know which treatment was implemented in the classroom of their child.

There is also no support for non-random attrition in the data. Table 8 in Appendix A.2 reports on the average number of absent pupils and the average ability (midterm grades) of the class by treatment. Comparing treatment groups to the Control Group shows that fewer pupils are absent on average in the Loss Treatment (4.27 vs. 4.13; t-test yields a p-value of 0.909) but that a higher share of pupils is absent in the Negative Treatment (4.27 vs. 6.27; $p = 0.175$). The average ability level seems to be lower in the Loss Treatment (6.49 vs. 6.68; $p = 0.572$) and higher in the Negative Treatment (6.49 vs. 6.26; $p = 0.478$) as compared to the Control Group. However, the differences in midterm grades between the Control Group and the Loss and Negative Treatment are small in size. Midterm grades in the dataset are coded on a scale from 1 to 15, where 1 is the highest and 15 the lowest grade (e.g. a midterm grade of 6 represents a B+ and a midterm grade of 7 equals a C-). Nevertheless, this small difference in midterm grades are controlled for in the regression analysis. Moreover, none of the observed differences (average class ability and rate of absenteeism) are statistically significant. Results should therefore not be biased by non-random selection.

6 Experimental Results

The result section is organized in the following way. First, the effectiveness of framing on the number of correct answers is analyzed using Poisson regression models (ordinary least square regressions are presented in Table 15 in Appendix A.4). Thereafter, treatment effect estimates are presented for the number of omitted questions and total points in the test using negative binomial regression models and ordinary least square regression is used to estimate treatment effects for the share of correctly given answers—the number of all correct answers divided by the number of given answers (correct + incorrect). Finally, I differentiate pupils by ability and gender. The results are discussed thereafter. I first analyze treatment effects estimates for the number of correct answer instead of the number of total points because teachers are likely more interested in the former. The number of total points is uninformative for teachers as points can be gained either by answering correctly or by skipping questions. For example, 20 points can be achieved by either giving 5 correct and 5 incorrect answers or by skipping 10 questions. However, teachers want to learn about whether

[37] This is a necessary legal prerequisite in NRW to conduct scientific studies with under-aged children (see https://www.schulministerium.nrw.de/docs/Recht/Schulrecht/Schulgesetz/Schulgesetz.pdf and http://www.berufsorientierung-nrw.de/cms/upload/BASS_10-45_Nr.2.pdf).

pupils are able to answer the question correctly to better tailor their teaching to pupils' needs.

6.1 Framing and test performance

The multiple-choice test consisted of 10 questions and therefore the outcome variable "correct answers" can take on values between 0 and 10 and represents count data. The identification of the average treatment effects on the number of correct answers relies on the block randomization strategy. To estimate the causal impact of framing on pupils' outcomes, treatment effects—differences between treatment and Control Group means—are estimated by applying count data models. Control variables on pupils and class level are included as well as school fixed effects.[38] Standard errors are clustered on classroom level—which is the level of randomization. The outcome variable of interest is the number of correct answers in the test. Therefore, I estimate the following Poisson model:

$$E(NumCorrect_i) = m\left(\beta_0 + \beta_1 Treatment_i + \beta_2 Midterm_i + \gamma P_i + \mu C_i + \delta School_i\right) \tag{1}$$

m(.) is the mean function of the Poisson model. $NumCorrect_i$ is the number of correctly answered questions by pupil i, $Treatment_i$ indicates the respective treatment, $Midterm_i$ is the grade in math on the last semester report, P_i is a vector of pupil-level characteristics, C_i a vector of class-level covariates and $School_i$ controls for school fixed effects. A linear model (OLS) is estimated as a robustness check; the results do not change in either significance or size (see Table 15 in Appendix A.4).

Table 3 presents estimates of the average treatment effects for the Loss Treatment and Negative Treatment. The dependent variable is the number of correct answers in the test (in marginal units) with standard errors clustered on class level. The first column presents estimates with no controls but school fixed effects. The second column controls for classroom characteristics and the third column controls for pupil characteristics. The fourth column controls for both class and pupil control variables and is the specification of interest.[39]

Pupils in the Loss Treatment as well as pupils in the Negative Treatment increase, as expected, the number of correct answers compared to pupils in the Control Group. These findings are statistically significant at conventional levels. Pupils in the Loss Treatment give on average 0.436 ($p = 0.002$) more correct answers which is an increase by about 11.2% compared to the performance of pupils in the Control Group. Similarly, pupils in the Negative Treatment increase their performance by about 8% (marginal effect: 0.309; $p = 0.029$). The difference between the Loss and Negative Treatment is statistically not significant.

Result 1 *Loss framing and a negative endowment increase significantly the number of correctly solved questions.*

[38] Furthermore, there has not been a change of the teacher between the midterm grade and the test.
[39] The change in significance levels between column (1) and (3) is driven by controlling for pupils' past performance.

Table 3: Treatment Effects - Number of Correct Answers

	(1)	(2)	(3)	(4)
Treatments				
Loss	0.320	0.364*	0.456***	0.436***
	(0.213)	(0.194)	(0.157)	(0.140)
Negative	0.482**	0.490**	0.265	0.309**
	(0.233)	(0.208)	(0.193)	(0.143)
Controls				
ClassCov	No	Yes	No	Yes
PupilCov	No	No	Yes	Yes
SchoolFE	Yes	Yes	Yes	Yes
N	1377	1377	1333	1333

Note: This table reports the marginal effects of a Poisson regression including school fixed effects. Dependent variable: number of correct answers. Covariates: last midterm grade, gender, number of books at home, academic year (grade 3 or 4), teachers' working experience (in years), day differences between test and next holidays and a dummy whether the test was written before or after the summer break. Standard errors are reported in parentheses and clustered on classroom-level. In specification (3) and (4), 44 observations are dropped due to missing values. The number of clusters is 71. Robustness checks with OLS regressions show similar results (see Appendix 15). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Seeking Risk or Answering Smart? It is crucial for educators to understand through which channels—risk seeking or cognitive effort—loss framing increases performance before implementing it in a large scaled intervention. Treatment effects on the number of correct answers are significantly positive in the Loss and Negative Treatment. One reading of these results could be that pupils exert more cognitive effort or—as prospect theory would predict—pupils increase their willingness to choose risky lotteries. Thus, the results could be also be driven by an increase in the willingness to answer risky multiple-choice questions rather than exerting more cognitive effort.[40]

The multiple-choice testing format allows to identify which mechanisms (effort or risk-seeking) increases the number of correct answers in the Loss and Negative Treatment. For each test item pupils have to decide whether they want to answer or skip the question. Answering a question without certainly knowing the correct answer is a risky decision and gives—in expected value—a positive number of points only if the probability to answer the question correctly is above 50 percent. Therefore, differences in the number of omitted questions between the Control Group and the treatments groups is an indication of a change in risk-seeking behavior. Prospect theory predicts that pupils become more risk-seeking if gambles are framed as a loss [Kahneman and Tversky, 1979] and hence, pupils are likely to become more risk-seeking in the

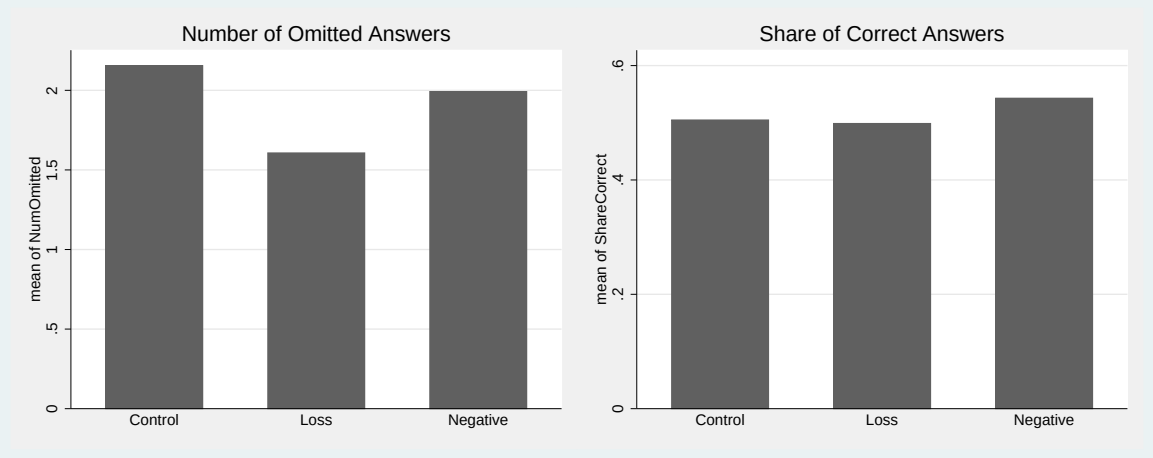
[40]Risky multiple-choice questions refers to a test question where the answer is unknown and thus answering this question is a decision under uncertainty.

Loss Treatment which means that they skip fewer answers. Whether the risk-seeking behavior changes in the Negative Treatment is less clear as earning points is framed as a gain. Nevertheless, pupils may become more risk-seeking in order to avoid a negative number of total points in the test or because they have more pessimistic beliefs about the grade they would get with a negative score. Another variable of interest is the share of correct answers because it can be interpreted as a measure of "accuracy". The term accuracy refers to the case in which pupils exert more cognitive effort—increasing the probability of answering correctly. In order to increase the number of correct answers, pupils could either take the risky-lottery and answer more questions or they could answer the same number of questions but increase the probability of success by exerting more cognitive effort. Thus, if pupils answer more questions but do not increase the share of correctly given answers, this would be an indication that they became more risk-seeking. On the other hand, if they answer the same amount of questions but increase the share of correct answers is an indication that they increase their accuracy level. It is also conceivable that framing increases the risk-seeking behavior and the accuracy level simultaneously.

The analysis of descriptive data—Figure 1—suggests that pupils in the Control Group skip more answers than pupils in the Loss Treatment (2.155 vs. 1.607, $p < 0.001$) while the share of correct answers does not differ between these two groups (0.5049 vs. 0.4988, $p = 0.709$). In contrast, the difference in skipping answers is small between the Control Group and the Negative Treatment (2.155 vs. 1.992, $p = 0.071$) but the share of correct answers is higher in the Negative Treatment (0.5049 vs. 0.5430, $p = 0.035$). These are indications that the number of correct answers is increased not through the same mechanism. While loss aversion can explain that pupils take more risky decisions in the Loss Treatment, loss aversion seems not to be induced in the Negative Treatment as the number of omitted answers does not differ from the Control Group. As discussed in hypothesize 2, pupils instead seem to adjust to the incurred loss of -20 points and seem to be motivated to exert effort due to the increased salience of the "0 point threshold".

Figure 1 shows the average number of omitted questions (left) and the average share of correct answers (right) of pupils by treatment.

Figure 1: Average number of omitted answers and share of correct answers



Note: This figure reports the average number of omitted answers (left) and the average share of correct answers (right) for the Control Group, Loss Treatment and Negative Treatment. Pupils in the Loss Treatment significantly omit more answers than in the Control Group but do not increase the share of correct answers. Pupils in the Negative Treatment do not significantly omit fewer answers but increase the share of correct answers compared to pupils in the Control Group.

Turning to the regression specification, confirms the pattern observed in Figure 1. As the data on the number of omitted questions and number of total points show a significant degree of overdispersion (omitted questions: ln α = -0.243 , p-value < 0.001 ; total points: ln α = -2.710, p-value < 0.001), the negative binomial provides a basis for a more efficient estimation for these two outcome variables. For purposes of estimating treatment effects on the share of correct answers, a linear model is applied (OLS).

Table 4 reports on the average treatment effects of the Loss and Negative Treatment on: (1) the number of correct answers (2) the number of omitted answers (3) the share of correct answers and (4) the final points in the test controlling for pupil and class covariates and school fixed effects. In the Loss Treatment, the positive change in correct answers is driven by the fact that pupils skip fewer questions which seems to be driven by an increase in risk taking. Pupils skip significantly fewer questions—respectively answer more questions—than pupils in the Control Group (-0.817, p < 0.001) but do not differ with respect to the share of correct answers. The size of the coefficient for the share of correct answers is close to zero and statistically not significant (0.001, p = 0.963). Interestingly, the share of correct answers in the Control Group is 50.49 percent and 49.88 percent in the Loss Treatment. Thus, pupils in the Control Group and Loss Treatment are indifferent between answering or skipping a question but loss framing leads to an increase in risk taking.[41]

Pupils in the Negative Treatment also increase the number of correct answers but, contrary to pupils in the Loss Treatment, do not skip significantly fewer questions than pupils in the Control Group (-0.333, p = 0.106). Nevertheless, the share of correct answers is significantly higher (0.034, p = 0.072).

Although pupils in the Loss and Negative Treatment answer significantly more questions correctly, they do not receive more points in the test. Coefficients for the total points in the test are positive for the Loss Treatment (0.178, p = 0.765) and Negative Treatment (0.846, p = 0.196) but statistically not significant. This is not surprising in the Loss Treatment as the probability to answer a question correctly is roughly 50 percent and hence the expected value (points) of answering a question is the same as omitting a question. As the probability of a correct answer is similar in the Control Group and in the Loss Treatment, differences in the number of answered and skipped questions should not change the number of total points. Moreover, the insignificant effects on the number of total points in both treatment groups and the insignificant effect on the share of correct answer in the Loss Treatment could be due to a lack of power. Nevertheless, even if the effect on the share of correct answers in the Loss Treatment would be significant in a larger sample, this would not change the interpretation of the results as the coefficient is close to zero.

To summarize, pupils in the Loss Treatment answer more questions than pupils in the Control Group but do not increase their accuracy level. In contrast, there is no significant difference in the number of skipped questions between the Negative Treatment and the Control Group. However, pupils in the Negative Treatment increase their level of accuracy.

Result 2 *Pupils in the Loss Treatment answer more questions (take more risky decisions) whereas pupils in the Negative Treatment increase the share of correct answers (answer more accurately).*

[41] The expected value of answering a question with a success probability of 50 percent is 2 which equals the value of omitting a question.

Table 4: Treatment Effects - All outcome variables

	(1) *Correct Answers*	(2) *Omitted Answers*	(3) *Share Correct Answers*	(4) *Points in Test*
Treatments				
Loss	0.436***	−0.817***	0.001	0.178
	(0.140)	(0.184)	(0.017)	(0.595)
Negative	0.309**	−0.333	0.034*	0.846
	(0.143)	(0.206)	(0.019)	(0.654)
Controls				
ClassCov	Yes	Yes	Yes	Yes
PupilCov	Yes	Yes	Yes	Yes
SchoolFE	Yes	Yes	Yes	Yes
N	1333	1333	1330	1333

Note: This table reports marginal treatment effects on the number of correct answers (1), on the number of omitted items (2), on the share of correct answers (3) and on the number of points in the test (4) including school fixed effects. Covariates: last midterm grade, gender, number of books at home, academic year (grade three or four), teachers' working experience (in years), day differences between test and next holidays and a dummy whether the test was written before or after the summer break. Standard errors are reported in parentheses and clustered on classroom-level. The number of clusters is 71. Robustness checks with OLS regressions (see Appendix 15) and estimation of treatment effects without any controls except including school fixed effects (see Appendix 12) show similar results. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6.2 Who can be framed?

In the following, I examine whether pupils with different mathematical skill levels respond differently to the Loss and Negative Treatment and whether heterogeneous gender effects of framing exist.

Ability Based on externally given midterm grades, the effectiveness of framing can be analyzed for different ability levels (low-, middle- and high-ability) which constitutes a novel contribution of this paper. Grades in Germany run from 1 (excellent) to 6 (insufficient), high-ability pupils refer therefore to those with a midterm grade of 1 or 2; middle-ability pupils have a midterm grade of 3 and low-ability pupils are those with a midterm grade of 4 or 5.[42] By asking pupils in the questionnaire about their affinity for mathematics on a 1 (not at all) to 5 (very much) scale, it can be approximated whether low- and high-ability pupils differ in their intrinsic motivation. High performers have a significantly higher affinity towards mathematics (3.94) than middle (3.52) and low performers (3.16).[43] This is an indication that loss-framing might lead to higher treatment effects for high-ability pupils because they are likely to have higher test score expectations than low-ability pupils.

Table 5 reports on the average treatment effects for low-, middle- and high-ability pupils. As hypothesized, high-ability pupils are effected positively by both treatments in almost all outcome variables. In the Loss

[42] In my sample, there was no child with a midterm grade of 6.

[43] The difference between high-ability pupils and middle-ability pupils as well as the difference between middle-ability pupils and low-ability pupils is significant on the 1%-level.

Treatment, high performers give significantly more correct answers (0.783, $p < 0.001$), skip fewer questions (-0.888, $p < 0.001$) and have higher test scores (1.418, $p = 0.057$) than high performers in the Control Group. Similar results in size and significance can be found for high-ability pupils in the Negative Treatment [number correct (0.722, $p < 0.001$), number omitted (-0.537, $p = 0.012$), points test (1.974, $p = 0.004$)]. Moreover, the accuracy level also increases significantly (0.057, $p = 0.003$) for pupils in the Negative Treatment. Differences between high performers in the Loss and Negative Treatment are not significant except for the number of skipped questions, indicating that the "risk-seeking" effect is larger in the Loss Treatment.

Middle-ability pupils in both treatments do not differ from middle-performers in the Control Group, except that they are significantly more risk-seeking in the Loss Treatment (-0.963, $p = 0.002$) which shows that predictions by prospect theory seem to be robust. Differences between the Loss and Negative Treatment are significant for the number of correct answers and the number of omitted answers but overall it seems that middle-performers are not affected by any treatment compared to the Control Group.

Turning to low-ability pupils reveals contrary treatment effects for pupils in the Loss and Negative Treatment. While all coefficients are positive in the Negative Treatment but statistically not significant, all coefficients are negative and significant—except for the number of correct answers—in the Loss Treatment. More importantly, all differences between the Loss and Negative Treatment are significant, indicating that the Negative Treatment is superior to the Loss Treatment for low performers. This could be explained by the fact that low performers in the Loss Treatment substitute questions which they normal would have skipped by wrong answers. They answer significantly more questions but also increase significantly the number of wrong answer because they might not be able to increase their cognitive level in the short-run.

The results on ability level do not change if a different grouping of midterm grades is applied. Table 16 in Appendix A.4 presents results for single grouped midterm grades and shows that the positive effects for high-ability pupils is driven by pupils with midterm grade 2—coefficients for pupils with midterm grade 1 could be insignificant due to a ceiling effect.[44] Although these pupils are not the highest performers of a class, they still perform good and above average.[45]

To summarize, the Loss and Negative Treatment work similarly well to increase the test performance of high-ability pupils. Nevertheless, the Loss and Negative Treatment have opposite effects on low-ability pupils. Furthermore, hypothesize 3 cannot be confirmed as the size of treatment effects is not smaller for low-ability pupils. Policy makers should therefore be cautious in implementing loss framing and might prefer the Negative Treatment over the Loss Treatment as performance of low-ability pupils decreases in the latter but not in the Negative Treatment.

Result 3 *The Negative Treatment is superior to the Loss Treatment as performance of low-ability pupils does not decrease. High-ability pupils increase performance in the Negatives as well as in the Loss Treatment.*

[44] Pupils with a midterm grade of 4 and 5 are grouped because there were in total only 25 pupils with a midterm grade of 5. The groups of *Low-* and *Middle-Ability Pupils* do not change but the group of *High-Ability Pupils* is splitted into midterm grades 1 and midterm grades 2.

[45] Grade 1 is assigned if the performance meets the requirements in an outstanding degree; grade 2 if the performance completely meets the requirements; grade 3 if the performance generally meets the requirements; grade 4 if the performance has shortcomings but as a whole still meets the requirements and grade 5 if the performance does not meet the requirements but indicates that the necessary basic knowledge exists and that shortcomings can be resolved in the near future (see https://www.schulministerium.nrw.de/docs/Recht/Schulrecht/Schulgesetz/Schulgesetz.pdf).

Table 5: Treatment Effects by Ability

	(1) Correct Answers	(2) Omitted Answers	(3) Share Correct Answers	(4) Points in Test
Low-Ability Pupils				
Loss	−0.314	−1.175***	−0.109***	−3.624***
	(0.201)	(0.414)	(0.025)	(0.922)
Negative	0.195	0.584	0.076*	2.150
	(0.350)	(0.750)	(0.044)	(1.473)
N	205	205	205	205
Middle-Ability Pupils				
Loss	0.271	−0.963***	−0.009	−0.717
	(0.197)	(0.318)	(0.025)	(0.850)
Negative	−0.191	−0.240	−0.015	−1.517
	(0.223)	(0.409)	(0.030)	(0.972)
N	376	376	375	376
High-Ability Pupils				
Loss	0.783***	−0.888***	0.026	1.418*
	(0.182)	(0.200)	(0.021)	(0.746)
Negative	0.722***	−0.537**	0.057***	1.974***
	(0.177)	(0.213)	(0.019)	(0.680)
N	755	755	753	755

Note: This table reports average treatment effects of separate regressions for high-, middle-, and low-ability pupils including pupil and class covariates as well as school fixed effects. Covariates: gender, number of books at home, academic year (grade 3 or 4), teachers' working experience (in years), day differences between test and next holidays and a dummy whether the test was written before or after the summer break. Standard errors are reported in parentheses and clustered on classroom-level. Robustness checks with OLS regressions show similar results. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Gender The literature has identified gender differences in risk preferences [see Croson and Gneezy, 2009, Eckel and Grossman, 2008, for a review] and Apostolova-Mihaylova et al. [2015] find that loss framing increases on average the final course grade of males but decreases the grade of females compared to the control group. Hence, it is of interest whether heterogeneous gender effects exist also for the Loss and Negative Treatment.

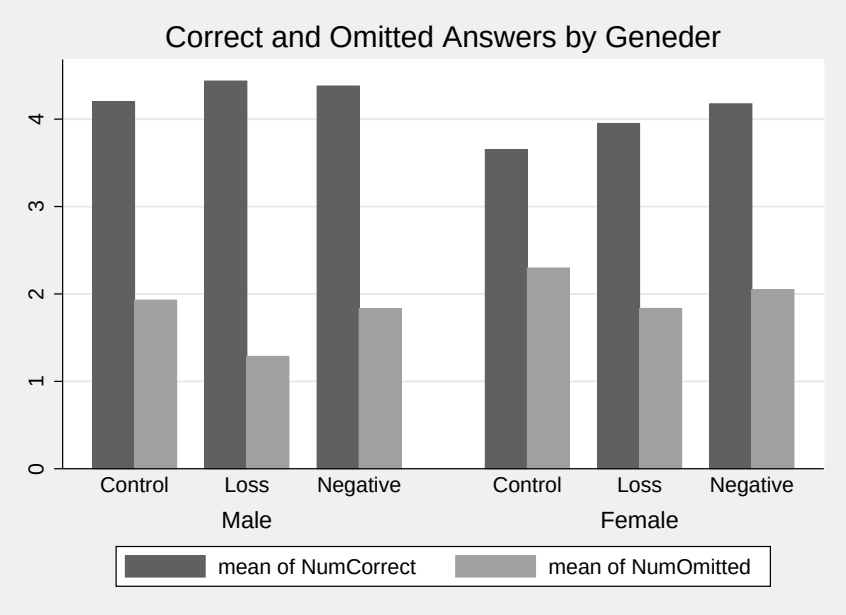
Table 13 in Appendix A.3 presents average treatment effects on the four outcome variables separately for boys and girls. In the Loss Treatment, boys (0.413, $p = 0.013$) as well as girls (0.460, $p = 0.014$) significantly increase the number of correct answers and also skip significantly fewer questions than boys and girls in the Control Group (boys: -0.867, $p < 0.001$; girls: -0.752, $p = 0.001$). In the Negative Treatment, the coefficient for the number of correct answers is positive and significant for girls (0.361, $p = 0.083$) but not for boys (0.262, $p = 0.117$). Furthermore, boys and girls in the Negative Treatment tend to skip more questions. This effect is significant for boys but not for girls (boys: -0.373, $p = 0.088$; girls: -0.284, $p = 0.276$). Overall, gender differences in all outcome variables are neither significant in the Loss nor in the Negative Treatment.

Interestingly, descriptive statistics suggest that females in the Negative Treatment tend to give the same amount of correct answers and skip an equal amount of questions than boys in the Control Group (see Figure 2). This is an indication that the Negative Treatment could help to close the gender gap in performance in standardized multiple-choice test which is found in recent studies [see Baldiga, 2014, Pekkarinen, 2015, and the literature mentioned therein].

The findings on total points in the test (column 4) in the Loss Treatment can be compared to the results of Apostolova-Mihaylova et al. [2015] as the authors focus on the effect of loss framing on students' final course grade. Contrary to Apostolova-Mihaylova et al. [2015], boys in the Loss Treatment score on average 0.183 points lower than boys in the Control Group and females score 0.551 points higher than females in the Control Group. However, neither the coefficients nor the difference between males and females in the Loss Treatment are significant at conventional levels. However, these opposite findings to Apostolova-Mihaylova et al. [2015] could be driven by pupils' age or the time horizon of the intervention.

Result 4 *There are no heterogeneous gender effects on performance when the grading scheme is manipulated.*

Figure 2: Average number of omitted answers and share of correct answers



Note: This figure reports the average number of correct and omitted answers separately for boys and girls.

7 Discussion

This section is devoted to discuss the experimental findings. First, whether pupils in the Loss Treatment answer marginally more difficult questions. Second, if pupils change their answering behavior when they reach the threshold of "passing". Third, I identify which questions are considered as difficult to analyze if pupils in the Loss Treatment answer strategically by choosing more easy questions.

Do pupils in the Loss Treatment answer marginally more difficult questions? Pupils in the Loss Treatment were found to not increase the share of correct answers compared to pupils in the Control group. However, they answer significantly more questions and hence it is conceivable that the marginally answered question is more difficult from a subjective point of view. If pupils answer marginally more difficult questions in the Loss Treatment, this should be taken into account in the analysis by e.g. assigning different weights to questions. This, in turn, could then result in a positive and significant treatment effect. To do so, I would need to identify the marginal answered questions for each individual. However, this is not possible due to the pen and paper testing format.

Do pupils in the Negative Treatment change their behavior if they reach the threshold of "passing"? On average, pupils in the Negative Treatment increased the number of correct answers compared to pupils in the Control Group. A question of interest is whether and how pupils change their behavior when they accumulated 20 points and hence reached the threshold of zero points? Does performance decline when they reach the positive domain of points? In order to answer this question, it requires to know the exact order of answered questions for each individual. Unfortunately, this was not possible due to the pen and paper testing format. Nevertheless, a change in pupils' behavior would be implicit rather than explicit as pupils did not get feedback about their performance during the test. Therefore they could not know how

well they did with other questions but they could have formed a belief on whether they are below or above the threshold.

Figure 12 in Appendix B shows Kernel density estimates for the number of points in the test for the Control Group and Negative Treatment. Points for the Negative Treatment have been adjusted to the negative endowment for a better comparison to the Control Group. It seems that fewer pupils in the Negative Treatment score below the threshold of zero points and that more pupils end up in the top quarter of the points distribution. However, if pupils would have implicitly changed their behavior after passing the threshold, say, a decrease in cognitive effort, a larger share of pupils should be scoring between 20 and 30 points. Thus, either pupils do not know explicitly or implicitly when they reached the threshold, or there is a constant motivational effect of the Negative Treatment. Indications for the latter can be found in Figure 3 in Appendix B. In Figure 3 it is assumed that pupils answered the questions according to the predefined order of questions, question 1 to question 10, and represents Kernel density estimates for the accumulated points in question 5—the first question in which pupils could reach 20 points. It seems that pupils in the Negative Treatment are more motivated to accumulate 20 Points after 5 questions than pupils in the Loss Treatment and Control Group. Figure 4 in Appendix B shows Kernel density estimates of the accumulated number of points at question 10 for pupils who reached 20 points in question 5. Again, it does not seem that pupils change their behavior—decrease performance—after reaching the threshold in the Negative Treatment.

Do pupils in the Negative Treatment answer strategically? Pupils in the Negative Treatment answer the same amount of questions as pupils in the Control Group. However, they answer these questions more accurately. Hence, the question is whether they answer strategically, say, focus on the 6 out of 10 easiest questions? Do they skip difficult questions to a larger extend than pupils in the Control Group?

Table 14 in Appendix A.3 presents descriptive statistics for each test item. *Correct Answer* is the share of pupils—on all pupils giving an answer—who answer the question correctly and *Question Answered* is the share of pupils who did not skip the question. Overall, there is no indication that some questions are considered as difficult for pupils in one treatment group but not for pupils in other treatment groups. However, questions 3,6,8,9 and 10 seem to be difficult as—across treatment groups—the share of pupils answering these questions correctly is below 50 percent. Moreover, pupils in the Negative Treatment do not seem to answer some questions more frequently than pupils in the Control Group (*Question Answered*) which is further indication that they do not answer strategically.

8 Conclusion

This paper presents the results of a field experiment in elementary schools in Germany on the effectiveness of loss and gain framing in a mathematical multiple-choice test. Pupils are endowed with the maximum number of points and earning points is framed as a loss in one treatment whereas in another treatment pupils are endowed with a negative number of points but earning points is framed as a gain. These two treatments are then compared to a "traditional" grading scheme in which pupils started with zero points and earning points is framed as a gain.

The overall finding is that pupils in both treatment groups answers significantly more questions correctly compared to pupils that are graded "traditionally". These improvements are driven by two different mech-

anisms. In line with prospect theory [Kahneman and Tversky, 1979], pupils in the Loss Treatment show an increased risk-seeking behavior—increase in answered questions but no decrease in the share of correct answers—whereas pupils in the Negative Treatment answer questions more accurately—same amount of answered questions but an increase in the share of correct answers.[46] Moreover, pupils can be differentiated by their ability—as measured by their past midterm grades. Both treatments work equally good to increase performance of high-ability pupils. In contrast, performance is significantly decreased for low-performers in the Loss Treatment but not for low-performers in the Negative Treatment.

Although the experimental design has some limitations—treatment effects can only be interpreted for the populations studied; short run and low-stakes intervention—the results give valuable insights to educators and policy makers who aim to apply insights from behavioral economics into the field. While loss framing might seem appealing to implement in the educational system as it represents a promising and cost-effective intervention, my results show that high-performers would benefit but low-performers—which are usually the target audience of policy interventions—are made worse of. Moreover, the experimental design allows to isolate the effort effect from the learning effect showing that differences in performance are driven by (cognitive) effort. This insight is interesting as it shows that success is not based solely on innate ability and that it might be effective to teach pupils that exerting effort while taking a test is as important as motivating pupils to put effort into learning.

While there are a number of laboratory and some field studies exploiting the effectiveness of loss framing [Hong et al., 2015, Armantier and Boly, 2015, Hossain and List, 2012], there are only a few field experiments applying loss framing in an educational setting and only a few studies in elementary and high schools [Levitt et al., Forthcoming, Apostolova-Mihaylova et al., 2015, Roland G. Fryer et al., 2012]. This study is one of the first studies showing how framing changes behavior for pupils of different ability levels and sheds light on the underlying mechanism. However, it remains for future research to analyze the impact of framing effects in high-stakes testing environments and in long-run interventions to get a more comprehensive picture of behavioral interventions in education.

[46] An increase in risk-seeking behavior can also be found if pupils are differentiated by gender or ability level.

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A Tables

A.1 Randomization Table

Table 6: Sample Size by Gender, Grade and Treatment

	Control	*Loss*	*Negative*	*Overall*
Full Sample				
N individuals	515	468	394	1377
Correct Answers	3.915	4.165	4.246	4.094
	(2.173)	(2.239)	(2.344)	(2.248)
Points Test	19.695	19.876	20.995	20.229
	(8.105)	(8.255)	(8.458)	(8.266)
Boys				
N individuals	254	227	203	684
Correct Answers	4.201	4.436	4.379	4.332
	(2.220)	(2.198)	(2.384)	(2.262)
Points Test	20.661	20.326	21.182	20.705
	(8.201)	(8.301)	(8.689)	(8.376)
Girls				
N individuals	246	224	182	652
Correct Answers	3.650	3.951	4.176	3.900
	(2.092)	(2.277)	(2.294)	(2.221)
Points Test	19.187	19.473	20.857	19.752
	(8.062)	(8.398)	(8.352)	(8.277)
Numb. Classes	26	23	21	71

Note: The table displays the descriptive statistics (means) of the number of pupils, number of correct answers and test scores in each of the treatment groups and the control group. 20 points have been added to the Negative Treatment to adjust for the negative endowment. Standard deviations are displayed in parentheses. In my final analysis, 1.333 observations are included. 41 pupils did not report their gender.

Table 7: Randomization Check

(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Treatments	**DI**	**p-values**			
			Unadj.	Multiplicity Adj.		
			Remark 3.1	Thm. 3.1	Bonf.	Holm
Age	Control vs. Loss	0.0593	0.2227	0.9147	1.0000	1.0000
	Control vs. Negative	0.0819	0.1217	0.8023	1.0000	1.0000
Month of Birth	Control vs. Loss	0.0831	0.7140	0.9793	1.0000	1.0000
	Control vs. Negative	0.1552	0.5087	0.9813	1.0000	1.0000
Num. Older Sib.	Control vs. Loss	0.0055	0.9307	0.9307	1.0000	0.9307
	Control vs. Negative	0.1043	0.1473	0.8473	1.0000	1.0000
Female Pupil	Control vs. Loss	0.0047	0.8800	0.9840	1.0000	1.0000
	Control vs. Negative	0.0193	0.5883	0.9697	1.0000	1.0000
Language German	Control vs. Loss	0.0699	0.0547**	0.5453	0.8747	0.8200
	Control vs. Negative	0.0351	0.3203	0.9500	1.0000	1.0000
Remedial Teaching	Control vs. Loss	0.0229	0.1593	0.8467	1.0000	1.0000
	Control vs. Negative	0.0227	0.0990*	0.7403	1.0000	1.0000
Teacher Exp.	Control vs. Loss	0.4606	0.5047	0.9910	1.0000	1.000
	Control vs. Negative	4.0972	0.0003***	0.0003***	0.0053***	0.0053***
Unemployment	Control vs. Loss	0.0017	0.5797	0.9877	1.0000	1.0000
	Control vs. Negative	0.0033	0.2810	0.9387	1.0000	1.0000

Note: This table presents randomization checks for control variables used in the analysis adjusting for multiple hypothesis testing. *DI* is the difference in means between the Control Group and each of the treatment groups. Columns 4-7 display p-values. Column (4) presents multiplicity-unadjusted p-value; columns (5)-(7) display multiplicity-adjusted p-values. See also List et al. [2016] on multiple hypothesis testing. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

A.2 Attrition

Table 8: Attrition by Treatment

	Control Group	*Loss Treatment*	*Negative Treatment*
# absent pupils	4.27	4.13	6.27
% absent pupils	17.71	17.18	25.79
Midterm Grade	6.49	6.68	6.26
N (# classes)	26	23	22

Note: This table reports on the number of pupils absent on the test day and pupils' last midterm grade. Cell entries represent averages on class level. Midterm Grade is measured on a 1 to 15 scale where 1 is the best grade and 15 the worst. In US equivalents a midterm grade of 6 is a B- and 7 a C+. Differences between Control and Treatment Groups are statistically not significant using a simple t-test.

A.3 Estimation Tables

Table 9: Treatment Effects - Number of Omitted Items

	(1)	(2)	(3)	(4)
Treatments				
Loss	-0.768^{***}	-0.797^{***}	-0.832^{***}	-0.817^{***}
	(0.211)	(0.201)	(0.189)	(0.184)
Negative	-0.271	-0.296	-0.286	-0.333
	(0.219)	(0.215)	(0.209)	(0.206)
Controls				
ClassCov	No	Yes	No	Yes
PupilCov	No	No	Yes	Yes
SchoolFE	Yes	Yes	Yes	Yes
N	1377	1377	1333	1333

Note: This table reports the marginal effects of a negative binomial regression including school fixed effects. Dependent variable: number of omitted questions. Covariates: last midterm grade, gender, number of books at home, academic year (grade 3 or 4), teachers' working experience (in years), day differences between test and next holidays and a dummy whether the test was written before or after the summer break. In specification (3) and (4), 44 observations are dropped due to missing values. Standard errors are reported in parentheses and clustered on classroom-level. The number of clusters is 71. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Treatment Effects - Share of Correct Answers

	(1)	(2)	(3)	(4)
Treatments				
Loss	−0.008	−0.010	0.007	0.001
	(0.020)	(0.019)	(0.018)	(0.017)
Negative	0.054**	0.051**	0.035	0.034*
	(0.024)	(0.022)	(0.023)	(0.019)
Controls				
ClassCov	No	Yes	No	Yes
PupilCov	No	No	Yes	Yes
SchoolFE	Yes	Yes	Yes	Yes
N	1374	1374	1330	1330

Note: This table reports the results of a generalized linear model school fixed effects. Dependent variable: share of correct answers ($\frac{\#Correct}{10-\#Omitted}$). Covariates: last midterm grade, gender, number of books at home, academic year (grade 3 or 4), teachers' working experience (in years), day differences between test and next holidays and a dummy whether the test was written before or after the summer break. In specification (3) and (4), 44 observations are dropped due to missing values. Standard errors are reported in parentheses and clustered on classroom-level. The number of clusters is 71. * p < 0.10, ** p < 0.05, *** p < 0.01

Table 11: Treatment Effects - Total Points in Test

	(1)	(2)	(3)	(4)
Treatments				
Loss	−0.053	−0.093	0.358	0.178
	(0.704)	(0.680)	(0.631)	(0.595)
Negative	1.584*	1.513**	0.826	0.846
	(0.836)	(0.747)	(0.807)	(0.654)
Controls				
ClassCov	No	Yes	No	Yes
PupilCov	No	No	Yes	Yes
SchoolFE	Yes	Yes	Yes	Yes
N	1377	1377	1333	1333

Note: This table reports the marginal effects of a negative binomial regression including school fixed effects. Dependent variable: total number of points in test. Covariates: last midterm grade, gender, number of books at home, academic year (grade 3 or 4), teachers' working experience (in years), day differences between test and next holidays and a dummy whether the test was written before or after the summer break. In specification (3) and (4), 44 observations are dropped due to missing values. Standard errors are reported in parentheses and clustered on classroom-level. The number of clusters is 71. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 12: Treatment Effects without control variables- Correct, Omitted, Share and Points

	(1)	(2)	(3)	(4)
	Correct Answers	*Omitted Answers*	*Share Correct Answers*	*Points in Test*
Treatments				
Loss	0.320	−0.768***	−0.008	−0.053
	(0.213)	(0.211)	(0.020)	(0.704)
Negative	0.482**	−0.271	0.054**	1.584*
	(0.233)	(0.219)	(0.024)	(0.836)
Controls				
ClassCov	No	No	No	No
PupilCov	No	No	No	No
SchoolFE	Yes	Yes	Yes	Yes
N	1377	1377	1374	1377

Note: This table reports marginal treatment effects on the number of correct answers (1), on the number of omitted items (2), on the share of correct answers (3) and on the number of points in the test (4) including only school fixed effects. Standard errors are reported in parentheses and clustered on classroom-level. The number of clusters is 71. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 13: Treatment Effects by Gender

Panel A: Regression	(1) *Correct Answers*	(2) *Omitted Answers*	(3) *Share Correct Answers*	(4) *Points in Test*
Treatments				
Loss	0.413**	−0.867***	−0.002	−0.183
	(0.166)	(0.215)	(0.021)	(0.768)
Negative	0.262	−0.373*	0.034	0.552
	(0.167)	(0.219)	(0.021)	(0.779)
Female	−0.248	0.299*	−0.001	−0.379
	(0.165)	(0.174)	(0.021)	(0.677)
Loss × Female	0.047	0.115	0.006	0.734
	(0.211)	(0.259)	(0.027)	(0.942)
Negative × Female	0.099	0.089	0.002	0.600
	(0.245)	(0.251)	(0.030)	(0.970)
Controls				
ClassCov	Yes	Yes	Yes	Yes
PupilCov	Yes	Yes	Yes	Yes
SchoolFE	Yes	Yes	Yes	Yes
Panel B: Contrast	*Treatment vs. No Treatment for Females*			
Loss	0.460**	−0.752***	0.004	0.551
	(0.186)	(0.231)	(0.022)	(0.751)
Negative	0.361*	−0.284	0.035	1.152
	(0.208)	(0.260)	(0.027)	(0.846)
N	1333	1333	1330	1333

Note: Panel A reports average treatment effects for boys including school fixed effects; panel B presents average treatment effects for girls. Covariates: last midterm grade, gender, number of books at home, academic year (grade three or four), teachers' working experience (in years), day differences between test and next holidays and a dummy whether the test was written before or after the summer break. Standard errors are reported in parentheses and clustered on classroom-level. The number of clusters is 71. Robustness checks with OLS regressions show similar results. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 14: Share of correct and answered questions by test item

	Control	*Loss*	*Negative*
Question 1			
Correct Answers	78.63	77.17	80.20
Question Answered	73.59	81.41	76.90
Question 2			
Correct Answers	59.38	55.43	62.92
Question Answered	87.96	92.52	90.36
Question 3			
Correct Answers	36.57	37.91	42.53
Question Answered	75.92	83.97	78.17
Question 4			
Correct Answers	54.59	50.62	55.38
Question Answered	80.39	86.11	82.49
Question 5			
Correct Answers	64.90	67.26	69.27
Question Answered	95.15	95.94	94.16
Question 6			
Correct Answers	37.75	34.94	38.11
Question Answered	87.96	88.68	83.25
Question 7			
Correct Answers	58.10	61.63	63.19
Question Answered	83.88	86.32	82.74
Question 8			
Correct Answers	41.61	46.88	48.50
Question Answered	60.19	68.38	67.51
Question 9			
Correct Answers	39.42	40.40	39.10
Question Answered	79.81	85.68	79.19
Question 10			
Correct Answers	15.91	16.16	21.96
Question Answered	59.81	70.09	64.72

Note: This table reports on the number of correct questions and answered questions separately for each test item. *Correct Answer* is the share of pupils on all pupils giving an answer who answer the question correctly. *Question Answered* is the share of pupils who did not omit the question. Cell entries present percentages. Standard errors are reported in parentheses and clustered on classroom-level. The number of clusters is 71. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

A.4 Robustness Checks

Table 15: Robustness Check - Correct Answers, Omitted Answers, Points in Test

	Correct Answers		*Omitted Answers*		*Points in Test*	
	OLS	Poisson	OLS	NBREG	OLS	NBREG
Treatments						
Loss	0.452***	0.436***	−0.761***	−0.817***	0.309	0.178
	(0.139)	(0.140)	(0.175)	(0.184)	(0.580)	(0.595)
Negative	0.352**	0.309**	−0.258	−0.333	0.932	0.846
	(0.137)	(0.143)	(0.202)	(0.206)	(0.609)	(0.654)
Controls						
ClassCov	Yes	Yes	Yes	Yes	Yes	Yes
PupilCov	Yes	Yes	Yes	Yes	Yes	Yes
SchoolFE	Yes	Yes	Yes	Yes	Yes	Yes
N	1333	1333	1333	1333	1333	1333

Note: This table compares the results of a linear (OLS) and a negative binomial regression (marginal effects) for the number of correct answers, number of omitted answers and the total points in the test. Covariates: gender, number of books at home, academic year (grade 3 or 4), teachers' working experience (in years), day differences between test and next holidays and a dummy whether the test was written before or after the summer break. Standard errors are reported in parentheses and clustered on classroom-level. The number of clusters is 71. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

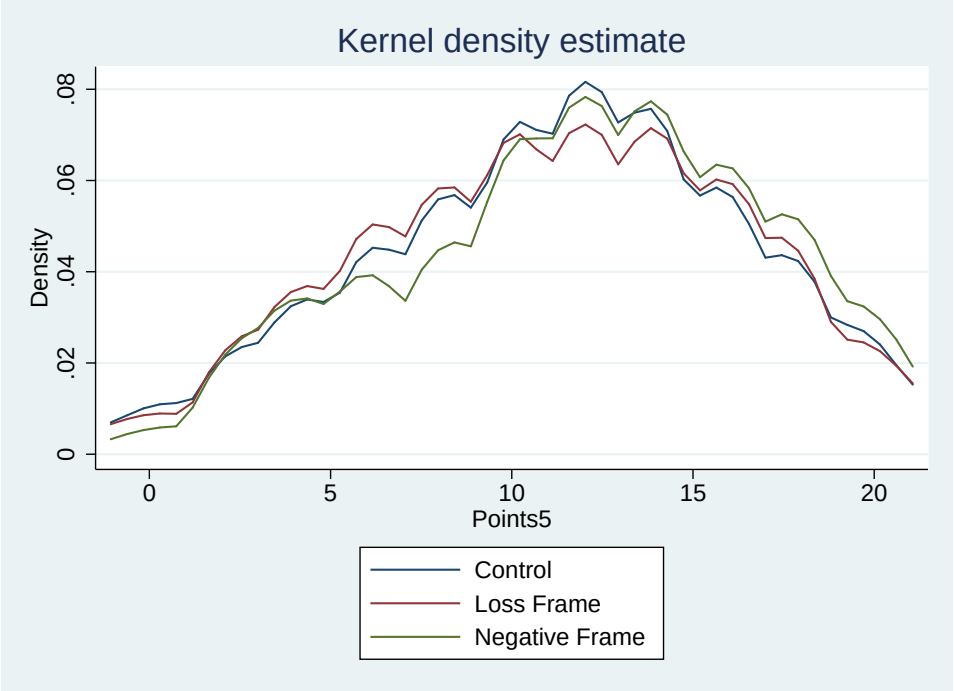
Table 16: Treatment Effects by Midterm Grade

	(1) Correct Answers	(2) Omitted Answers	(3) Share Correct Answers	(4) Points in Test
Midterm Grade = 4 and 5				
Loss	−0.314	−1.175***	−0.109***	−3.624***
	(0.201)	(0.414)	(0.025)	(0.922)
Negative	0.195	0.584	0.076*	2.150
	(0.350)	(0.750)	(0.044)	(1.473)
N	205	205	205	205
Midterm Grade = 3				
Loss	0.271	−0.963***	−0.009	−0.717
	(0.197)	(0.318)	(0.025)	(0.850)
Negative	−0.191	−0.240	−0.015	−1.517
	(0.223)	(0.409)	(0.030)	(0.972)
N	376	376	375	376
Midterm Grade = 2				
Loss	0.822***	−0.952***	0.039*	1.641**
	(0.203)	(0.244)	(0.023)	(0.798)
Negative	0.654***	−0.519**	0.060***	1.794***
	(0.176)	(0.254)	(0.021)	(0.689)
N	564	564	562	564
Midterm Grade = 1				
Loss	0.482	−0.448	−0.002	0.832
	(0.342)	(0.282)	(0.036)	(1.218)
Negative	0.567	−0.468**	0.022	1.413
	(0.403)	(0.247)	(0.033)	(1.240)
N	191	191	191	191

Note: This table reports average treatment effects of separate regressions for midterm grades including pupil and class covariates as well as school fixed effects. . In comparison to Table 5 in Section 6.2, the group of pupils with a midterm grade of 3 (4 & 5) is equivalent to the group of *Middle-Ability Pupils* (*Low-Ability Pupils*). In contrast, the group of *High-Ability Pupils* is splitted into midterm grades 1 and 2. Covariates: gender, number of books at home, academic year (grade 3 or 4), teachers' working experience (in years), day differences between test and next holidays and a dummy whether the test was written before or after the summer break. Standard errors are reported in parentheses and clustered on classroom-level. Robustness checks with OLS regressions show similar results. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

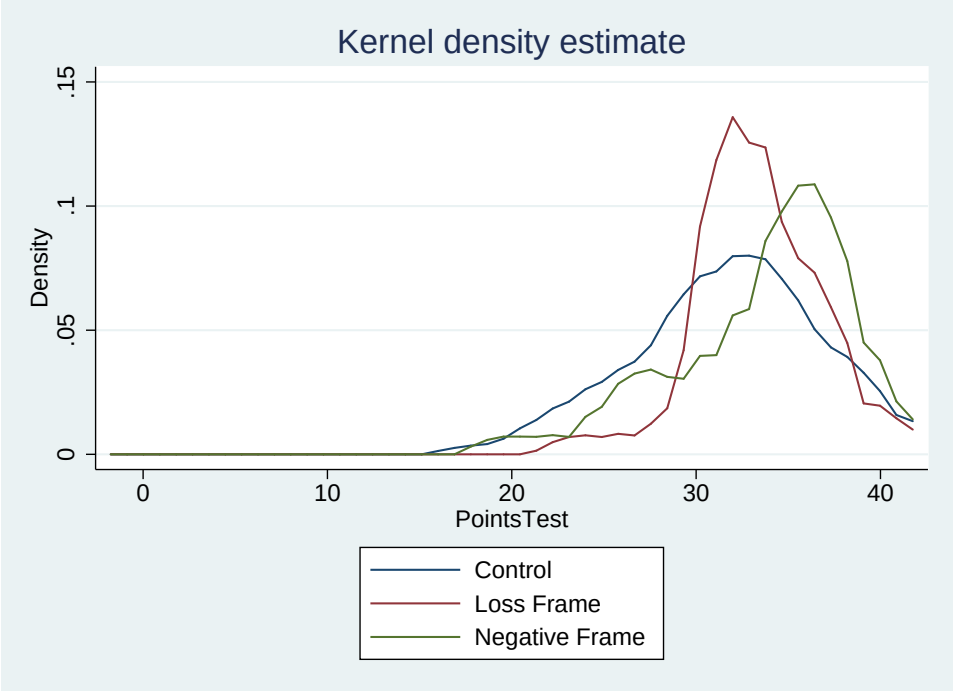
B Kernel density plots

Figure 3: Points after five questions (Q1-Q5)



Note: This Figure presents Kernel density estimates for the number of points reached in the first five questions for the Control Group, the Loss Treatment and the Negative Treatment.

Figure 4: Final points of pupils who accumulated 20 points at Q5



Note: This Figure presents Kernel density estimates for the number of final points reached in the test for pupils who accumulated 20 points in the first five questions.

C Instructions, Questionnaire and Consent Form

C.1 Instruction for Teacher

—not intended for publication—

The following instructions were given to teachers in the Loss Treatment. Instructions for the Control Group and Negative Treatment contained the same information but explained the respective allocation of points accordingly.

Figure 5: Teacher Instructions—First Letter [translated from German]

Instructions for [class] of [name of school]

Thank you for supporting my research project. Today I am sending you the instructions to perform the test. For the research project, it is necessary that the same procedure is carried out in each class. Otherwise, the experiment cannot be carried out properly and the results are no longer of use. Therefore, you are requested to act according to the instructions given in this letter.

The mathematical test shall be written **until 13.11.2015.** When exactly is up to you. Please chose a testing week in which no other exam is written so that the workload of the pupils is minimized. You receive in total two envelopes containing materials to carry out the experiment. In this envelope I send you instructions on how to announce the test, preparation material for pupils as well as consent forms to be signed by parents. In the second envelope you will get further instructions on how exactly to execute the test at the testing day, the actual tests as well as pupil questionnaires. This second envelope is mailed to you close to the testing day. Therefore, it is important that you send me the exact testing date to wagner@dice.hhu.de as soon as you now when the test shall take place.

The test is similar to the Känguru-Wettbewerb. However, the scoring is slightly different from the original test. Pupils in your class start the test with the maximum number of points (40 points). 0 points are deducted for each correct answer, -2 points are deducted for a skipped answers and -4 points are deducted if the answer is wrong. The highest achievable score is 40, the lowest 0. The test takes 30 minutes, is evaluated by us and pupils will receive a score at the end. It's up to you whether you want to assign a grade for the score.

Test announcement

1. The test will be announced exactly **one week** in advance. Please write the test date on the board. Pupils shall have the opportunity to prepare for the test.

2. Please explain that the test is mandatory and that it will be corrected and evaluated but that it will not count for the report marks. Do not yet explain in which way points are allocated in the test. This will be done immediately prior to the test on the test day.

3. Please distribute the preparation material afterwards and answer all remaining questions.You can justify the test by saying that you want to try out a different kind of testing format. Otherwise, you could also justify the test by saying that you want to find out in which areas of mathematics pupils need to catch up in the course material. Please refrain from actively motivating pupils to study for the test during this week. Questions about the learning materials or the process of the test can be answered, of course. I also ask you not to tell the pupils that this test is taking place as part of a broader study by the University of Düsseldorf. Please do not mention that other classes also participate in this project.

Please send us an e-mail with the date of the test **on the same day** you announce the test. Please do not tell the pupils the background of this research project before the actual test was written. Please be not surprised if the test instructions are different for the classes of your colleagues. This is intentional and is part of the research project.

Please contact us by phone or email in case you have any question.

Figure 6: Teacher Instructions—Second Letter [translated from German]

Instructions for the Control Group and Negative Treatment differ in point 2 where the respective allocation of points is explained.

Instructions for [class] of [name of school]
With this envelope you get the tests, questionnaires, a list to enter the midterm grades and a statement of privacy. Please read the instructions carefully and execute the test in the given order:

Execution of the test: time 30 minutes

1. Please let the pupils—similar to exams—set the tables a little bit apart. Additionally let them put up a privacy screen between each other. Remind the pupils that all questions have to be answered independently and that each attempt to copy from the test will be punished with the removal of the test. If the latter happens, please indicate this by an "X" in the upper right corner of the first page of the test.

2. Before the test starts, please read out aloud the following text to the class: "The test contains a total of 10 tasks that must be solved within 30 minutes. For each task, there are 4 wrong and 1 correct answers. Every one of you starts with the full score, which is 40 points. For each correct answer you get 0 points and for each wrong answer 4 points are deducted. 2 points are deducted if you skip an answer. Calculators are not allowed, but "scratch paper" for sketches and small calculations are allowed, of course!"

3. Please tell the pupils that they should not write their names on the test. For privacy reasons, each test receives a "Test-ID number".

4. Now the test starts and lasts 30 minutes in total.

5. While the test is ongoing, please write down on a sheet of paper the corresponding name for each Test-ID number (upper left corner on the first page of the test). For this, you could also use a class list. This sheet serves as the "encryption key" that you do not send back to us and keep for yourself. This is important so that you know which test belongs to which pupil after you receive the corrected tests from us.

6. After the test, the questionnaires have to be answered. These have already been attached to the test. Again, this is to be filled out independently and quietly by each pupil.

Please send the tests, questionnaires, preparation sheets and the list with the midterm grades back to us with the enclosed envelope on the same day. The tests are then corrected by us immediately and sent back to you. Please fill in the midterm grades in the list we have send you. The Test-ID numbers serve here as an encryption key. Example: The pupil "Andrea Albers", has the Test-ID number 12, then please write down under the number 12 in the list the midterm grade plus tendency of Andrea Albers. By this method, we can meet the requirements of privacy policy since so it cannot be identified which grade belongs to which pupil retrospectively. In addition, all materials which are handed out during the project will be returned to you. Once all participating schools have conducted the tests, we start with the statistical analysis and send you the results.
Thank you very much.

C.2 Teacher and Student Questionnaire

—not intended for publication—

Figure 7: Teacher Questionnaire [translated from German]

Teacher Questionnaire

Please answer all of the following questions truthfully. The questions are very important for us to gain insights from the teacher perspective. Please send the questionnaire backt to us. A stamped envelope is attached.

School: _____ Class:_____

For how many years have you benn a teacher now?: _____Date of test: _____

How many students are in your class?_____ …attend the school (approx.)?:_____

1.In which school hour was the test written?_____

2. Please rank the difficulty of the tests for your students?

1 □	2 □	3 □	4 □	5 □
too easy		medium		too difficult

3. Does your school apply inter-grade teaching? If yes, which grades are teached together?

_____

4. Does your school have media facilities where pupils can learn media skills?
Yes □ No □

5. If yes, do you actively teach media competencies in your courses?
Yes □ No □

6. Do you plan to participate in a mathematics competition this year (Känguru, Pangea etc.)?
Yes □ No □

7. Did you actively prepare pupils for the test?
Yes □ No □

If yes, how exactly: _____

8. Please rank the social environment in which the school is located?

1 □	2 □	3 □	4 □	5 □
socially troubled area				Very good residential area

9. Did you inform parents about the study?
Yes □ No □

If yes: before the test □ after the test □

10. On which basis are pupils sorted into classes?

_____

11. Please give us a short feedback on the backside.Did you notice anything that could be of relevance for our analysis during the project? Do you have any comments / suggestions for improvement concerning this project?

Thank you

Figure 8: Student Questionnaire [translated from German]

Student Questionnaire

Please answer all of the following questions and tick the appropriate boxes. It is very important that you answer all questions truthfully. Your answers will be treated anonymously and no other students in your class will have access to them.

Test-ID: Class: ____

School: _____ Age: _____

Gender: □ Girl □ Boy

Mother tongue: □ German □ other

1. How difficult was the test for you?:

1 □	2 □	3 □	4 □	5 □
too easy		medium		too hard

2. How much do you like the subject mathematics?

□	□	□	□	□
not at all		medium		very much

3. Did you learn for the test?

□ Yes □ No

If yes,

a)How many hours did you approx. learn? _____

b) How many preparation sheets did you solve? _____

4. How many books do you have at home?
Approximately 40 books fit on a meter of bookcase. Please do not count in newspapers and your textbooks.

0-10 □ 11-25 □ 26-100 □ 101–200 □ 201–500 □ more than 500 □

5. How many siblings do you have?:

0 □ 1 □ 2 □ 3 □ more than 3 □

6. How many of your siblings are older than you?

_____

7. In which month is your birthdy?

_____

Thank you

C.3 Consent Form

—not intended for publication—

Figure 9: Consent Form to be signed by parents (translated from German)

Dear Parents,
as a doctoral student of economics at the Heinrich-Heine University of Düsseldorf I am researching in the field of empirical economics of education. As part of my thesis, I am currently working on a research project on "Motivation in schools".
In this context, I run a scientific study which takes part from **May to November 2015**. The aim of the study is to analyze pupils' motivation in a mathematical multiple-choice test. Some pupils will start the test with the maximum number of points while others start, as usually, with 0 Points. I then analyze how the starting situation affects pupils' motivation.
The mathematical questions are a compilation of old test questions of the *Känguru-Test* (http://www.mathe-kaenguru.de/). This is a nationwide test with about 886.00 participants last year and which has been conducted for over 20 years by the Department of Mathematics of the Humboldt University Berlin. The question of the *Känguru-Test* are designed in a way that by solving the tasks, the joy of (mathematical) thinking and working shall be awakened and supported.
I would be delighted if your child is allowed to participate in the test which takes place in a regular scheduled lesson. For this I need your consent. I ask you to sign the attached consent form and hand it to your child. The teacher will then collect the forms.
Thank you for your cooperation!
Sincerely yours,

Declaration of Consent for study participation

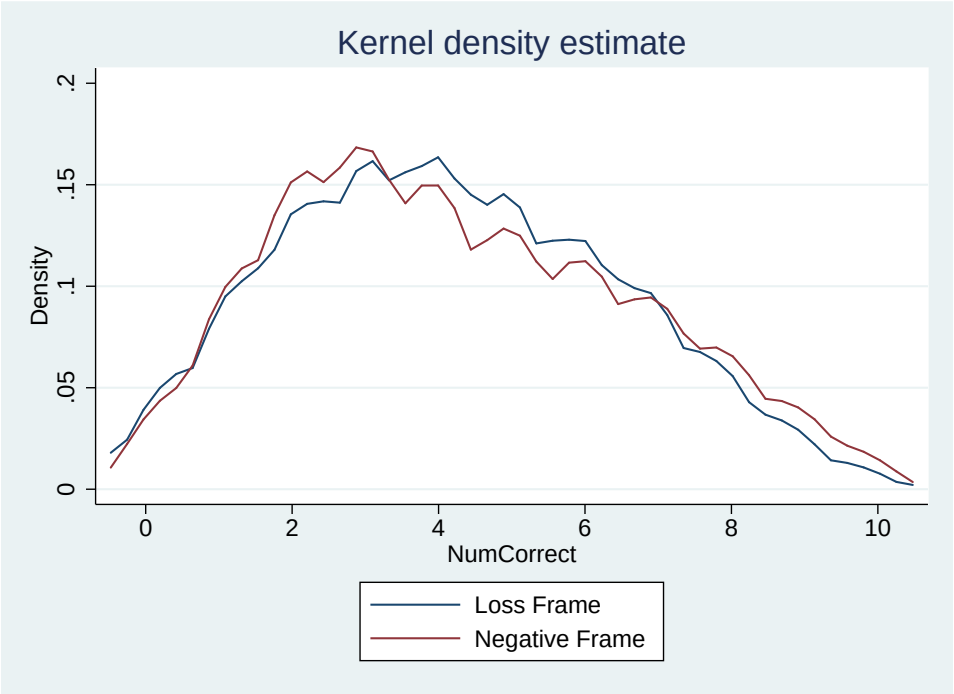
Hereby I (name of parent) voluntarily agree that my child (name of child) born on (date of birth) participates in the project described above and writes the test as part of a lesson. I give my consent to the storage and analysis of relevant scientific data. The obtained data of my child are treated privately and anonymously, so that thereby it is impossible to trace back on my child. It is—for me and my child—always possible to cancel participation. The participation in the study does not entail any physical or psychological risks for me and my child. A cancelation of participation has no adverse consequences. I can contact the Heinrich Heine University in Düsseldorf (Valentin Wagner) at any time to ask questions.

(Place and Date) (Signature of parent)

Kernel density plots by Treatment

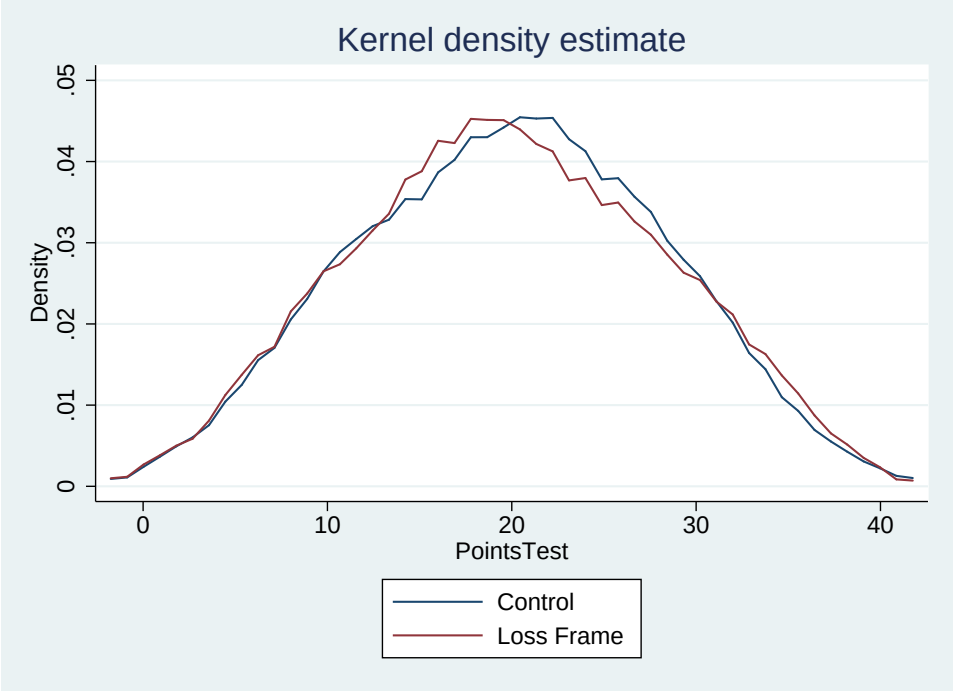
—not intended for publication—

Figure 10: Correct Answers: Loss Treatment vs. Negative Treatment



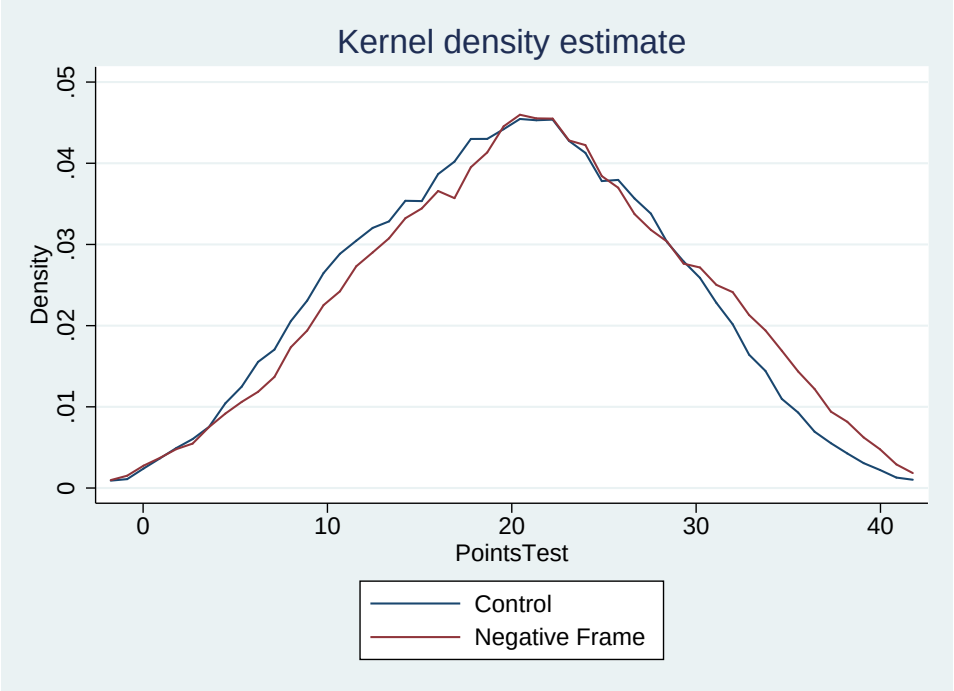
Note: This Figure presents Kernel density estimates for the number of correct answers for the Loss Treatment and the Negative Treatment.

Figure 11: Points: Control vs. Loss Treatment



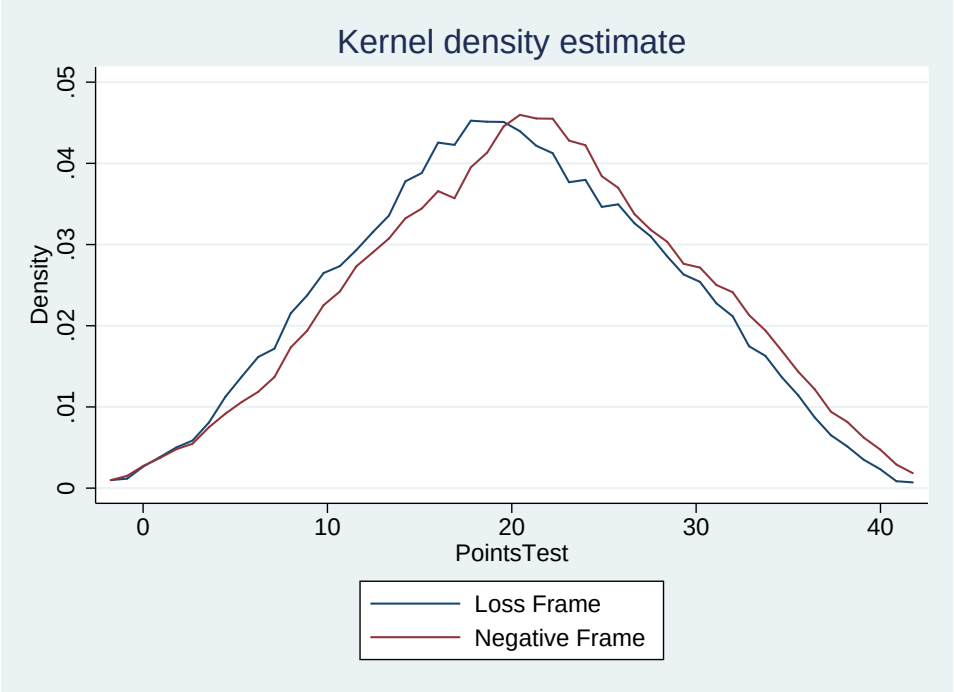
Note: This Figure presents Kernel density estimates for the number of points reached in the test for the Control Group and the Loss Treatment.

Figure 12: Points: Control vs. Negative Treatment



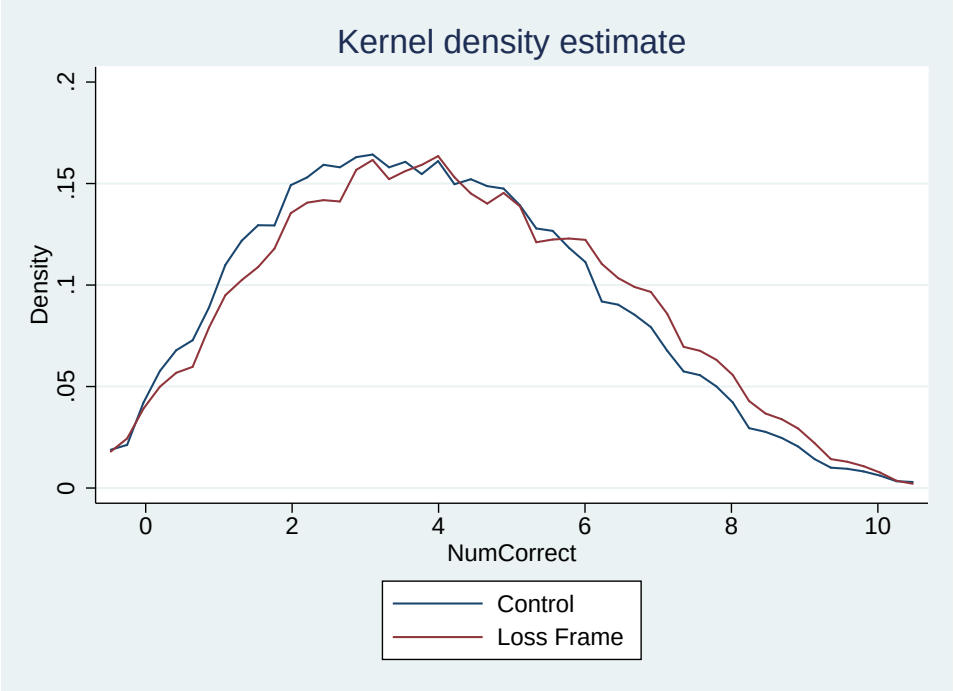
Note: This Figure presents Kernel density estimates for the number of points reached in the test for the Control Group and the Negative Treatment.

Figure 13: Points: Loss Treatment vs. Negative Treatment



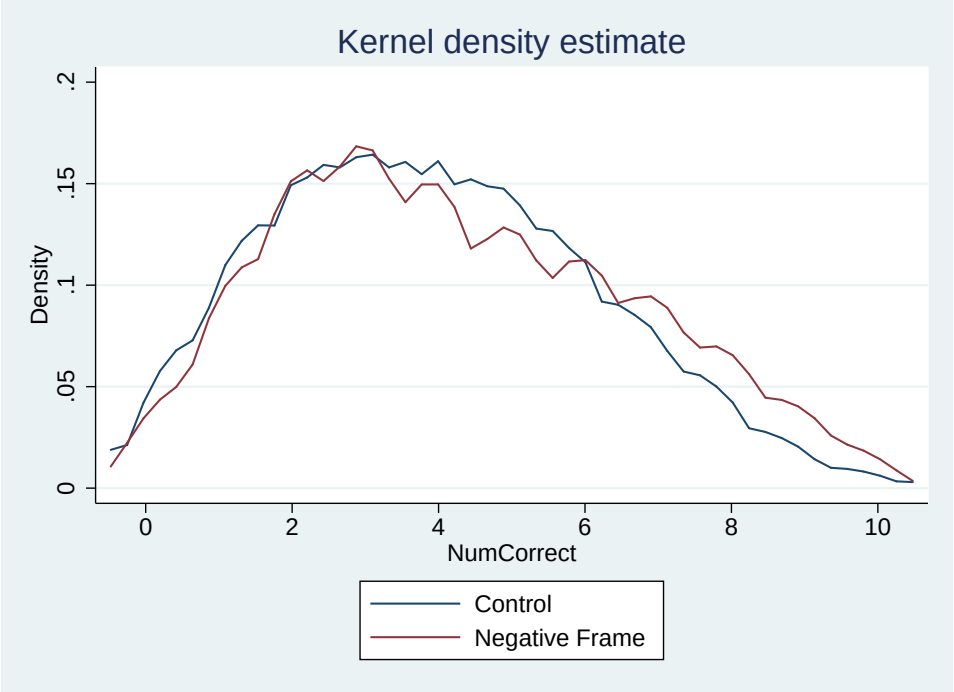
Note: This Figure presents Kernel density estimates for the number of points reached in the test for the Loss Treatment and the Negative Treatment.

Figure 14: Correct Answers: Control vs. Loss Treatment



Note: This Figure presents Kernel density estimates for the number of correct answers for the Control Group and the Loss Treatment.

Figure 15: Correct Answers: Control vs. Negative Treatment



Note: This Figure presents Kernel density estimates for the number of correct answers for the Control Group and the Negative Treatment.