The Incentive Effects of Affirmative Action in a Real-Effort Experiment

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Abstract

We conduct pairwise tournaments among school children from two different schools that compete against each other based on a real effort task (solving simple sudokus). The important difference between children is the ex-ante experience with this task that differs systematically between the two schools. We interpret this difference in experience as an exogenous source of heterogeneity and analyze the incentive effects of different affirmative action policies that balance this asymmetry. Our experimental data confirms that affirmative action does not result in a significant decline in performance. This result is robust with respect to different information structures, as well as different types and degrees of the affirmative action policy. Moreover there is evidence that (at least for non-experienced subjects) affirmative action has performance-enhancing effects.

Keywords: Affirmative action, framed field experiment, sudoku

JEL classification:

1 Introduction

The implementation of affirmative action policies that directly favor discriminated individuals is frequently accompanied by an intense public debate. Opponents of those policies often claim that affirmative action instruments presumably generate incentive distortions in competitive environments which might result in high social costs due to overall losses in performance. Advocates of affirmative action instead argue that the normative objective of those policies, i.e. to create a level playing field, has positive effects on incentives because higher competitive pressure between competitors enhances effort exertion.

The objective of our experimental study is to differentiate between those two alternative predictions in a natural environment. Therefore we conduct pairwise tournaments among school children based on a real effort task, i.e., each student competes against an opponent by solving simple sudokus. The important feature of our experimental design is the ex-ante difference that exists between the matched opponents: In each tournament one student is highly advantaged because he or she is extensively experienced with this task as it was part of its usual course work. The respective opponent from the other school does not have this experience because solving sudokus was not part of the teaching activities in that school. From the perspective of the students this difference in experience is exogenous (i.e. beyond the control of the students) and is therefore interpreted as a natural form of discrimination. Affirmative action is then implemented as a biased tournament rule (of different types and sizes) to induce a level playing field by favoring the disadvantaged student. We analyze the incentive effects of affirmative action by comparing the performance, i.e. the number of solved sudokus, under the different tournament rules (varying type and size of the affirmative action bias) with a benchmark treatment where no bias is implemented.

We also control for other sources of heterogeneity among the children (gender, age, and school grades) by partitioning the subject pool in such a way that groups that compete under different tournament rules are homogeneous with respect to the mentioned characteristics. Additionally, we vary the amount of information with respect to the experience of the respective opponent that is provided to the participants. Revealing information with respect to characteristics of the participants might have psychological effects that influence behavior (e.g. 'stereotype threat' where discriminated individuals perform worse if ex-ante differences among the subjects are emphasized). By varying the information structure we are able to detect whether these psychological factors affect performance.

A preliminary analysis of the experimental results suggests that the implementation of affirmative action policies does not lead to performance losses by affected individuals: For experienced subjects there are no significant differences between the benchmark and the affirmative action treatments with respect to the number of correctly solved sudokus. Instead, there is weak evidence for increased performance under affirmative action. This effect is even sharper for non-experienced subjects: Here, under affirmative action the number of cor-

rectly solved sudokus is significantly higher than without. Hence, in our experimental setting the implementation of affirmative action policies seems to have overall performance-enhancing effects for affected individuals which also implies that the social costs of those policies are negligible.

This outcome is also suggested by theoretical models: Fu (2006) models affirmative action in college admission as a two-player all-pay auction under complete information where the auction rule is biased in favor of discriminated agents by granting them a lump-sum bonus on their grade point average. Franke (2007) considers a contest framework where the contest rule is affected by affirmative action in the sense that exerted effort of discriminated contestants is weighted by a multiplicative factor. In both cases individual and aggregated equilibrium effort is higher under the biased rule because the underlying heterogeneity of the agents (induced through discrimination) is successfully reduced. Those two different types of biases, i.e., an additive lump-sum bonus and a multiplicative (proportional) bonus, are also used in our experimental setting to model the implementation of different types of affirmative action policies. They can also be observed in real-life situations where affirmative action is implemented. An example is the admission procedure for the undergraduate program at the University of Michigan where a fixed lump-sum bonus of 20 (out of 150) points was added to the score of minority applicants.[1] Proportional types of affirmative action policies are observed in public procurement auctions where bid preferences are granted in a multiplicative way, e.g., road construction contracts in California are auctioned off by granting a 5-percent reduction of the submitted bid to small business enterprises.

To our knowledge there exists no theoretical attempt that explicitly analyzes the incentive effects of different types of affirmative action policies in a comprehensive way. Calsamiglia (2008) examines different types of affirmative action in a decentralized multi-tournament situation from a normative perspective. She concludes that affirmative action types that equalize reward to effort are normatively superior where equalizing reward to effort usually coincides with an effort-dependent (proportional) type of affirmative action policy. However, the incentive effects of those policies are not addressed in this model. Our experiment can therefore also be interpreted as a first attempt to analyze the incentive effects of different types of affirmative action instruments.

There exists a large empirical literature on tournaments, see Prendergast (1999) for a survey, as well as on affirmative action, see Holzer and Neumark (2000). However, empirical studies that explicitly analyze the incentive effects of affirmative action in tournament-like situations (and its robustness with respect to the extent and type of those policies) are scarce, also because the relevant data might not be available.[2]

[1] A procedure that was ruled as unconstitutional by the Supreme Court because the affirmative action policy was too mechanistic and not 'narrowly tailored' with respect to its objective, achieving a diverse student body.

[2] A recent exception is the empirical analysis of the mentioned road construction contracts by Krasnokutskaya and Seim (2007) and Marion (2007), where it is shown that bid preferences for small businesses induce higher procurement costs because (besides balancing the

Besides obtaining relevant data conducting an experiment has the advantage that it can be designed specifically to address the underlying research question without loosing control over other relevant factors. An example for such an experimental approach based on a laboratory setting is Schotter and Weigelt (1992). In this paper the consequences of affirmative action in tournaments are examined and the already mentioned theoretical predictions are mainly confirmed. Using a laboratory setting has the advantage that the experimenter can discretionary induce specific cost functions on the subjects because the disutility of effort can be substituted by monetary disincentives. In their study discriminated subjects are those subjects that face a relatively high cost function that is randomly assigned to them.

In our experimental setting the difference between subjects is interpreted as a natural form of discrimination because the difference in ex-ante experience with the task exists de facto and occurred in a natural way.[3] This captures in a realistic way the nature of discrimination.

Several recent experimental studies employ similar strategies based on natural occurring differences in characteristics among social groups, see Hoff and Pandey (2006) for an experimental study where the consequences of making salient the social caste of the opponent in rural India are examined, as well as Gneezy et al. (2003), and Niederle and Vesterlund (2007), that analyze the performance of women versus men and their respective propensity to compete in mixed gender tournaments. Niederle et al. (2008) combines this insight on gender differences with the decisions to entry into tournaments in an affirmative action framework based on gender quotas. Entry into tournament is not an issue in our framework because we are interested in the isolated analysis of incentive effects of different types of affirmative action policies implemented as preferential treatment.

Note, that contrary to the mentioned experimental literature the subjects in our experiment are children. Recruiting children has some convenient advantages, see Harbaugh et. al. (2001): Children react very spontaneously in competitive situations, they are not spoiled by questioning the underlying motivation of the experimenter and it is also relatively easy (cheap) to incentivize them. It has also been shown that they react rationally and in line with economic theory, see Krause and Harbaugh (1999).

We proceed as follows: In the next section we present the theoretical predictions of performance reaction after affirmative action is implemented and contrast them with behavioral interpretations and common critical remarks of opponents of those policies. Our experimental procedure is described in section 3 while a preliminary analysis of the obtained experimental data is presented in section 4. The last section concludes.

asymmetry of entrants) the entry decisions of low cost large firms are distorted. The issue of entry is excluded from our experimental setup because here participation is mandatory.

[3]The difference in experience is discriminatory because non-experienced subjects are not personally responsible for not being systematically trained in solving sudokus at school. It occurred in a natural way because it is not artificially induced on the subjects as part of the experimental procedure.

2 Tournaments, Discrimination, and Affirmative Action

Theoretical models that analyze the incentive effects of affirmative action in simple tournament settings suggest that affected individuals exert more effort as a response to the implementation of those policies, see the two mentioned papers in the introduction. The intuition behind this result is straight forward: Discriminated individuals are ex-ante disadvantaged which induces an asymmetry in the competition. Appropriately designed affirmative action policies generate a balanced playing field by favoring ex-ante discriminated individuals which reduces the asymmetry among participants. This induces higher competitive pressure which results in higher performance by all individuals. Similar results are derived for rank-order tournaments in Lazear and Rosen (1981) and for asymmetric auctions in McAfee and McMillan (1989); see also the theoretical part in Schotter and Weigelt (1992). We summarize the theoretical prediction in the following statement that is testable in our experimental setting:

Affirmative action that generates a level playing field should induce higher performance by discriminated and non-discriminated individuals.

The argumentation of opponents of affirmative action is based on a more behavioral perspective: Non-discriminated individuals might perceive the preferential treatment of their (discriminated) opponents as unfair which could lead to discouragement. Discriminated individuals could anticipate this reaction by their opponents or perceive the affirmative action policy simply as a substitute for own effort.[4] Both considerations would imply less effort exertion by discriminated and non-discriminated individuals which is summarized in the following statement:

Affirmative action results in performance losses by discriminated and non-discriminated individuals.

An additional psychological factor that might have adverse consequences for discriminated contestants is the so called 'stereotype threat', see Steele et al. (2002), where the salience of discrimination in a competitive situation affects negatively the performance of discriminated individuals. This effect has been experimentally verified in unbiased competitive environments where no affirmative action is applied. In Hoff and Pandey (2006), for instance, the performance of discriminated caste members in rural India declined in mixed caste tournaments if their caste membership was revealed. Our experimental design also allows the analysis of this factor because we vary the provided information with respect to ex-ante experience of the tournament participants.

[4] The introductory remarks in Sowell (2004) are an example for this kind of argumentation. Compare also the discussion in Fryer and Loury (2005), especially their remarks in the section called 'Myth No. 3: Affirmative action undercuts investment incentives'.

3 Experimental Design

We conduct simple tournaments among school children, aged 10-13, from one private and two public schools in Barcelona, that have systematically different experience with a specific real effort task, i.e., solving simple sudokus. This ex-ante difference is due to the fact that solving sudokus was part of the regular class activities in the private school but not in the two public schools. Results from pilot experiments showed that not being experienced with this task is a severe disadvantage in tournaments that are based on this task. As the students cannot influence the decision whether they are taught how to solve sudokus in class, non-experienced students cannot be held personally responsible for their lack in experience. Hence, this naturally occurred difference in experience is interpreted as discrimination which is used to justify the implementation of affirmative action in the tournament.

In each tournament we match one experienced student from the private school with one non-experienced student from the public school. The tournament lasts 30 minutes in which the subjects can solve up to 96 sudokus of a simple 4x4-type, the same for every individual.[5] In figure 1 we present an example for this type of sudoku and its solution.[6]

Figure 1: A 4x4-Sudoku and its Correct Solution

	4		2
		3	
1			

3	4	1	2
2	1	3	4
1	2	4	3
4	3	2	1

The objective is to complete the whole grid with numbers such that the same number can only occur once in each column, row, and box. We choose this task because "the rules are simple, yet the line of reasoning required to solve the puzzle may be complex" (Wikipedia-Entry on Sudokus at http://en.wikipedia.org/wiki/Sudoku). Also the number of correctly solved Sudokus is a convenient measure for exerted effort.[7]

[5] No subject was able to solve all provided sudokus in the given time limit.

[6] The sudokus are randomly generated by a computer program (SuDoku Pro by dualogy systems) with the same level of difficulty.

[7] Also the analysis of the total number of sudokus (i.e. correctly and wrongly solved) might be of interest: If for instance the total number of sudokus is high because the number of

The final score of a student in the tournament is the number of correctly solved sudokus plus an eventually implemented affirmative action bonus. The student with the higher score wins a prize which is a coupon for a bookshop with a value of 7 EU.[8] The implemented affirmative action bonus varies with respect to type and size which is different in each treatment. We focus our attention on the following distinct types of affirmative action policies (implemented as different treatments) and a benchmark treatment where no bonus is applied:

- Benchmark treatments (NK, K): In the two benchmark treatments no affirmative action policy is implemented (the tournament is unbiased) but the extent of provided information with respect to the experience with the task is varied: In treatment NK subjects do not know that their opponents belongs to the groups of experienced or non-experienced students while this information is provided to the participants in treatment K.

- Lump sum affirmative action policy (LL, LH): A fixed bonus is added to the number of correctly solved sudokus of a non-experienced subject. The bonus can be either low, 8 sudokus in treatment LL, or high, 20 sudokus in treatment LH.

- Proportional affirmative action policy (PL, PH): A multiplicative bonus is granted to non-experienced subjects that depends positively on the number of correctly solved sudokus. In treatment PL the number of correctly solved sudokus is multiplied by factor 1.5, i.e., for each two correctly solved sudoku one sudoku is added to the the respective score. In treatment PH the multiplicative factor is 2, i.e., the final score of non-experienced subjects is twice the number of correctly solved sudokus.[9]

By comparing the number of correctly solved sudokus in the two benchmark treatments NK and K we can first analyze how information about the relevant experience affects the performance of the subjects. For instance, we can detect whether there exists a stereotype threat or if the students are instead encouraged by making public the asymmetry in experience. The incentive effects of the different affirmative action policies can then be evaluated through a comparison with the non-biased benchmark treatments.

An evaluation of the pilot experiments revealed that there was a significant amount of variance in performance among the students which was highly correlated with gender (girls performed significantly better than boys), grades (the average grade was correlated with performance), and age of the respective

wrongly solved sudokus has increased then this would indicate that increased competitive pressure does not lead automatically to enhanced performance.

[8]Some schools were concerned with giving monetary incentives to students. We decided to use coupons from a bookshop as prizes which satisfies the pedagogic concerns of the schools. At the same time the 7 EU value of the voucher is a substantive amount for a 10-13 years old child.

[9]The exact specification of those two boni is based on the results of the pilot experiment and it is chosen in such a way that the expected probability to win the tournament between advantaged and disadvantaged groups would have been (roughly) equal in the pilot experiment for treatment PL and LL.

individual. For the main experiment this information is provided ex-ante for each individual which allows us to create homogeneous groups (with respect to age, gender, and grades) for each treatment. Therefore, differences in the group composition with respect to the mentioned characteristics can be excluded as potential explanation for differences in performance across treatments.

3.1 Experimental Procedures

The tournaments are conducted directly in the respective school and the students are not informed ex-ante that they will participate in an experiment. Hence, from the perspective of the students the experiment is perceived as an extracurricular class activity in a natural environment.[10] This also implies that participation is quasi-mandatory because the option of non-participation is never articulated. Problems of selection bias due to voluntary participation can therefore be circumvented.[11]

To exclude psychological effects that might be related with different experimenters, the same experimenter is used in all treatments and in both schools. This also implies that the tournaments across treatments cannot be conducted simultaneously in the two schools and that the respective opponent of each subject is not actually present in the tournament because an experienced subject was always matched with a non-experienced subject from the other school. This guarantees that the tournament is anonymous and that the performance of subjects is not contaminated by specific characteristics of the respective opponent. Learning effects from repeated participation are avoided because each subject only participates once in a tournament and is not informed about its respective number of correctly solved sudokus in the course of the tournament.

The experiment is conducted in three phases. In each phase the students are isolated in different rooms such that there is no interaction among students between different phases to avoid subject contamination. In the first phase all students are guided to a common room where an activity is started to keep them quiet (an activity that is not related to solving sudokus). Students that participate in a specific treatment are selected according to the pre-specified group composition by announcing their personal code and are guided to a separated room where the tournament is conducted. In this second phase the students find written instructions (a version of those can be obtained from the authors on request), a pencil, and a rubber. The experimenter (identical for all treatments) reads the instructions, responds to questions, and shows the 7 EU-coupon to increase the credibility of the tournament. The instructions contain an explanation of the rules that completed sudokus satisfy which are clarified by the experimenter by solving one example sudoku on the blackboard. After that the students have 5 minutes to solve up to 12 sudokus to show they understand

[10] Following the taxonomy suggested in Harrison and List (2004), the experimental setting can be described as a framed field experiment.

[11] We excluded one student from the tournament because he continuously distracted his colleagues.

the rules.[12] Additionally, it is clarified that each student competes against an anonymous student from another comparable school and that students in those school are systematically experienced (or not) with solving sudokus (for treatment NK this information is omitted). This difference in ex-ante experience is explicitly mentioned and is used to justify the implementation of the affirmative action bias in favor of the non-experienced group in treatment LL, LH, PL, and PH. The tournament rule (specific for each treatment) is explained by giving numerical examples for the potential outcomes of the tournament, i.e loosing, winning, and tying. Also, some aggregate information with respect to the number of correctly solved sudokus (i.e. mean, minimum and maximum) of a comparable subject pool is provided that is based on the results of the pilot experiments. This information should enable the pupils to form expectations with respect to the relative performance of their rivals.

The tournament starts after all remaining questions are answered and is terminated after 30 minutes by an acoustic signal from a digital alarm clock. After the tournament phase the students are guided to another separated room (third phase) where they respond to a post-experimental questionnaire that contains questions about whether the students believe that they have won the tournament, if they have any experience with solving sudokus besides school, and how they perceived the bias in favor of non-experienced subjects. Based on this information individual confidence and fairness measures can be constructed which will facilitate the analysis of performance effects of affirmative action with respect to psychological or behavioral factors.

After correcting the sudokus of all subjects the winner for each paired tournament is determined according to the relevant tournament rule (treatment) and the coupons are handed to the respective students.

4 Preliminary Results

Until the time of writing this part of the paper a final experiment in the private school with non-experienced students is still pending. This implies that the subsequent analysis is preliminary, and rather selective. The data for the non-experienced subjects stems from two experiments that were conducted in two public schools in Barcelona where solving sudokus was not part of the teaching activities.[13] As both public schools are comparable among each other, we aggregate the results for the non-experienced subjects from the two public schools.[14] The subject pool is described in table 1. In table 2 the average number of correctly solved sudokus (and the standard deviation) are presented.

The basic assumption in our approach is that students that are systematically taught in school how to solve sudokus are in fact advantaged. Fig-

[12] The results of this exercise will later be used as a proxy for unobserved ability.

[13] Those experiments were based on the same methodology, instructions, treatments, identical experimenter etc.

[14] The difference in the distribution of solved sudokus among the two public school is non-significant according to a non-parametric two-sided Mann-Whitney U test (p-value 0.731).

Table 1: The Subject Pool

	Private School	**Public School**	**Total**
Male	94	89	183
Female	86	119	205
4th	98	21	119
5th	0	93	93
6th	82	94	176
Total	180	208	388

Table 2: Average Performance

	Private School	**Public School**	**Average**
Male	35.49 (14.94)	17.79 (10.91)	26.88 (15.82)
Female	36.30 (16.67)	23.03 (11.39)	28.60 (15.30)
4th	29.00 (13.86)	15.43 (10.32)	26.61 (14.24)
5th	/	18.48 (9.78)	18.48 (9.78)
6th	44.10 (13.88)	24.26 (12.27)	33.50 (16.36)
Average	35.88 (15.75)	20.78 (11.45)	27.79 (15.55)

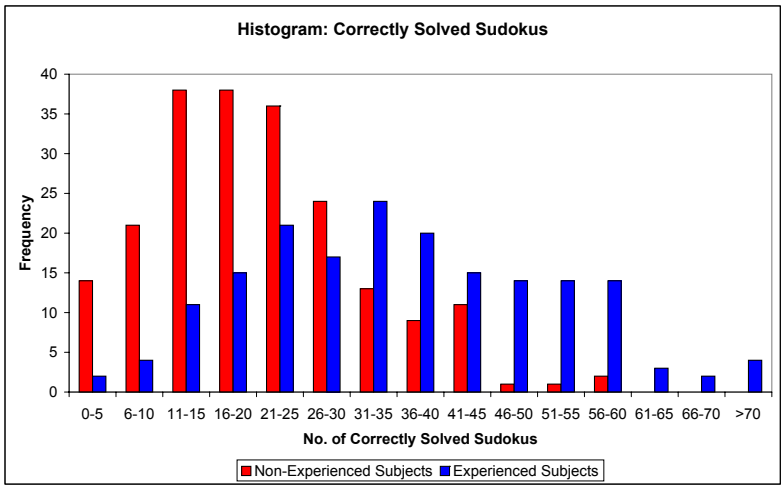
Note: The standard deviation is in parenthesis. The minimum performance is 0 correct sudokus while the maximum performance is 79 correctly solved sudokus.

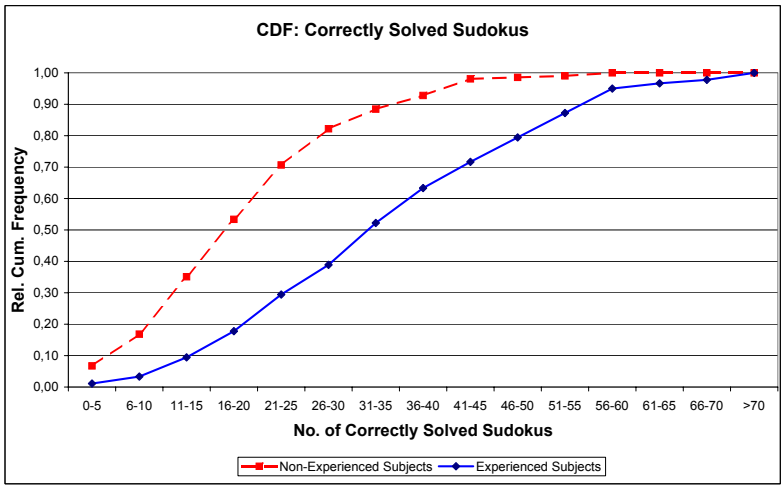
ure 2 shows two histograms of correctly solved sudokus for experienced and non-experienced students while the respective cumulative distribution functions (CDFs) are presented below. The graphs suggest that the two CDFs do not stem from the same distribution which is verified by a two-sided Mann-Whitney U test (p-value: 0.000).[15] Average performance is 35.88 correct sudokus for experienced subjects, versus 20.78 by unexperienced subjects. Hence, students that are not taught how to solve sudokus in class are in fact disadvantaged in this tournament and solve on average 15.1 sudokus less.[16]

[15]Students from the public school are relatively older and there are more girls than in the private school. As both factors are positively correlated with performance, the presented graphs are likely to underrepresent the difference in performance that is due to ex-ante experience. There might exist other factors that affect performance and that might differ between public and private schools. The final experiment that is going to be conducted in September in another private school where students are not ex-ante experienced will allow to control for these factors.

[16]Considering only the benchmark case NK where the performance of students is not influenced by information about their respective rivals yields similar results: Experienced students solve 33.28 sudokus on average versus 17.72 for non-experienced students. As before the two

Figure 2: Experienced versus Non-Experienced Subjects





Based on an analysis of the pilot experiments it became obvious that a part of the large variance in the number of correctly solved sudokus is due to personal characteristics like age, gender and grades. This observation also holds for the subject pool in the main experiment: the Spearman rank correlation coefficient between math grades and solved sudokus lies between 0.313 for 5th class and 0.495 for 6th class students, and 0.449 for the correlation between age and solved sudokus.[17] Also there are substantive gender differences, at least for the group of non-experienced students: while girls solve on average 23.03 sudokus correctly, boys solve on average 17.79 sudokus, i.e. boys solve on average 5.24 sudokus less. Comparing the two CDFs with a two-sided Mann-Whitney U test implies that there is a significant difference among gender (p-value: 0.003). The gender difference in the group of experienced subjects is not as strong: 36.30 correctly solved sudokus by girls versus 35.40 sudokus by boys. For this subject group of experienced students the CDFs with respect to gender are not sufficiently different (p-value 0.73 of a two-sided Mann-Whitney U test) to reject the hypothesis that they stem from the same distribution. As already mentioned, we control for this heterogeneity in the experimental design by creating ex-ante homogeneous groups with respect to these personal characteristics.

4.1 Discrimination and Information

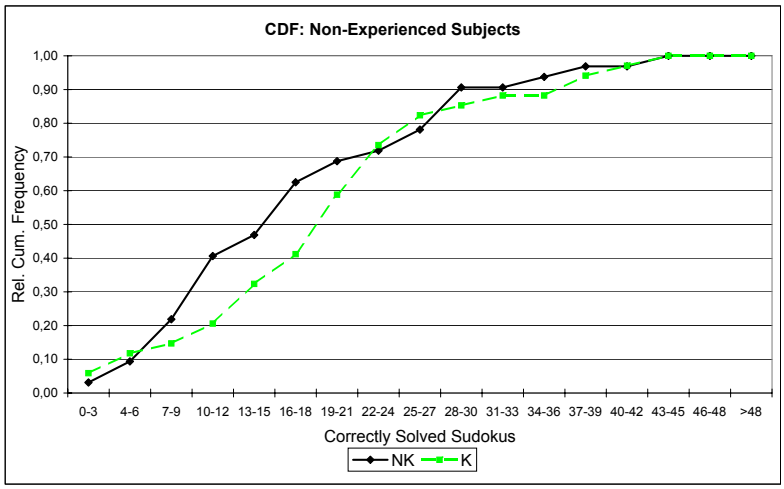
Revealing information about the fact whether the opponent belongs to the discriminated groups or not might constitute an important behavioral effect for individual performance. We test the existence of this effect in our setting by comparing the performance under treatment NK with those of treatment K (the only difference between the two treatments is the provided information about the ex-ante experience of the rival). The cumulative distribution of solved sudokus under the two treatments are provided in figure 3 for non-experienced and experienced students. Regarding non-experienced subjects the first graph shows that there is no clear difference between the distributions of solved sudokus for treatment NK and K, i.e. the performance of non-experienced pupils is not affected to a large extent by the knowledge about ex-ante experience of their rivals. On average non-experienced subjects solve 2.55 sudokus more if they know that their rivals are experienced. However, there is no significant difference between the two CDFs according to a two-sided Mann-Whitney U test (p-value 0.227). We conclude that, if anything, non-experienced subjects are encouraged by the fact that they are disadvantaged which implies that for our experimental setting a stereotype threat of discriminated individuals cannot be detected.

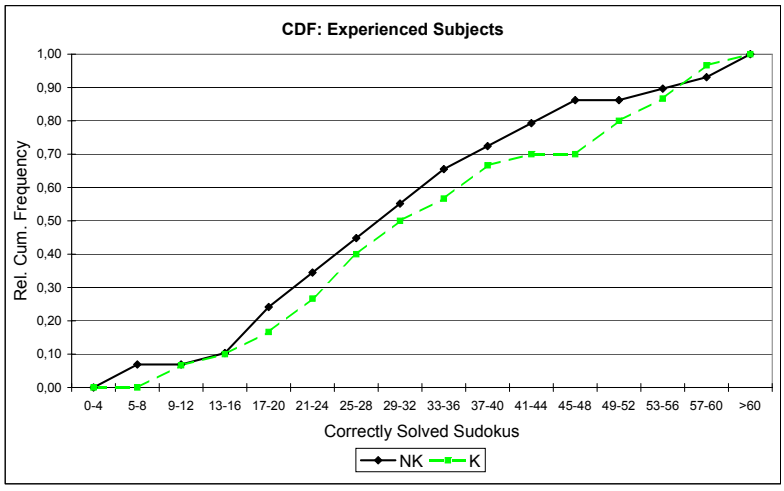
For experienced subjects there is a slightly more pronounced difference in performance, as suggested by the second graph in figure 3. Here, experienced

CDFs are significantly different (p-value 0.000 of a two-sided Mann-Whitney U test).

[17] Compare the regressions presented below for the significance of those characteristics.

Figure 3: Information About Discrimination.





subjects solve on average 2.29 sudokus more if they know that their rivals are non-experienced. However, the difference between the CDFs of treatment NK and K is still insignificant according to a two-sided Mann-Whitney U test (p-value 0,601).

Those results should be compared with Hoff and Pandey (2006), where revealing information about the identity (caste) of the rivals has a discouraging effect on discriminated individuals, while non-discriminated individuals do not react in a substantive way. Our results are different in the sense that non-experienced subjects are not affected by revealing to them that their rivals are trained in the task, while experienced subjects solve on average more sudokus if they know of the difference in ex-ante experience.[18] However, we also observe that the provision of information about the level of discrimination of competitors seems to augment the differences in performance between the two groups.

4.2 Treatment Analysis

Subjects might react very differently to the implementation of affirmative action depending whether they are favored or not by those policies. Therefore, we analyze the performance of the students separated for each school, i.e. isolated for ex-ante experienced and non-experienced subjects. We proceed by comparing first the performance of the two unbiased tournament rules NK and K with the average level of performance under all affirmative action policies, denoted by AA.[19] A separated analysis of each affirmative action treatment is presented afterwards.

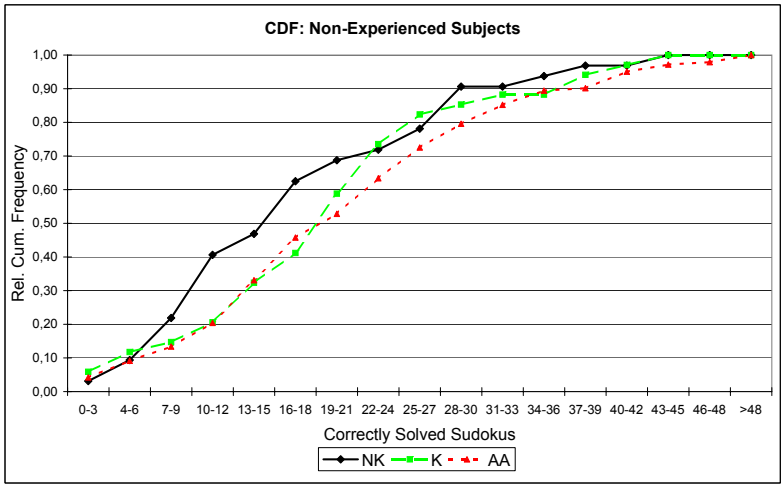
4.2.1 Affirmative Action and Non-Experienced Subjects

In Figure 4 three cumulative distribution function for treatments NK, K, and AA are presented based on the number of correctly solved sudokus for non-experienced subjects. From the inspection of the graph it becomes obvious that for (nearly) all quantiles the performance under affirmative action is higher than under the unbiased NK treatment. Hence, for non-experienced subjects affirmative action has, on average, a performance enhancing effect in comparison with a situation where they do not know that their opponents are experienced in this task. This is verified by comparing the two distributions with a non-parametric two-sided Mann-Whitney U test which is significant at 10 percent (p-value: 0.080). The difference in means between treatment AA and NK is 3.88, i.e. non-experienced subjects solve on average 3.88 sudokus more under affirmative action in comparison to the unbiased NK treatment. However, it should be noted that the main part of this performance gain can be attributed to

[18] A possible explanation could be that the revealed information in Hoff and Pandey (2006) is social caste identity which has a higher social stigma than knowing that the respective rival is ex-ante experienced with solving sudokus. They attribute the performance loss of the discriminated group to mistrust against the experimenter (who is from a differenct caste), an explanation which is not relevant in our framework.

[19] None of the affirmative action treatments LL, LH, PL, or PH is significantly different from each other, so the aggregated measure AA is constructed for convenience.

Figure 4: Non-Experienced Subjects



the provision of information with respect to ex-ante experience of the opponent because the difference in means between K and NK is 2.55. Hence, 66 percent of the performance gain between NK and AA is in fact contributed by the provision of additional information under treatment K.

A more detailed analysis is provided in Table 3 based on an OLS-regression where the the number of correctly solved sudokus is the dependent variable and the already mentioned personal characteristics (AGE, SEX, and GRADE), as well as the treatment variables for affirmative action (LL, LH, PL, and PH) and for the provision of information with respect to ex-ante experience (K) are the explanatory variables. This specification allows to differentiate between the effects for each specific affirmative action treatment and K.

In Table 3 all personal characteristics are highly significant which justifies again our decision to construct a homogenous partition of the subject pool ex-ante among treatments. The coefficients of the policy variables are all positive (and mostly significant at least at 10 percent), i.e. students solve between 3.66 (under PL) and 5.5 (under LH) more sudokus in comparison to the NK treatment. However, the change from treatment NK to K already contributes a performance gain of 4.06 sudokus. However, with respect to the competing theoretical predictions the regression confirms the inference that is made based on the graphical analysis: non-experienced subjects that face affirmative action are rather motivated than discouraged by those policies.

Table 3: Non-Experienced Subjects

Dependent Variable: Correctly Solved Sudokus				
	Estimate	**Std. Error**	**t-Value**	**Pr**$(>\|\mathbf{t}\|)$
Constant	-33.2984	6.9077	-4.820	$2.86e-06**$
CLASS	6.6618	1.0963	6.077	$6.23e-09**$
MATH	3.7949	0.5867	6.468	$7.66e-10**$
SEX	4.9712	1.3867	3.585	$0.000425**$
K	4.0574	2.4185	1.678	$0.094992*$
LH	5.5451	2.3977	2.313	$0.021776**$
LL	4.7896	2.4151	1.983	$0.048735**$
PH	4.1086	2.3810	1.726	$0.085992*$
PL	3.6649	2.4018	1.526	0.128647
Adj. R^2	0.2638			
No. of obs.	206			
F-test	10.18			$7.167E-12**$

Note: CLASS is equal to 4,5, or 6 depending on class membership of the individual (no information about age is available; MATH is school grade in math between 1 and 5; SEX is a dummy variable equal to 1 for girls; K, LL, LH, PH, and PH are dummy variables for the respective treatments.

4.2.2 Affirmative Action and Experienced Subjects

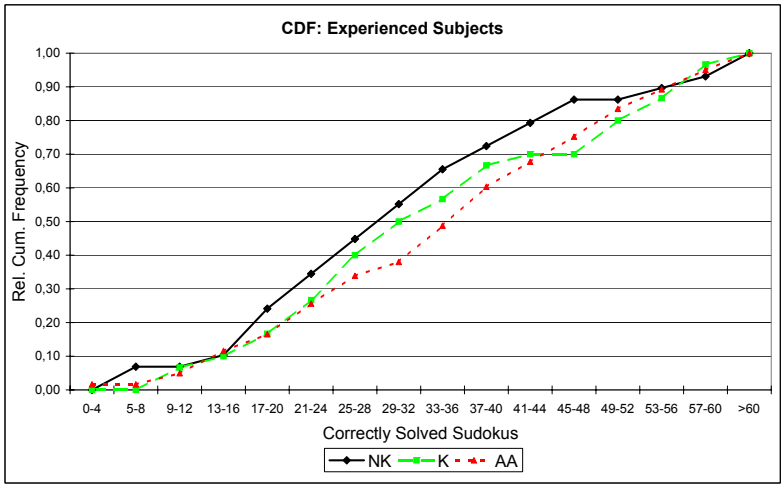
The results for experienced subjects point in the same direction. This becomes obvious in figure 5 where the cumulative distribution functions for treatment AA, the performance under all affirmative action policies, and the two non-biased treatments K and NK are presented.

From the graphical analysis there seems to be a difference in the sense of first order stochastic dominance between the NK and AA treatments. However, this difference is not significant (p-value 0.195 for the two-sided Mann-Whitney U test). Based on average performance experienced subjects solve 3.30 sudokus more if they face opponents that are favored under affirmative action in comparison to the symmetric treatment NK. The fact that the difference is non-significant could also be the result of very different reactions with respect to some specific affirmative action treatments.

However, this is not the case as becomes obvious by inspection of table 4 which presents the results of an OLS-regression for experienced subjects.

As before all coefficients are positive, however due to large standard errors not significantly different from zero. Moreover there is some variation in the size of the coefficients and only two specific affirmative action treatments (LL and PH) clearly dominate the unbiased treatment K. The overall conclusion for the experienced group remains as before (due to the fact that all coefficients are

Figure 5: Experienced Subjects



positive): in our experiment preferential treatment does not have a significant discouraging effect on individuals that are handicapped by affirmative action. Instead, there even is some weak evidence that individuals perform slightly better under affirmative action.

Hence, the implementation of affirmative action does not affect adversely the performance of students in a significant way. The incentives that are generated through the tournament structure are robust with respect to the implementation of such policies for experienced subject. For non-experienced subjects that are favored by affirmative action there is some evidence that these policies are even performance enhancing.

Table 4: Experienced Subjects

Dependent Variable: Correctly Solved Sudokus				
	Estimate	**Std. Error**	**t-Value**	**Pr**$(>\|\mathbf{t}\|)$
Constant	1.28859	4.38021	0.294	0.769
AGE	0.76860	0.07997	9.611	$< 2e-16 **$
MAT	5.99269	0.93545	6.406	$1.39e-09 **$
SEX	1.70264	1.90995	0.891	0.374
K	2.08134	3.29939	0.631	0.529
LH	0.83774	3.28473	0.255	0.799
LL	3.70660	3.31100	1.119	0.265
PH	4.55451	3.35991	1.356	0.177
PL	1.21843	3.25212	0.375	0.708
Adj. R^2	0.354			
No. of obs.	180			
F-test	13.26			$7.885E-15 **$

Note: AGE is normalized age measured in months.

5 Concluding Remarks

We conducted a field experiment in a tournament set-up based on real effort task where subjects are discriminated in a natural way due to systematically different ex-ante experience with the relevant task. Some psychological theories suggest that emphasizing the fact that participants belong to a discriminated group results in performance losses in competitive environments. In our experimental setting we could not find evidence for this psychological explanation: here, disadvantaged subjects reacted with performance increases to the information that their rivals are ex-ante advantaged. Focusing on the incentive effects of the implementation of normatively justified affirmative action policies we also found no evidence that affirmative action results in losses in performance. This result is robust with respect to different levels as well as different types of preferential treatment. Instead, there exists weak evidence that those policies even lead to enhanced performance (especially for individuals that are ex-ante disadvantaged). Hence, the incentives that are induced by a tournament set-up are not affected negatively by the implementation of affirmative action.

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