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Heterogeneous Treatment Effects in Groups*

Gerhard Riener† and Simon Wiederhold‡

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Abstract

We show in a laboratory experiment that the same method of group induction carries different behavioral consequences. These heterogeneous treatment effects can be directly related to the quality of the relationship established between the subjects. Our results indicate the importance of manipulation checks in group-formation tasks in economic experiments.

1 Introduction

Research in experimental economics is increasingly concerned about how artificially created groups influence the behavior of group members. In the standard method, participants are assigned to 'minimal' groups, either randomly or based on individual preferences (for instance, for one of two painters; see Tajfel et al., 1971; Chen and Li, 2009). Recently, it has become prominent to make group membership more salient than in the minimal-group paradigm, accomplished by adding financial incentives (Charness et al., 2007) or by relying on joint experiences of group members (Eckel and Grossman, 2005; Pan and Houser, 2012). However, it has not yet been explored in any of this research whether group manipulation homogeneously affects the subjects in the way desired by the experimenter.

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In this study, we use the joint problem-solving task introduced in Riener and Wiederhold (2012) to illustrate that the same method of group induction exhibits differential treatment effects in the subsequent gift-exchange game. Effect heterogeneity is driven by differences in the quality of the relationship established between the subjects in the group-induction stage, measured as a subject's perception of the partner's behavior. Not properly accounting for treatment heterogeneity can lead to the misleading conclusion that treatment effects on the outcome variable of interest are absent.

2 Experimental Design

Subjects were divided into groups of two, with the role as either principal or agent being randomly assigned. This role was fixed throughout the whole experiment. In the first step, we established groups in the Group Manipulation treatment (GM). In the control treatment (NoGM), individuals performed a task in isolation. In the second part of the experiment, all subjects played a simple gift-exchange game. Here, the agent has the opportunity to take a costly action that benefits the principal, who may control the agent by imposing a minimum effort restriction (see Falk and Kosfeld, 2006, for a similar approach).[1]

Treatment Manipulation

Group induction

In the GM treatment, subjects could distribute 50 experimental currency units (ECUs, where 1 ECU was worth 0.10 €) to a private or a public account. The returns to the group account were the smaller of the two contributions to the public account, doubled by the experimenter. A subject's total payment was the sum of the private and the group account. After an explanation of the game, a message on a screen asked each group of two to discuss their strategy for this game via an online chat. The coordination game had an obvious focal point, to ease the establishment of group feelings. We attempt to capture the social-ties aspect of groups that emerges from the shared experience of the principal and

[1] The experiment also comprised a real-effort stage in which the agents had to add five two-digit numbers. The results of this stage are not reported here. For a detailed description of the experimental design see Riener and Wiederhold (2012).

agent and the knowledge of each other's behavior, as it is common in team-building activities in real firms (Buller, 1986; Salas et al., 1999).[2]

Group manipulation feedback

After the game and the disclosure of the results, the subjects had to give their partners feedback on how fair they found the other's behavior. The subjects could pick any natural number between 1 (very unfair) and 5 (very fair), but were not allowed to further explain their opinion. Both partners received this feedback before the experiment proceeded to the next stage.

Control group

Subjects in the NoGM treatment were asked to perform a slider task (developed by Gill and Prowse, 2012). The challenge here was to bring 48 sliders into the middle position within 2:15 minutes. Participants in this task received a flat fee of 80 ECUs, independent of their performance.[3]

Gift-Exchange Game

In the second stage of the experiment, the agent was provided a windfall endowment of 117 ECUs by the experimenter, part of which he could transfer to the principal. The transferred amount was doubled by the experimenter. The marginal monetary costs for the agent to exert one unit of effort were set to 1. The principal had no initial endowment, but could enforce one of the following three minimum transfers: 0, 6, or 21. Forcing the agent to provide at least a minimum compulsory effort approximates the use of control (Falk and Kosfeld, 2006). We elicited the agent's response to each of the control levels available for the principal to choose using the strategy method (Selten, 1967).

Sample

In total, 330 subjects participated in the experiment (172 GM and 158 NoGM subjects, respectively). However, two GM subjects appear not to have under-

[2] As evidenced by Goette et al. (2012), the additional motives arising when group induction is not minimal are important determinants of individual behavior, especially with regard to the response to within-group norm violations.

[3] 80 ECU were the average payoff of GM subjects in the pilot sessions.

stood the gift-exchange game properly.[4] These agent observations are dropped from our preferred sample. All remaining results are not sensitive to the inclusion of the outliers.[5]

3 Results

We first classify the subject pairs in the GM treatment by their perceived and communicated fairness ratings. From Table 1, it becomes apparent that in 73 percent of the cases both subjects found each others behavior 'Fair' or 'Very fair'. For those individuals, we are confident that our manipulation successfully created social groups. For the remaining individuals, the group-induction exercise is likely to not have rendered group identity salient.

Table 1: Group formation: Player's Satisfaction With the Partner in the GM Treatment

	Very unfair (=1)	**Unfair (=2)**	**Neutral (=3)**	**Fair (=4)**	**Very fair (=5)**	***Total***
Very unfair (=1)	**0**	0	1	0	7	*8*
Unfair (=2)	0	**2**	0	1	6	*9*
Neutral (=3)	1	0	**4**	1	4	*10*
Fair (=4)	0	1	1	**2**	7	*11*
Very fair (=5)	7	6	4	6	**109**	*132*
Total	*8*	*9*	*10*	*10*	*133*	*170*

Note: This table shows all combinations of a player's rating of the other player's allocation decision in the group-formation stage. The extreme cases of the player's decision options (that is, very unfair/very fair) were explained, while the other choices (that is, 2-4) only appeared as natural numbers. For the sake of exposition, this table contains both the number and the description associated with a satisfaction rating. Each player received feedback on her partner's rating before proceeding to the gift-exchange game.

Agent

In Table 2, we show the results of the agent's effort response to the principal's control in the gift-exchange game. We run separate regressions for each of the three control levels the principal could impose (No control, Min 6, Min 21).

[4] They transferred the full endowment of 117 ECUs or 116 ECUs *irrespective* of the control level, although both rated their partner's decision in the coordination game as 'very unfair.'
[5] Results are available on request

Because our dependent variable, agent effort, can only take non-negative integer values and displays signs of over-dispersion[6], we perform negative binomial regressions.[7] Session dummies are included to control for session-specific effects (for instance, cohort size).

The basic results are shown in Columns 1–3. We pool agents from groups in which at least one player was not satisfied with the partner's behavior in the group-induction stage (*Not satisfied*). It appears that the effort decisions of *Not satisfied* agents are statistically indistinguishable from the *No induction* agents; that is, these subjects behave as if group induction had never happened. Thus, it is not the common experience *per se* that drives the agent's future behavior. However, agents for whom group induction can be expected to have worked properly (*Both satisfied*) exert a higher effort than both *No induction* and *Not satisfied* agents. The difference in effort is significant at 5 percent or better.

These results continue to hold in Columns 4–6, where we control for individual heterogeneity using information on the subjects' gender, age, previous experimental experience, number of semesters, and academic major. Interestingly, the effort gap between *No induction* and *Both satisfied* agents appears to decrease in the level of control, suggesting that the crowding-out effect of control ('hidden costs') is particularly pronounced when group membership is salient.[8]

The regressions in Table 2 ignore the fact that group induction can be expected to not have been successful for three distinct reasons: (a) the agent was not satisfied with the principal's decision; (b) the principal was not satisfied with the agent's decision; (c) both were not satisfied with each other's decision.[9] In Table 3, we account for the possibility that different reasons for unsuccessful group induction may also trigger different behavior. To do so, we split the *Not satisfied* agent sample into three categories: *Both not satisfied; Self not satisfied, partner is;* and *Self satisfied, partner not.*

The results indeed reveal a more nuanced picture of the agent's behavior than Table 2 conveys: First, agents in groups in which both players were not satisfied with each other's decision in the coordination game do not differ from *No induction* agents. Second, agents who were not satisfied with their partner's

[6] Formal tests of over-dispersion are reported in the regression tables.
[7] Our results remain qualitatively similar when we run OLS regressions instead.
[8] The interplay between group assignment and hidden costs of control is further explored in Riener and Wiederhold (2012).
[9] For the clarity of exposition, we use the terms 'agent' and 'principal' here, although these roles were not yet assigned when group induction took place.

Table 2: Agents' Effort Choices: Treatment Effects for Pooled Sample

	Agent Effort Min 0 (1)	Agent Effort Min 6 (2)	Agent Effort Min 21 (3)	Agent Effort Min 0 (4)	Agent Effort Min 6 (5)	Agent Effort Min 21 (6)
No induction	3.497***	3.182***	3.190***	2.618***	3.284***	3.245***
	(0.197)	(0.205)	(0.101)	(0.421)	(0.684)	(0.427)
Not satisfied	0.010	-0.118	0.160	-0.160	-0.154	0.094
	(0.234)	(0.191)	(0.135)	(0.272)	(0.199)	(0.136)
Both satisified	0.435***	0.353**	0.163*	0.407***	0.371**	0.187*
	(0.111)	(0.125)	(0.074)	(0.123)	(0.139)	(0.083)
Individual heterogeneity	No	No	No	Yes	Yes	Yes
Session dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	163	163	163	146	146	146
Wald chi-square	6190.85	3977.25	21398.49	8723.80	3688.61	19985.83
Prob > chi-square	0.000	0.000	0.000	0.000	0.000	0.000
Likelihood-ratio test of alpha=0	1703.31	1487.35	601.09	1377.28	1262.39	538.26
Prob > chi-square	0.000	0.000	0.000	0.000	0.000	0.000

Note: The table contains the results of negative binomial regressions showing, for each control level, how agent effort differs by group type. Individual heterogeneity is controlled for using biographic information on gender, age, experimental experience, number of semesters, and academic major. Experimental experience is a binary variable, which takes the value of 1 if a subject participated in an experiment in the past and 0 otherwise. The subject's academic major belongs to either of the following categories (see also Ploner et al., 2012): business administration and economics, other social sciences, humanities, engineering and natural sciences, as well as unknown/no student. Since not all individuals provide evaluable biographic information in the questionnaire at the end of the experiment, the number of observations in Columns 4–6 reduces to 146. A full set of session dummies is also included. The negative binomial model was chosen to take into account the over-dispersion of the data. As can be seen from the bottom of the table, the results from a likelihood-ratio test (estimated without robust standard errors) indicate over-dispersion for all specifications. Robust standard errors are in parentheses. * $z < 0.05$, ** $z < 0.01$, *** $z < 0.001$.

decision, while the partner was, exert less effort than *No induction* agents as soon as the principal chooses to control. Third, agents who were satisfied with their partner's decision in the group-induction game, while the partner was not, transfer more to her than *No induction* agents transfer to their partners. This difference reaches statistical significance for maximum control. In Columns 4–6, we show that these findings continue to hold when individual heterogeneity is accounted for. Our results indicate the presence of a 'bad conscience' effect; agents who have disappointed the partner in the group-induction game try to compensate her in future stages of the experiment.

Principal

Next, we examine the principal's control behavior in the gift-exchange game reported in Table 4. Interestingly, the same broad pattern as for the agent sample emerges. In Columns 1–2, analogous to Table 2, we pool all principals for whom group induction can be expected to not have succeeded into a single category (*Not satisfied*). We find that the control choices of *Not satisfied* principals do not differ from those of principals who have never interacted with the agent before (*No induction*). However, treatment effects with respect to control are also absent considering principals who received—and submitted—a high fairness rating in the group-induction stage; the coefficient on *Both satisfied* fails to capture statistical significance at conventional levels.

In Columns 3–4, we break up the sample further, separating *Not satisfied* principals by the specific reason for which group induction can be expected to not have worked properly. If both the principal and agent were not satisfied with each other's decision in the group-induction stage (*Both not satisfied*), the principals' control choices do not significantly differ from those of *No induction* principals. However, principals who behaved fairly in the eyes of the agent in the coordination game, but were themselves disappointed by the agent's decision (*Self not satisfied, partner is*), seem to retaliate—they control significantly stronger than the baseline group. We also find some evidence for a 'bad conscience' effect. Principals who disappointed the partner before, while being satisfied themselves (*Self satisfied, partner not*), attempt to make up for their misbehavior; they control less strong than the baseline. This difference is significant at conventional levels when we account for individual heterogeneity (Column 4).

Table 3: Agents' Effort Choices: Heterogeneous Treatment Effects

	Agent Effort Min 0 (1)	Agent Effort Min 6 (2)	Agent Effort Min 21 (3)	Agent Effort Min 0 (4)	Agent Effort Min 6 (5)	Agent Effort Min 21 (6)
No induction	3.496***	3.182***	3.187***	2.175***	2.984***	2.995***
	(0.198)	(0.205)	(0.102)	(0.555)	(0.590)	(0.371)
Both not satisfied	-0.071	-0.167	-0.069	-0.301	-0.296	-0.070
	(0.564)	(0.387)	(0.117)	(0.737)	(0.409)	(0.124)
Self not satisfied, partner is	-0.122	-0.751***	-0.288**	-0.767	-0.899***	-0.352**
	(0.419)	(0.210)	(0.106)	(0.471)	(0.222)	(0.114)
Self satisfied, partner not	0.147	0.299	0.520**	0.299	0.368	0.451*
	(0.310)	(0.250)	(0.175)	(0.381)	(0.266)	(0.189)
Both satisified	0.435***	0.352**	0.169*	0.405**	0.364**	0.187*
	(0.113)	(0.125)	(0.074)	(0.126)	(0.137)	(0.082)
Individual heterogeneity	No	No	No	Yes	Yes	Yes
Session dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	163	163	163	146	146	146
Wald chi-square	6282.86	4188.06	20647.91	7194.91	4109.93	20610.15
Prob > chi-square	0.000	0.000	0.000	0.000	0.000	0.000
Likelihood-ratio test of alpha=0	1697.73	1413.16	519.92	1344.54	1168.90	470.83
Prob > chi-square	0.000	0.000	0.000	0.000	0.000	0.000

Note: The table shows the results of negative binomial regressions of detailed group type on agent effort. See Table 2 for a description of the further control variables. A likelihood-ratio test (estimated without robust standard errors) indicates over-dispersion of the data for all specifications. Robust standard errors are in parentheses. * $z < 0.05$, ** $z < 0.01$, *** $z < 0.001$.

Table 4: Principals' Control Choices: Treatment Effects by Group Type

	(1)	(2)	(3)	(4)
No induction	2.715***	3.822***	2.662***	3.806***
	(0.234)	(0.672)	(0.239)	(0.683)
Not satisfied	-0.013	-0.093		
	(0.153)	(0.193)		
Both not satisfied			-0.485	-0.575
			(0.393)	(0.349)
Self not satisfied, partner is			0.387*	0.424*
			(0.155)	(0.205)
Self satisfied, partner not			-0.367	-0.557*
			(0.232)	(0.226)
Both satisified	-0.174	-0.186	-0.176	-0.200
	(0.118)	(0.132)	(0.118)	(0.131)
Individual heterogeneity	No	Yes	No	Yes
Session dummies	Yes	Yes	Yes	Yes
Observations	165	147	165	147
Wald chi-square	31524.55	10673.44	6672.17	7556.96
Prob > chi-square	0.000	0.000	0.000	0.000
Likelihood-ratio test of alpha=0	441.68	304.64	412.71	273.93
Prob > chi-square	0.000	0.000	0.000	0.000

Note: The table shows the results of negative binomial regressions of group type on the level of control implemented by the principal. The same control variables as in Tables 2 and 3 are used to account for individual heterogeneity (Columns 2 and 4) and session-specific effects (all columns). A likelihood-ratio test (estimated without robust standard errors) indicates over-dispersion of the data for all specifications. Robust standard errors are in parentheses. * $z < 0.05$, ** $z < 0.01$, *** $z < 0.001$.

4 Conclusions

Our results imply that not only successful group induction carries behavioral consequences. Even if group induction failed, the subjects' behavior can appear similar to that in groups involving social ties. The underlying motivations for the seemingly identical behavior, however, are quite distinct. When group membership is salient, individuals appear to 'identify' with their fellow group members, resulting the well-known pattern of in-group favoritism (for instance, Tajfel, 1978; Akerlof and Kranton, 2000). When the attempt to induce group membership failed due to the misbehavior of one partner, the 'identity' effect seems to be replaced by a 'bad conscience' effect, both leading to similar outcomes. While group-manipulation checks are already common in other behavioral sciences such as psychology (Perdue and Summers, 1986; Mayer and Davis, 1999), our finding of heterogeneous treatment effects advocates their importance also for economic experiments.

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5 Experimental Instructions

5.1 Written (English Translation)

Welcome to this experiment and thank you for your participation!

In this experiment – financed by the German Research Foundation (DFG) – you can earn money, depending on your own performance and decisions as well as the decisions of other participants. Therefore, it is important that you read these instructions carefully.

If you have questions at any time, please press the 'pause' key on your keyboard. We will come to you and answer your question. Please pose your question quietly. All participants in the experiment receive the same printed instructions. You will obtain more information on your screen as the experiment progresses. Please read this thoroughly and carefully. The information on the screen is only intended for the respective participant. Please do not look at the screens of other participants and do not talk to each other. If you offend against these rules, we are unfortunately required to expel you from the experiment. Please switch off your mobiles now.

General Schedule This experiment takes about 45 minutes. The experiment comprises three stages and a final questionnaire. You will receive detailed instructions for every stage during the experiment on your screen. Please read these instructions carefully.

Questionnaire A short questionnaire will follow after the experiment. Having filled out this questionnaire, please remain seated until we call you separately for payment.

Further Schedule After you have read the instructions carefully, please wait for the other participants and then start with the computer program on your screen. After the completion of the questionnaire after the last part of the experiment you will be called individually to receive your payment. Please note that for this experiment the use of electronic devices (e.g. pocket calculators) is not allowed. Please turn off your cell phones now.

Good luck!

5.2 On-Screen (English Translation)

Intro [*The headlines (in bold) are not shown to the participants*]

Welcome to the experiment!

Thank you for your willingness to participate in this experiment. Please read all descriptions during the experiment carefully.

This experiment consists of three stages. At the end of the experiment, one of these stages is chosen randomly to determine your payment. Payment is made after the experiment. All payouts are rounded to the nearest 10 cents.

During the experiment, all calculations are shown in ECU. One ECU corresponds to 0.10.

For showing-up to this experiment in time, you will, in addition to your payoffs earned during the experiment, receive 2.50.

All information you provide in this experiment will be treated confidentially.

Pre-Game: Group Formation Intro

Part One

You will be asked to make a decision with one of of the other participants in this experiment – your partner. Below we will explain the decision situation.

Both you and your partner have an endowment of 50 ECUs for this task. You can distribute this money to a private account, to a group account, or to both accounts.

Your total payoff depends on your choice how to distribute the money and on the choice of your partner. You will receive the sum of the private account

and twice the minimum deposit in the group account. The following formula illustrates your payment:

Total payment = money on the private account + 2 times the minimum of your contribution to the group account and your partner's contribution to that account

Before you will have to make your decision you now have the opportunity to talk with your partner about this game and your strategies how to play the game.

Pre-Game: Group Formation Chat Now, please talk to your partner about the game! Also discuss how you will play the game best! After the time has expired, you will be passed on automatically.

Pre-Game: Group Formation Game Please divide the 50 ECUs between the group account and the private account.

Group account

Private account

[PARTICIPANT MAKES DECISION]

Pre-Game: Group Formation Feedback Results

Group account

Your partner's contribution

Your contribution

Private Account

Your contribution

Your payoff

Please tell your partner now how you assess his decision

Very unfair (1) (2) (3) (4) (5) Very fair

[PARTICIPANT MAKES DECISION]

Pre-Game: Group Formation Feedback Back Your partner regards you on a scale of 1-5 (where 1 is very unfair and 5 is very fair) as: [Chosen number of partner]

In the course of the experiment you will again play together with your partner. To recognize your partner, all decisions of your partner will be marked in blue!

Pre-Game: No Group Formation Intro

Part One
In this stage, you are asked to solve as many tasks as possible in 2:15 minutes. The task is to bring the slider shown on the screen in the middle position (to the value 50). Once you have positioned the slider for the first time, you will see the position (shown as a number). You can move the slider as often as you want. The number of sliders you already positioned correctly will appear at the top of the screen.

You get 80 ECUs for this task, no matter how many sliders you move in the correct position.

Pre-Game: No Group Formation Game [PARTICIPANT PERFORMS SLIDER TASK]

[When finished] Please wait until everyone is finished with the task.

Effort-Choice Game: Intro

Principal [NCE/CE] [*below, the first part in the square brackets is only shown to NCE participants, the second part is only shown to CE participants*]

Part Two
Players: You play this stage together with [another player/your partner form the previous stage].

Endowment: You do not have any own endowment in this stage. Your [fellow player/partner] has an endowment of 117 ECUs. Your [fellow player/partner] has the opportunity to share with you something from his endowment of 117 ECUs. You have the opportunity to require a minimum contribution from your [fellow player/partner]. In his sharing decision, your [fellow player/partner] is not allowed to fall short of this minimum. However, your [fellow player/partner] is free to give you more than the required minimum contribution.

The possible minimum contributions are:

No minimum contribution / 6 / 21

Own payoff: Your [fellow player's/partner's] transfer, which is doubled by the experimenter. You get paid that amount with a probability of 90%. With a probability of 10% you will receive the minimum contribution that you required

(again, doubled by the experimenter); that is, you cannot know whether your [fellow player/partner] provided only the minimum requirement or more.

Payoff of your [fellow player/partner]: Your [fellow player/partner] gets the difference between his endowment and the amount transferred to you.

Agent [NCE/CE]

Part Two

Players: You play this stage together with [another player/your partner form the previous stage].

Endowment: In the following stage of the experiment, you have an endowment of 117 ECUs. Your [fellow player/partner] does not have an own endowment. You have the opportunity to transfer to your [fellow player/partner] some part of your endowment. Your [fellow player/partner] may request a minimum contribution from you. If he decides to do so, you are not allowed to fall short of this minimum requirement in your decision how much to transfer to him.

The possible minimum contributions you may face are:

No minimum contribution / 6 / 21

Own payoff: You will get paid the difference between your endowment and the amount you decide to transfer to your [fellow player/partner].

Payoff of your [fellow player/partner]: The amount that you have decided to transfer, which is doubled by the experimenter. Your [fellow player/partner] gets this amount with a probability of 90%. With a probability of 10% he receives the minimum contribution that he required for himself (again, doubled by the experimenter).

Effort-Choice Game: Decision Principal Below you can decide how much your [fellow player/partner] at least has to a transfer to you.

Please indicate here how high the minimum requirement should be.

- No minimum
- At least 6 (so you get at least 12)
- At least 21 (so you get at least 42)

[PRINCIPAL MAKES DECISION]

Effort-Choice Game: Expectations Agent

Expectations Please indicate now for how likely you consider the following minimum requirements of your [fellow player/partner]. Please provide all information in percent (that is, your numbers must add up to 100).

How likely do you think it is that your [fellow player/partner]

- Leaves the decision to you
- At least requires 6 from you
- At least requires 21 from you

[AGENT MAKES DECISION]

Effort-Choice Game: Second-Order Expectations Principal

Expectations Please think about with which probability your [fellow player/partner] expects you to impose each possible minimum contribution. Please provide all information in percent (that is, your numbers must add up to 100).

How likely do you think it is that your [fellow player/partner] thinks that ...

- You leave the decision to him.
- You require at least 6
- You require at least 21

[PRINCIPAL MAKES DECISION]

Effort-Choice Game: Decision Agent (strategy method) The table shown below lists all possible minimum requirements your [fellow player/partner] can impose. Your [fellow player/partner] has already made his decision, which you do not know as of yet. Please decide for all possible minimum requirement of your [fellow player/partner] how much you are willing to transfer to him. Your final payment is determined by the transfer decision you have made for your [fellow player's/partner's] actual minimum restriction. Please note that all possible transfers must not exceed 117 ECUs. If you have questions, please press the *Pause* button.

Your [fellow player/partner] ...	Your transfer
leaves the decision to you	
requires you to contribute at least 6.	
requires you to contribute at least 21	

[AGENT MAKES DECISION]

Real Effort Game [NOT DISCUSSED IN THE PAPER]

Experiment: End The experiment is now complete. We will now show you which of the three stages of the experiment is chosen to determine your payoff.

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