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**TEAM COMPOSITION, DIVERSITY, AND PERFORMANCE: AN  
EXPERIMENTAL APPROACH**

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*Abstract*

Does socio-demographic diversity within undergraduate student teams affect learning outcomes? Based on an experiment among undergraduate student teams, we found some evidence of the aggregate of a team's socio-demographic characteristics influencing its performance, no such association was found concerning intra-team diversity. Remarkably, though, the greater degree of familiarity among the team members in self-selected as opposed to randomly assigned teams is associated with lower team performance. This result may be worth bearing in mind for students and instructors alike, not least in the context of peer instruction.

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**Keywords:** Team composition, team diversity, team performance.

## 1. Introduction

The heterogeneity of student bodies is on the increase, certainly at German universities (Willich et al. 2011; DSW 2014). Whether this development constitutes more of a challenge or of an opportunity for the learning process (Wielepp, 2013; Krüger-Basener et al. 2013) depends not least on choices to be made by the students (e.g. in their choice of partners in team work), by lecturers (e.g. in (not) allowing their students a free choice of partners), and by the higher education institutions (e.g. the provision of language

courses and intercultural training). In this context, as everywhere, information is the key to good decisions, and we aim to make a small contribution to improving the information base of such decisions. |

## **2. Problem Statement**

|This paper offers additional insights in a particular sphere of the learning environment, namely where students work in teams of two to achieve the outcomes prescribed by the curriculum. For this purpose, it describes the set-up, the results and the implications of an experiment among second-year students of Management at the University of Hamburg. We ask, firstly, how team composition differs in terms of socio-demographic diversity if students are allowed to freely choose their team partner, as compared to randomly assigned teams. Secondly, we examine whether a team's socio-demographic characteristics, and the degree of diversity with respect to these characteristics, affects team performance, which is proxied by the number of correct responses to a brief single-choice test of the material taught in previous lectures. Regression analysis is used to test for any association between (the degree of diversity in) student characteristics and team performance. |

## **3. Research Questions**

|The questions addressed in this article touch upon a range of existing research, and reference to more specific results from the literature will be made below in the Discussion. Regarding team composition, Byrne's (1971) 'law of attraction' suggests a tendency to team up with similar individuals. This expectation is confirmed empirically by Goins/Mannix (1999), who furthermore also investigate the relationship between team composition and performance. In a setting not dissimilar to ours, Chapman et al. (2006) likewise examine the performance differential between randomly and voluntarily assembled teams, but they do not focus on diversity as a potential transmission mechanism. Rienties et al. (2014) also investigate voluntary versus random teams of two students, but with respect to other outcome variables.

Besides team formation, this study expands upon literature regarding the connection between students' socio-demographic characteristics and their learning performance. Prior work in this area includes Schmucker/Häseler (2015, 2016), but also Erdel (2010) and Jirjahn (2007). Once students collaborate in teams, the relationship between personal characteristics and performance naturally becomes more complex. Rastetter (2006) provides a general overview of the challenges associated with diversity in teams. Since the 1980s, a large number of studies have examined the interconnection between team diversity and performance, including Wegge et al. (2008) and several meta-studies, such as Horwitz/Horwitz (2007), Bell et al. (2011) and Schneid et al. (2014). However, most of this (empirical) literature applies to the corporate rather than to the higher education context. The present study aims to close this gap.

The theoretical framework concerning the association between team diversity and performance can be summarised in terms of two opposing arguments. On the one hand, cognitive diversity within a team – the degree to which the members differ regarding their perspectives, expertise, and experiences (Miller et al. 1998) – is hypothesised to enhance team performance because the unique cognitive attributes of the

individual members promote creativity, innovation, and problem solving (Hambrinck et al. 1996, McLeod/Lobel 1992, Cox/Blake 1991).

By contrast, a negative association between team diversity and performance would be expected under the perspective of social identity theory (Tajfel/Turner 1986, Tziner 1985): homogeneous teams work together well because of the shared characteristics of their members; a high degree of similarity promotes team cohesion and thus performance.

Finally, in terms of methodology, the student experiment that underlies this study constitutes yet another interesting application of a class room response systems with so-called ‘clicker’ devices. These are handheld transmitters featuring a set of buttons which the participants in a survey or test can press to convey their selection from a list of available responses. The answer choices are recorded electronically for subsequent analysis. Clickers are experiencing ever wider use (Kundisch et al. 2013, Bender/Thiele 2014) and have been associated with a number of benefits in teaching (Kay/Lesage 2009, Caldwell 2007, Simpson/Oliver 2007, Wolf et al. 2014, Schmucker 2015, Schmucker/Häseler 2015, 2016).

From the preceding theoretical considerations and literature, we derive three main hypotheses. Firstly, it is assumed that the mode of team formation – voluntary versus random – will make a difference to the degree of socio-demographic diversity within the team. More specifically, it might be expected that students, if allowed to choose, will tend to select partners who are in certain respects (e.g. gender, age, cultural background) similar to them and whom they know: similarity and familiarity are associated with trust and ease of communication (Byrne 1971). Thus, the students are expected to make a convenient choice of team partner. Secondly, we hypothesise that socio-demographic characteristics matter to team performance and, thirdly, that team performance moreover depends on the degree of diversity within a team. This latter effect, if any, could be driven by either or both of (at least) two theoretical considerations: on the one hand, it might be argued that collaboration within a homogenous team involves lower transaction costs (Williams/O’Reilly 1997), yielding better outcomes. On the other hand, diversity within a team can prevent groupthink (McLeod/Lobel 1992) and thus lead to better decisions. |

#### **4. Purpose of the Study**

|The results of the experiment may serve to guide students in their choice of team partners, and provide a hint to lecturers and other rule-setting institutions in the (higher) education context as to whether to permit such choice in the first place. |

#### **5. Research Methods**

|The experiment was conducted in April 2016 during regular lecture hours in the class “Introduction to Human Resource Management” attended by undergraduate (mostly third semester) students studying for their bachelor degree in Socioeconomics at the University of Hamburg, Germany. The students were advised beforehand that an experiment was to take place in class with the twofold objective of generating data for a social science research project and of providing them with an opportunity to check their grasp of the course contents taught so far. The students were also asked to pair up in teams of two, if possible, before they entered the lecture theatre. The smallest possible team size of

two was selected for ease of analysis, to gain insights relevant to the technique of peer instruction (Mazur 2013), and in light of recent research suggesting the particular effectiveness of such small teams (Verganti, 2016).

On the day of the experiment, as the self-selected student teams entered the lecture theatre, they were assigned in a quasi-random fashion to specific seats that had a pair of clicker devices ready for use on the tables in front of them. Once the students had settled down, roughly half of the teams were asked to split up: each team was to swap one member with the neighbour team. As a result, we now had, on the one hand, 30 teams who had paired up voluntarily (with the exception of one or two late arrivals, who were assigned a partner on an ad hoc basis), and, on the other hand, 24 teams who were assembled virtually at random.<sup>1</sup>

The experiment began with each student answering, through his or her individual clicker, a set of questions regarding their socio-demographic characteristics, namely their gender, age group, the qualification on whose basis they had been admitted to the course of study, whether they had completed vocational training prior to entering the university, and their migratory and native language backgrounds.

Table 1 shows the answer choices and the frequency distribution for each of these characteristics.

**Table 1.** Descriptive statistics on the participating students

Questions and Answer Options		Frequency
Please indicate your gender.		
	Male	33
	Female	71
Please indicate your age.		
	up to 20 years	17
	21 to 25 years	55
	26 to 30 years	23
	31 to 35 years	6
	above 35 years	4
How did you qualify for entry to the course of study? <sup>2</sup>		
	general high school certificate	85
	qualified high school certificate plus oral entry exam	6
	written and oral entry exam	11
	Other	7
Have you completed vocational training prior to your studies? <sup>3</sup>		
	No	73
	Yes	36
What is your nationality / migratory background?		
	German	60

<sup>1</sup> Since 109 students participated in the experiment and there were no “left-over” individual students, we can only deduct that one clicker must have failed, despite prior testing.

<sup>2</sup> ‘General high school certificate’ refers to the German *Abitur* exam, while ‘qualified high school certificate’ refers to the *Fachabitur*, which tends to be associated with somewhat lower achievement than *Abitur*.

<sup>3</sup> This will typically mean around three years of on-the-job training and further education.

	German, 1 <sup>st</sup> generation migratory background	14
	German, 2 <sup>nd</sup> generation migratory background	24
	other nationality	11
What is your native language?		
	German only	58
	a different language	9
	two languages, one of which is German	33
	two languages, neither of which is German	6

Next, the students were asked to answer, again individually and through their clickers, a set of ten single-choice questions on the course contents taught so far. Either three or five answer options were given for each question. The partners in each team were asked to leave one seat vacant as collaboration was not intended for this part of the task. The number of correct responses out of these ten questions yielded the measure of individual performance, which we later use as a predictor of team performance.

The experimenters then approached each team and collected one of the two clickers, having noted the serial numbers on both clickers so that the responses conveyed through them could later be matched. Following this, the team members were asked to move closer together again and to indicate, using the one remaining clicker, whether they were a voluntary team and how familiar they were with each other.<sup>4</sup> Finally, the teams were to respond to another set of ten questions regarding the contents of the course, though this time after consulting with each other in the manner of peer instruction (Mazur 2013). The number of correct responses formed our measure of team performance, the main dependent variable of interest.

## 6. Findings

### 6.1. Team Composition

The first research question is whether the self-selected teams differ from the randomly assembled ones with respect to their degree of diversity. Table 3 shows summary statistics regarding a number of indicators, covering – depending on the completeness of data for each indicator – between 27 and 30 self-selected teams and between 22 and 24 random teams.

Not surprisingly, the members of the ‘voluntary’ teams are much more familiar with each other, with a mean value of 1.83 on the 0 to 3 scale, compared to a mean of 0.5 for the random teams. The difference is highly significant. A marked difference also exists with respect to the proportion of teams whose members match in the sense of both (not) having a German-only native language background. Nearly 80% of the ‘voluntary’ teams exhibit no diversity (i.e. a match) in this respect, compared to only 36.4% of the random teams. This difference, too, is statistically significant at standard levels of confidence. The theoretically expected proportion of teams with a match in this regard – 50.2% – lies in between these two values.

<sup>4</sup> The question regarding familiarity was, “How well do you know your team partner?”, and the answer choices were, “not at all”, “hardly”, “fairly well”, and “very well”. Later in the analysis, these values are coded on a 0 to 3 scale.

Regarding the other socio-demographic characteristics, the two types of teams do not differ significantly in their degrees of diversity, so there is less of a tendency of participants with similar characteristics to team up than might perhaps be expected. Notably, gender does not appear to play a role in the students' choice of team partners.

**Table 2.** Degrees of diversity in random versus self-selected teams

Basis of comparison	Self-selected teams	Random teams	Expected value <sup>5</sup>	t-value <sup>6</sup>
mean of familiarity value	1.83	0.5	n/a	5.73***
proportion of same-sex teams	66.5%	63.6%	55.8%	0.2
mean number of age categories between team members	0.81	0.91	0.97	0.44
proportion of teams with equal training status	39.3%	45.9%	55.6%	0.7
proportion of teams with equal German-only migratory background status	72.4%	58.3%	50.4%	1.08
proportion of teams with equal German-only native language status	79.3%	36.4%	50.2%	3.31***

## 6.2. Team Performance

Next, we turn to the determinants of team performance, examining the responses to the second block of ten questions. In Table 3, 'Voluntary teams' refers to a dummy variable that takes the value of 1 if the team members came together voluntarily, and 0 otherwise. 'Performance maximum' refers to the greater of the two individual performance scores from the first round of questions. All variables ending in "sum" represent the sum of the two individuals' values for that variable. For example, 'Male sum' can take the values 0 (two females), 1 (mixed team) and 2 (two males). 'Abitur' refers to a team member having been admitted to the course of study on the basis of a general high school certificate (*Abitur*, value of 1) versus all other options (value of 0). Accordingly, 'Abitur sum' can also take the values of 0, 1, or 2. The following variables are constructed in a parallel manner: 'Training sum' (prior vocational training for none, one or both team members), 'German language only sum' (native language is only German, versus all other options), 'No migratory background sum' (German nationality without a migratory background, versus all other options). This set of regressions thus looks at *aggregate* indicators of the students' socio-demographics, rather than at *diversity* within the teams. Poisson regression was used throughout owing to the non-continuous (count data) nature of the dependent variable.

<sup>5</sup> The expected value is the likelihood of obtaining a match from two consecutive random draws from the set of participants without replacement, except for age indicator, where the calculation differs due to the larger number of possibilities.

<sup>6</sup> t-test for the difference between the sample means / proportions of the self-selected versus random teams. (\*\*\*) statistically significant at the 1% level.

**Table 3.** Determinants of team performance – aggregate characteristics

<b>Variable</b>	<b>Model 1.1</b>	<b>Model 1.2</b>
Voluntary teams	0.329* (0.195)	0.199 (0.169)
Familiarity	-0.185* (0.107)	-0.182** (0.075)
Performance sum	-0.051 (0.066)	
Performance maximum	0.2* 0.114	0.101* (0.054)
Male sum	-0.017 (0.135)	
Abitur sum	0.041 (0.174)	
Age sum	0.007 (0.066)	
Training sum	-0.136 (0.185)	
German language only sum	0.229 (0.194)	0.224** (0.09)
No migratory background sum	0.042 (0.176)	
number of observations	41	49
adjusted R <sup>2</sup>	0.388	0.365
Poisson regression. Standard errors in parentheses. (*) statistically significant at the 10% level and (**) at the 5% level. Constant term included but not reported.		

Model 1.1 includes all the information we have on the teams, but the results do not lend themselves to interpretation, due to the low levels of statistical significance. If we alternatively include only either of ‘Performance maximum’ and ‘Performance sum’ in the model, we find that the former adds significantly more to explaining team performance than the latter (additional tests conducted but not reported). This seems to suggest that the member with the lower individual score does not contribute much to the team effort – perhaps an indication that the task at hand does not really require a true team effort, a point we return to in the limitations section.

Model 1.2 is derived by sequentially eliminating the variables with the least significant coefficients. Somewhat surprisingly, we find that team performance is strongly negatively associated with the degree of familiarity, an additional unit of familiarity costing about 0.2 correct answers. A possible explanation of this finding is offered in the Discussion below. Furthermore, the more German-only native speakers a team contains, the higher its performance. The results are similar if we replace that variable with the indicator for ‘No migratory background sum’ (not reported in the table). The mode of team selection (voluntary versus random) does not have a significant impact on performance, even if we drop ‘Familiarity’ from the model.

A related and yet different question is whether performance depends on the *degree of diversity* within the teams. To this end, we compile a different set of independent variables for the regressions summarised in Table 4. Indicators that end in ‘difference’ measure the difference between the two team members in ordinal or interval terms: ‘Age difference’ (difference in age categories) and ‘Performance difference’ (difference in the two individual performance scores). By contrast, variables that end in ‘diversity’ refer to underlying dummy variables (‘Male’, ‘Abitur’, etc.) and are themselves dummy variables, taking the value 1 if there is diversity (i.e. no match) among the team members with respect to that characteristic, and 0 otherwise. Finally, ‘Diversity index’ is an index of diversity in all of a team’s socio-demographic characteristics, calculated as the size of a team’s age difference plus a point for each difference between the members with respect to gender, entry qualification, training status, and German-only migratory and native language backgrounds. Thus, the more diversity there is within a team, the higher the index.

**Table 4.** Determinants of team performance – diversity of characteristics

Variable	Model 2.1	Model 2.2	Model 2.3
Voluntary teams	0.239 (0.182)	0.247 (0.164)	0.188 (0.155)
Familiarity	-0.139 (0.093)	-0.126* (0.072)	-0.119 (0.075)
Performance difference	0.068 (0.059)		
Male diversity	0.143 (0.175)		
Abitur diversity	-0.247 (0.191)		
Age difference	0.025 (0.121)		
Training diversity	-0.051 (0.17)		
German language only diversity	0.119 (0.212)	0.308** (0.143)	
No migratory background diversity	0.11 (0.215)		
Diversity index			0.039 (0.043)
number of observations	41	49	52
adjusted R <sup>2</sup>	0.242	0.185	0.051
Poisson regression. Standard errors in brackets. Statistically significant at the 10% (*) / 5% level (**). Constant term included but not reported.			

Model 2.1 is notable only for the complete lack of statistically significant coefficients. The overall fit is much lower than with aggregate team characteristics (Table 3). Much of the explained variation is due to the explanatory power of the mode of team selection and the degree of familiarity, both of which are not specifically related to diversity and were included only for the sake of comparability. The

coefficients on these two variables exhibit the same signs as previously. The (insignificant) positive sign on 'Performance difference' most likely reflects the effect that a team with a large difference in individual performances usually also has a high maximum performance – which is what really drives team performance (see model 1.1). And indeed, if we add 'Performance maximum' to model 2.1 (not reported), the coefficient on 'Performance difference' tends to zero.

Again sequentially eliminating the variables with the lowest levels of significance, we are left with only one diversity-related variable in model 2.2. 'German language only diversity' is positively related to team performance at the 5% level of significance. Here, too, the results are similar but slightly less pronounced if we use 'No migratory background diversity' instead. Yet even here we need to be careful in interpreting this result. A team that is diverse in this respect is one that includes a native speaker of only German. One might hypothesise that the positive coefficient in particular differentiates such teams from those that comprise no such students. This hypothesis is confirmed if we control for the latter type of teams (results not reported). Indeed, teams in which both members have a migratory / partial foreign language background perform significantly worse than other types of teams (0.6 fewer questions answered correctly on average – the strongest effect in any of the regressions), and once this auxiliary variable is controlled for, the coefficient on 'German language only diversity' becomes negligible. Thus, the initial result is not driven by diversity as such.

Finally, the insignificant and small coefficient on the 'Diversity index' in model 2.3 in a sense summarily confirms the non-effect of diversity within teams on their performance.

### 6.3. Discussion

Our first research question concerned the way in which students pick their team members if allowed to choose, as compared to (quasi-)random team formation. We found no significant difference in the levels of diversity within the two types of teams, except with respect to native language background and – not surprisingly – the degree of familiarity. In particular, gender, age and prior education do not appear to be relevant criteria in the choice of partners. To a certain extent, this result contradicts our prior expectations ('students will make convenient choices') and theory, especially the 'laws of attraction' (Byrne, 1971). Particularly with respect to gender, we hypothesized that the students of Socioeconomics would behave in accordance with the evidence provided by Goins/Mannix (1999), who found that especially young people tend to choose team partners of the same gender. Perhaps our inability to confirm these findings may be explained by the existence of a few (aspiring) mixed-gender couples in our group; however, information on relationship status was not collected, so there is no way of knowing.

By contrast, there is no room for speculation with respect to the second apparent basis of partner selection: native language, which in our sample is almost equivalent to migratory status. Goins/Mannix (1999) also find evidence of team selection being based on ethnic background. This is a cause of concern as, in an increasingly ethnically diverse environment, it may lead to segregation.

Once the teams had been assembled, we investigated whether their *aggregate* socio-demographic characteristics had an impact on their performance, as measured by the number of correct answers in the repeat test. Among these characteristics, only native language (or, almost equivalently, migratory status) evidenced a significant (positive) association with team performance. Specifically, teams with more

German-only native speakers did better. At first glance, this is not surprising, considering that the lectures and test questions were in German language. At second glance, though, the results also imply a disadvantage for native speakers of German plus a second language (in this group, likely Turkish in most cases). Since bilingualism per se is not generally associated with lower educational performance (Han 2012), it remains unclear what other mechanisms are at work here.

Holding the degree of familiarity constant, we also found that voluntary teams achieve marginally better results (model 1.1), in accordance with Chapman et al. (2006). Earlier we saw that the degree of familiarity is significantly higher in the voluntary teams than in the quasi-random teams. This is not particularly surprising and mirrors similar findings by Rienties et al. (2014), Chapman et al. (2006), and Goins/Mannix (1999). What is remarkable, though, is the negative relationship we found between the degree of familiarity and team performance in model 1.2. This means that the marginally higher performance of voluntary teams cannot be explained by the greater familiarity within them. Instead, the convenient selection of a well-known team partner appears to be a poor choice in terms of performance prospects.

How may this be explained? We suspect that ‘groupthink’ (Janis 1972) comes into play: a process by which a well-established team makes poor decisions because its members value harmony over creativity achieved through constructive conflict. By contrast, teams composed of strangers may place less importance on harmony and thus be prepared to admit more dissent and unpopular views. Moreover, unfamiliar team partners do not know each other’s strengths and weaknesses and therefore cannot ‘blindly’ rely on each other. In our setting, each partner in a ‘random’ team must make up their own mind as to the correct answer and will only be prepared to adopt a deviating point of view in the face of convincing arguments. Such discussion provides the students with an opportunity not just to improve their team performance and knowledge of the course contents but also to develop their communication and people skills, to expand their personal network, and a number of other positive effects. Many of these benefits are lost to those who team up with their more familiar peers, for interaction with friends does less for a young person’s education than interaction with foreigners. These findings lead us to question students’ and instructors’ common preference for the democratic, voluntary mode of team selection.

The final part of the analysis focused on the question whether team performance is driven by the degree of socio-demographic diversity within the team. The summary answer is ‘no’. Diversity with respect to gender and age is unrelated to performance, as also found by Schneid et al. (2014) and Horwitz/Horwitz (2007). However, the latter authors find a slight positive effect of so-called task-related diversity on performance, as do Bell et al. (2011) in their meta study. By contrast, our proxies of task-related diversity – university access qualification and prior vocational training – exhibit a slight negative, if insignificant, association with team performance.

#### **6.4. Limitations**

Caution is clearly warranted in generalising the findings just discussed. This is due, on the one hand, to the general difficulty of applying experimental evidence to other settings (see Biemann/Weckmüller 2012, in the same context) and, on the other hand, to several limitations of the study. These limitations primarily concern the nature of the teams and of the task posed to them. Our

groups of two students are barely teams in the usual sense, not just because of the small size but because they lacked any team-building phase and because the task at hand did not require much in-depth interaction of them. Creativity – the type of output best produced by teams – was not called for, nor was there any scope for a division of labour.

To elicit some dynamics within the teams and also to provide scope for more complex tasks, future research could embrace a longitudinal design. Teams could comprise four to five members, and their collaboration and output could be monitored at regular intervals throughout the term to produce a richer picture of diversity in teams. A second strategy to improve the results would be to maintain the present research design but to collect data on additional control variables in order to obtain more precise estimates of the effects. A candidate for an omitted variable, for example, would be the educational achievements of the students' parents as a proxy of their children's commitment to their studies. |

## 7. Conclusion

| In the experiment presented in this paper, the degree of socio-demographic diversity within student teams of two hardly differed between teams formed voluntarily and those assembled in a quasi-random fashion. The notable exception to this finding was the students' tendency to form ethnically homogeneous teams – a cause of concern, given the ever more ethnically diverse world we live in.

While we found some evidence of the *aggregate* of a team's socio-demographic characteristics influencing its performance, no such association was found concerning *intra-team diversity*. From this we deduct the tentative recommendation for students to select team partners of whom they expect a strong performance, and not to worry about diversity.

We have more confidence, by contrast, in recommending that students resist the temptation to select team partners they are well familiar with. Such a convenient choice is not only likely to reduce team performance but also deprives them of an important opportunity for personal enrichment. And since the students themselves perhaps cannot be trusted to act against their own (short-term) preferences, the duty falls on other institutions within higher education – especially the lecturers – to promote the non-voluntary formation of teams. This recommendation appears especially relevant in the context of the method of peer instruction. |

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