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Automatic and controlled information processing in the context of students' ethnic background and social status: An eye-tracking study

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Abstract

Based on the continuum model of impression formation (Fiske & Neuberg, 1990), information processing can be more or less automated or controlled and thus relies more or less on stereotype-based or individual-based characteristics. Also, teachers' impression formation can be influenced by social categories like students' ethnic background or social status. However, when teachers form an impression of students' abilities or performance social categories should not play a role. But a lot of empirical findings show that teachers make a difference depending on students' backgrounds. Whether this can be explained by a more automated or controlled information processing depending on students' backgrounds is still an open question. Accordingly, the purpose of this study was to investigate teacher students' impression formation in dependence on students' ethnic backgrounds and social status. In order to investigate whether information processing differs according to students' ethnic backgrounds and social status, an experimental eye-tracking study with 45 teacher students was designed. As physiological processes are strongly connected to psychological processes, specific eye-movements can be interpreted as indicators for physiological arousal in first place, but might also allow conclusions about mental processes like information processing. Pupil diameter and blink rate were measured while participants read three case vignettes with manipulated student background. Analysis of variance with repeated measures showed differences in pupil diameter and blink rate according to students' background. Results showed less arousal when forming an impression about students without immigrant background and with high social status compared to students with immigrant background and with low social status. This might indicate more automated information processing

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for non-immigrant students with high-status, and more controlled processing for students with immigrant background and low-status.

Keywords Impression formation · Information processing · Eye-tracking · Teacher students · Students' immigrant background · Students' social status

1 Introduction

Students with immigrant background still face several challenges in school, e.g., they achieve lower performance or leave school more often without graduating (e.g., Aud et al., 2010; Kena et al., 2015; Lee, 2002). Empirical research shows that even when controlling for students' actual test performance, some teachers give lower grades to students with an immigrant background or low social status compared to students without an immigrant background or high social status (e.g., Bonefeld et al., 2017). In this context, teachers' influence, e.g., through their judgments and attitudes, is discussed as an important factor for disparities in educational success (e.g., Hattie, 2014). Teachers' judgments underlie mechanisms of social information processing and are thus potentially influenced by cognitive distortions or biases. Because of limited cognitive capacities, people do not always process social information according to individual details but tend to categorize people via existing patterns (e.g., Bruner, 1957; Neisser, 1976). According to the continuum model of impression formation (Fiske & Neuberg, 1990), a less stereotype-based impression formation is the result of deeper, i.e., more controlled processes, which need more cognitive capacities. This might indicate that more controlled processing is more exhausting, demands more capacities and is associated with more cognitive effort. Eye-tracking is considered as a promising method to measure information processing (e.g., Krolak-Schwerdt & Kneer, 2006; Krolak-Schwerdt & Wintermantel, 2004) and has already been used in some educational research (e.g., Hörstermann et al., 2017). Because an analysis of judgments allows only limited conclusions about the underlying cognitive processes (and also might be distorted due to, e.g., social desirability), eye-tracking data were used in the present study to overcome these limitations and to enrich the existing research with data that are closer to the actual processes and not the results of impression formation. To the best of our knowledge, existing studies have mainly focused on fixation data but not on further eye movements that might be indicators for cognitive processes like pupil dilatation and blink rate. The present work aims to discover the underlying cognitive processes of information processing when forming impressions about and judge achievement of ethnic and social minority and majority students. For this reason, an experimental eye-tracking study was conducted.

1.1 Disparities in educational success and the role of teacher judgments

Students' grades, achievements, or graduation are indicators for educational success. Disparities based on students' backgrounds can be found in all of these areas. Students with immigrant background or low status achieve lower performance in school, leave school more often without graduating, and are underrepresented at universities

compared to other students (e.g., Aud et al., 2010; Kena et al., 2015; Lee, 2002). They also have a higher probability to repeat a school year even when actual achievement is controlled for (e.g., Klapproth & Schaltz, 2015). The proportion of students leaving school without graduating or students who are expelled from school is much higher among students with immigrant background compared to students without immigrant background (e.g., American Psychological Association, 2012; Aud et al., 2010; Fenning & Rose, 2007; Gregory & Weinstein, 2008). Although, students with immigrant background can also achieve high performance, they have half the probability compared to ethnic majority students of being recommended for a gifted program (e.g., Nicholson-Crotty et al., 2011). Additionally, despite equivalent cognitive abilities and performance, students with a high social status have a significantly higher probability to attend a higher secondary school track compared to students with a lower social status (e.g., Arnold et al., 2007). So, disparities in educational success depending on students' background can be identified on several levels in the course of education.

Disparities in educational success based on students' ethnic background and social status can be explained by a variety of factors like structural aspects, family conditions, or individual characteristics. As teachers play an important role in students' educational success (e.g., Hattie, 2014), their influence on disparities has also been regularly discussed. It is assumed that the interaction between teachers and students, as well as teachers' judgments and expectations, have a great influence on students' learning and achievement (e.g., Dee, 2005; Weir, 2016). In the context of disparities based on students' ethnic background or social status, empirical research has shown the impact teachers have. For example, Dresel et al. (2017) showed that teachers' frame of reference has an influence on achievement disparities based on students' social status: the more teachers focused on an individual frame of reference, the less disparities based on minority status were found in their class. Teachers' judgments of students' abilities and achievement are particularly essential factors of students' success. But research on teachers' judgment accuracy shows that most of the achievement relevant student characteristics as well as achievements themselves are not judged precisely by teachers (e.g., Alvidrez & Weinstein, 1999; Spinath, 2005; Südkamp et al., 2012). Glock and Krolak-Schwerdt (2013) showed that especially for low achieving students, minority status influences teachers' judgments. Additionally, some research on teachers' expectations—which also might influence students' behavior and achievement (e.g., Good & Brophy, 2003; Jussim, 1990)—indicates that student characteristics can influence teachers' expectations (e.g., Wang et al., 2018). Some empirical research points out that expectations are higher for ethnic and social majority students compared to minority students (e.g., Darley & Gross, 1983; Rubie-Davies et al., 2006; Tenenbaum & Ruck, 2007). As judgments and expectations are a result of social information processing, distortions of teachers' judgments due to students' backgrounds might be explained by different cognitive processes and already existing mental structures.

As each country has specific ethnic minority groups with which certain stereotypes are linked, a short view on the situation in Germany is relevant. In Germany, Turkish students are the largest ethnic minority group (e.g., Statistisches Bundesamt, 2017) and also show the biggest gap in educational success compared to the ethnic

majority and other minority students (e.g., Mehringer, 2013). Therefore, this ethnic minority was focused in the study. Comparable to other countries, in Germany ethnic background is highly confounded with social status (e.g., Herwartz-Emden et al., 2010; Mehringer, 2013; OECD, 2012) and thus needs to be considered (e.g., Becker et al., 2013). Based on the stereotype content model (Fiske et al., 2002; Asbrock, 2010) showed for the German context that people attribute less warmth and less competence to people with an ethnic minority background compared to people with a majority background. As stereotype activation depends on the context (Wittenbrink et al., 2001), it can be assumed that stereotyped attributes for a minority and the majority might be specific for the school context. Although teachers have rather positive explicit attitudes towards culturally previous research by (e.g., Gebauer & McElvany 2017), teachers have less positive attitudes towards ethnic minority students compared to majority students (e.g., Vervaet et al., 2016). For example, Glock and Karbach (2015) showed that teacher students have more negative implicit attitudes towards minority students compared to majority students. Furthermore, a variety of studies show that immigrant background is highly confounded with social status and that effects of ethnicity can partly be explained by social status (e.g., Becker et al., 2013; Kristen & Granato, 2007). Thus, when investigating effects of ethnic background on teachers' judgments, students' social status should also be considered (e.g., Freijo & Jaeger, 1976). However, not only people with an ethnic minority background are confronted with more negative attitudes, as people with low social status are also attributed more negative characteristics (e.g., Glock et al., 2016; Rössel & Pape, 2010; Sielschott, 2010). Due to the high confounding of ethnic background and social status in Germany as well as in other countries (e.g., Herwartz-Emden et al., 2010), this could lead to double discrimination or a preference for certain social groups (e.g., Leacock, 1969).

1.2 Teacher judgments and students' background

Minority status does not necessarily lead to negative distortions in judgment formation. Some empirical research indicates that children with an immigrant background are judged more accurately, but ethnic majority children are overestimated (e.g., Glock & Krolak-Schwerdt, 2014; Kaiser et al., 2017; Ready & Chu, 2015; Ready & Wright, 2011; Tobisch & Dresel, 2017). This might indicate that the problem seems not only to be a negative attitude towards minority students but a more positive attitude towards majority students (e.g., Glock & Karbach, 2015; Glock et al., 2016). For example, Kaiser et al. (2017) investigated if teacher judgment accuracy is influenced by student ethnicity by manipulating students' minority status in a simulated classroom (e.g., Südkamp et al., 2008). With four experimental studies the authors showed that teachers had more accurate judgments for ethnic minority students, which was in line with previous research by Glock and Krolak-Schwerdt (2014). In an experimental study, they showed that teachers remembered more of the presented information in the minority student condition (Glock & Krolak-Schwerdt, 2014), which might be an indicator of more attention and thus more controlled or individual-based processing. For social minority children, Ready and Chu (2015) as well as Ready and Wright (2011) showed in field studies in the preschool context an overestimation of children

with a high social status. This might be explained with more positively attributed characteristics and therefore more category-based processing. In an experimental study with case vignettes and manipulated student background, accurate achievement judgments of ethnic minority students with low-status and an overestimation of ethnic majority students with high-status was found (Tobisch & Dresel, 2017). In some of these studies, the context in which student information was presented might be important, too–e.g., immigrant students as a minority in the simulated classroom (Kaiser et al., 2017) or good grades in the case vignettes (Tobisch & Dresel, 2017). This could lead to more attention because of more salience of minority students or because of information that does not conform with a specific stereotype. In these studies, more accurate judgments of minority students might be a result of more controlled and thus piecemeal based processing, due to this salience. Concerning the overestimation of majority students, it can be assumed that information processing when judging these students might be more automated and thus category based. This might lead to the assumption that positive attitudes towards majority students and stereotype-conforming information might lead to a positively biased judgment that is based on more category-based processing. On the other hand, accurate judgments of minority students might be the result of more individual-based and thus controlled processing. So far, it is still unclear whether the cognitive processes of judgment formation are really different when judging majority and minority students. To our knowledge, most studies have focused on teachers' or teacher students' judgments as a product of these processes, but the underlying cognitive processes are mostly only indicated by judgments or self-reported data. Measurement of physiological data, like eye movements, seems to be a promising approach to supplement another perspective on information processing (e.g., Krolak-Schwerdt & Kneer, 2006; Krolak-Schwerdt & Wintermantel, 2004).

1.3 Information processing and teachers' attitudes

Processing social information, such as achievement-relevant information of students, can be influenced by mental structures and patterns (Neisser, 1976) like stereotypes or attitudes (e.g., Hamilton et al., 1990), which exist for social categories like social or ethnic background. Based on the continuum model of impression formation (Fiske & Neuberg, 1990; Fiske et al., 1999), it can be assumed that people's judgments of others can be more or less category-based and thus automated or more or less based on individual characteristics and thus controlled. Social categories like ethnicity or social status serve as important information sources for categorization and are connected with stereotype knowledge (e.g., Taylor, 1981), which can influence category-based information processing and also judgments (e.g., Glock et al., 2016). People tend to form more automated judgments based on social categories if there are only few cognitive resources, low motivation, or no personal relevance (Fiske & Neuberg, 1990). In 1946, Asch already postulated that social impression formation occurs after a short time and on the basis of only a little information. Empirical research confirmed that impression formation requires only a fraction of a second, is based on only few information that is sufficient for participants to draw conclusions about a person's competence, and, furthermore, that the first impression is relatively stable (e.g., Wil-

lis & Todorov, 2006). In school contexts, Praetorius et al. (2015) showed that teacher students, who saw only a 30s video sequence of students, judged their academic self-concept comparable to teachers who knew those students personally for a longer time. This shows that some social hints are perceived very quickly and lead to judgments that do not differ much from judgments when more time and information is available. In a moment, people judge others' characteristics and can also assign them to social categories as well as associate them with attributes of the categorized groups (e.g., Taylor, 1981). Of course, social categorization and stereotypes as well as attitudes are context dependent (e.g., Casper et al., 2010; Greenwald & Banaji, 1995; Wittenbrink et al., 2001). In the school context, teachers also categorize their students into social groups, for example, they draw conclusions from students' clothes about their social status (e.g., Dunkake & Schuchart, 2015). This is also strongly connected to existing mental patterns like stereotypes and attitudes. Attitudes imply an evaluation of an attitude object (e.g., Eagly & Chaiken, 1993); thus, they play an important role when forming judgments. As these existing mental patterns of favor or disfavor can be associated with the affiliation to a social category, attitudes can influence information processing (e.g., Bargh et al., 1992) about students with a different ethnic background and/or social status. As impression formation occurs in a very short time, this process can also be influenced by implicit attitudes, which people do not need to be aware of, but which are activated automatically. Based on the assumption of in-group preference (e.g., Brewer, 1999) and empirical findings about more positive attitudes towards people from the ethnic majority and with a high-status (e.g., Asbrock, 2010; Devine & Elliot, 1995; Sielschott, 2010; Wittenbrink et al., 1997; Zick et al., 2008), ethnic minority students with low status seem to be confronted with more negative attitudes than ethnic majority students with high-status. According to the continuum model of impression formation (Fiske & Neuberg, 1990) these negative attitudes and stereotypes are especially important in more automated processes, when people do not have the time or cognitive capacities to include more individual information. But, if an information in a situation conforms to the stereotype, people might not see the relevance for more individual information. In contrast, it could be assumed that students to whom negative attributes are linked but who perform well, might attract more attention as this does not conform with the stereotype and, thus, leads to more controlled processing. In the school context for example, Klapproth et al. (2018) showed with an experimental study that stereotype-(dis-)conforming context information influenced preservice teachers' judgments of ethnic minority students.

1.4 Eye-tracking as a method to measure the depth of information processing

To overcome tendencies to answer socially desirable or other limitations of questionnaires, eye-tracking data are discussed as a possibility to get process-data (e.g., Krolak-Schwerdt & Kneer, 2006; Krolak-Schwerdt & Wintermantel, 2004). Hörstermann et al. (2017) already used eye-tracking data to get closer to cognitive processing in judgment formation in the educational context. They conducted an eye-tracking study with undergraduate teacher students and measured fixation duration to analyze attention as a consequence of sequence effects of the presented student information and also included social background information. In contrast to Hörstermann et al.

(2017), we did not focus on attention but on arousal as an indicator for the depth of information processing; therefore, other eye movements were used as indicators.

Oculomotoric reactions, i.e., pupil diameter and blink rate, are directly affected by reactions of the autonomous nervous system, within which the sympathetic part is responsible for activation and the parasympathetic part for damping (e.g., Birbaumer & Schmidt, 2010; Gramann & Schandry, 2009; Meinold, 2005). Pupil dilatation and blink rate are muscular reactions that are innervated by arousal of the autonomous nervous system (e.g., Drake et al., 2015; Galley, 2001; Holmqvist et al., 2011; Pschyrembel, 1997). As psychological arousal is also manifested on a neuronal level (e.g., Fowles et al., 2000; Stemmler, 2001), it also leads to arousal in the autonomous nervous system and allows conclusions to be drawn about psychological processes and, therefore, can be used to overcome some limitations of questionnaire data (e.g., Cacioppo et al., 2004). Empirical research has shown correlations between blink rate and cognitive information processing, for example, in reading studies (e.g., Orchard & Stern, 1991). Tsai et al. (2007) reported an increase in blink rate for participants with higher cognitive load, so it can be associated with deeper cognitive processing. Although, a visual stimulus leads first to a decreased blink rate, Fukuda (2001) showed in two experimental studies that after the inhibition of blinks there was a clear increase in blink rate. More specifically, an increased blink rate occurred at the end of information processing, when working memory load decreases (Ichikawa & Ohira, 2004; Siegle et al., 2008). Besides blink rate, changes in pupil diameter also allow conclusions to be drawn about arousal of the nervous system (e.g., Beatty & Lucero-Wagoner, 2000; Bonowski, 2002) and is therefore an indicator of the depth of information processing. Several empirical findings reveal that pupil diameter increases when information processing is more effortful (e.g., Hyönä et al., 1995; Kruger et al., 2013; Paas et al., 2003). Based on these findings, an increase in pupil diameter and blink rate can be indicators of more arousal. As pupil reaction and blink rate are automated physiological reactions triggered by the autonomous nervous system, they can hardly be deliberately manipulated by participants. Furthermore, the low latency time of pupil reaction (e.g., Gramann & Schandry, 2009) allows a precise connection to a specific presented stimulus. As these physiological reactions are, more or less, automated and allow conclusions to be drawn about arousal, these data were used in our study as an indicator of information processing.

2 Research question and hypotheses

Based on the continuum-model of impression formation (Fiske & Neuberg, 1990) and empirical evidence about teachers' and teacher students' judgments, it was assumed that teacher students' depth of information processing depends on students' ethnic background and social status. As some previous research has indicated that, on the one hand, students with immigrant background are judged more accurately and, on the other hand, some research shows an overestimation of students' performance without immigrant background and high-status (Kaiser et al., 2017; Ready & Chu, 2015; Tobisch & Dresel, 2017), it is assumed that overestimation of students without immigrant background and high-status is the result of a more stereotype-based and

therefore more automated processing, when the information confirms the stereotype. As empirical findings to accuracy and student background are heterogenous, it can be assumed that context information is an important factor. Accurate judgments of students with immigrant background might only occur if student information (e.g., good performance) does not fit the existing stereotypes (i.e., lower achievement of students with immigrant background). As teachers' judgments can be based on more or less stereotyped knowledge, we tried to investigate if teachers' arousal (as an indicator of depth of information processing) differs by students' background when forming an impression. Furthermore, as existing mental structures like attitudes can influence judgments and actions (e.g., Bargh et al., 1996), it is assumed that implicit attitudes also play an important role in the underlying cognitive processes. In particular, automated processes should be affected especially by implicit attitudes. The following directed hypotheses were examined to test these assumptions:

H_1: Teacher students show more arousal (more controlled processing) when reading case vignettes of immigrant and low-status students compared to case vignettes of non-immigrant and high-status students.

H_2: Teacher students with high positive implicit attitudes towards the ethnic majority tend to process information of non-immigrant students more automatically (less arousal) than participants with lower positive implicit attitudes towards the ethnic majority.

3 Method

3.1 Sample and procedure

In an experimental laboratory study (within-subject design), 46 teacher students were asked to read case vignettes that represented mid-year school reports of three boys in fourth grade, whereby participants' pupil diameter and blink rate were detected with an eye-tracker.1 Participants were asked to form an impression about the students.[1]

Since ingroup preferences might influence the impression formation and therefore lead to more or less stereotype-based information processing (e.g., Brewer, 1999), participants were asked about their own social and ethnic background on a 5-point rating scale to which social class they thought their family belonged, from 1 (*lower-level*) to 5 (*upper-level*). The majority of participants reported that their family had an average socioeconomic level (54%) or upper middle-class level (41%), 2% of participants reported that they were from the lower-middle class, 2% from the upper-level and none indicated they were from the lower level. Analyses of ethnic background showed that 22% had at least one parent that had not been born in Germany. Participants with an immigration background varied in their ethnic origin (e.g., Russia, Austria or Sri Lanka). Only one participant had a Turkish background and thus possibly

[1] The data were collected as part of a larger study, in which the participants were then supposed to form judgments about performance-related student characteristics; no correlations of judgments and oculomotoric data were found. As we focus here on information processing no further information about judgment data is presented, but further information can be found at Tobisch (2019).

might identify with the ethnic minority in this experiment, which could distort the analyses. Hence, this participant was excluded from the analyses. Thus, the analyzed sample consisted of $N=45$ teacher students, with a high percentage of women (91%), which is typical for German primary teacher studies. On average, participants were $M=21.47$ ($SD=3.09$) years old and had studied the teaching profession for $M=3.38$ ($SD=1.97$) semesters.

Each case vignette consisted of two parts: one numeric part with all grades and one verbal description of the students' behavior. The numeric report of all case vignettes had a grade point average of 2.33 – based on German grades from 1 (*very good*) to 6 (*insufficient*) – in the three main subjects (German, Mathematics, Social Studies). The verbal report consisted of positive, negative and neutral information about students' learning, social and working behavior. Overall, the case vignettes represented students with rather good performance and rather positive behavior. As each teacher student had to read all three case vignettes, the vignettes varied in their specific formulations, but the proportion and valence of the statements and grades were balanced. The sequence in which the case vignettes were presented was the same for all participants. Only students' ethnic background and social status were systematically varied as in other studies, names were used to manipulate students' background (e.g., Bonefeld & Dickhäuser, 2018; Sprietsma, 2013; Hoenig & Wenz, 2013; Wenz & Hoenig, 2020; Tobisch & Dresel, 2017). Names had to point out clearly students' ethnic background and social status; therefore, names were selected that were associated with a German and Turkish background as well as a low and high social status (e.g., Tobisch, 2013; Tobisch & Dresel, 2017; Utech, 2011; Wenz & Hoenig, 2020). As boys with an (Turkish) ethnic minority background have lower success in the German educational system (e.g., Federal Government Commissioner for Migration, Refugees and Integration, 2014) and, furthermore, are associated by teachers with more problematic behavior (e.g., Weber, 2003), only male students were represented in the case vignettes. As ethnicity and social status are highly confounded (e.g., Mehringer, 2013) and thus ethnic minority names are usually associated with a low-status, only three combinations of ethnic background and social status could be implemented by using names for stereotype activation (*Julius*: German background and high social status; *Justin*: German background and low social status; *Murat*: Turkish background and low social status).

As a manipulation check, participants had to report at the end of the questionnaire their perception of students' ethnic background and social status in the case vignettes. Friedman's ANOVA showed that the manipulation of ethnic background worked very well for all three case vignettes, $\chi^2\ (2)=80.05$, $p<.001$. Both names that were supposed to represent the ethnic majority were rated as non-immigrant students (Julius: 98%; Justin: 96%) and the name that was supposed to indicate an ethnic minority student was rated as an immigrant student by 96% of the sample. As a check for the manipulation of students' social status, participants had to rate the social status of each student's family from 1 (*lower-level*) to 5 (*upper-level*). ANOVAs with repeated measures showed a main effect of students' name on participants' rating of students' social status, $F(1.845,81.199)=7.792$, $p<.001$, $\eta^2 = 0.15$. A priori Helmert contrast analyses showed that participants rated the social status of the case vignette with the student supposedly representing a high-status as higher (Julius: $M=3.36$, $SD=0.65$)

than both the case vignettes supposedly representing a low-status, $F(1,44)=16.155$, $p<.001$, $\eta^2 = 0.27$. Separate analyses showed a significant difference for both low-status students compared to the high-status student: *Julius vs. Justin*, $F(1,44)=2.098$, $p<.05$); *Julius vs. Murat,* $F(1,44)=4.578$, $p<.001$. The two case vignettes that represented low-status students (Justin: $M=3.02$, $SD=0.81$; Murat: $M=2.73$, $SD=0.65$) were perceived as middle-/low-status students, with no significant difference in status perception, $F(1,44)=2.698$, $p=.11$, $\eta^2 = 0.06$.

3.2 Measures

Oculomotoric data were collected with a binocular remote eye-tracker (Sensomotoric Instruments, 2012). To compensate for natural fluctuations in pupil diameter, a sampling rate of at least 120Hz is recommended (e.g., Gramann & Schandry, 2009). Thus, data were collected at a sampling rate of 120Hz and an accuracy of 0.5°. The stimulus was presented on a 19-inch monitor. As suggested by Holmqvist et al. (2011), the eye-tracking laboratory was illuminated with constant neon fluorescent light and no natural light source could cause fluctuations. The stimulus was written in black letters on a white screen and all stimulus pages were comparable in the amount of text. If calibration showed adequate results (deviation lower than 0.5°), the data were used for further analyses. The experiment was designed and implemented with SMI Experiment Center™ 3.6 software (Sensomotoric Instruments, 2014).

Implicit attitude for ethnicity was measured with the Implicit Association Test (IAT; e.g., Greenwald et al., 1998). Based on the assumption that it is easier to combine categories with attributes if there is a strong cognitive association, reaction times are shorter for assigning attributes to target categories that are stored mentally closer. The central aspect of attitudes is a positive or negative tendency towards an object (e.g., Eagly & Chaiken, 1993). Therefore, positive (e.g., intelligent) and negative (e.g., lazy) characteristics (that can be important student characteristics) were selected as attribute dimensions. The target categories were German and Turkish, which were represented by typical first names (e.g., German: Andreas; Turkish: Mehmet; Tobisch, 2013). The IAT was implemented in Inquisit 5 (Millisecond Software, 2016), and participants had to work on stereotype consistent and inconsistent blocks, whereupon reaction times in the consistent block were subtracted from reaction times in the inconsistent block. To avoid effects of the presentation sequence of consistent and inconsistent blocks (e.g., Mierke, 2004), participants were randomly assigned to different block sequences. Results showed no significant differences in implicit attitudes by the sequence of consistent or inconsistent blocks, $t(43)=0.446$, $p=.66$.

There were no missing data of pupil diameter and blink rate as well as of implicit attitudes, as every participant's data were collected in single sessions.

3.3 Analyses

To analyze oculomotoric data for separate parts of the stimulus material, the text was divided into several areas of interest (AOIs), for positive and negative information as well as for specific content (e.g., social behavior). We assume that oculomotoric data

do not differ for all information presented in the same way. As positive and negative information was presented in the case vignettes this might be more or less conform to stereotypes associated with the different student backgrounds. As pupil diameter and blink rate vary between participants, individual data of the instruction pages were used as a baseline. Afterwards, pupil diameter was aggregated for each text part and the baseline was subtracted from the aggregated pupil diameter. Values below zero indicate a decreased pupil diameter compared to the baseline, which indicates less arousal and thus less information processing. Because blinks are technically those moments in data collection when the eye-tracker gets no data (eyes are closed), it is not possible to assign blinks to specific text passages. Hence, the count of blinks was measured on the level of stimulus pages and also set into relation to the blink rate during the first baseline pages. Here, values lower than zero also indicate less arousal compared to the baseline.

To test if information processing differs by students' background, ANOVAs with repeated measures with two repeated measurement factors (students' names and text parts in the case vignettes) for pupil diameter and ANOVAs with repeated measures with one repeated measurement factor (students' names) for blink rate were calculated. As Mauchly's test of sphericity is not precise for small samples (e.g., Rasch et al., 2010), degrees of freedom were corrected with the Greenhouse-Geisser correction. Furthermore, a priori Helmert contrasts were calculated to differentiate the effects of students' ethnic background and social status. The first contrast compares high vs. low social status (Julius vs. Justin and Murat), and the second contrast compares the two case vignettes with low-status for effects of ethnicity (German vs. Turkish background; Justin vs. Murat). To investigate the influence of implicit attitudes about ethnic groups, implicit attitudes were included as a covariate.

4 Results

4.1 Descriptive results

Table1 shows means, standard deviations and bivariate correlations of implicit attitudes (IAT), blink rate and pupil diameter. The results of the IAT indicated a stronger association of positive attributes with a German background than with a Turkish background as well as a stronger association of negative attributes with a Turkish background compared to a German background. No correlations were found of IAT measures with the oculomotor data. We see high correlations of the pupil data between the positive and negative AOIs and also some medium correlations of pupil data across the different student backgrounds. Correlations between the blink rates across the three different student background combinations are also very high.

4.2 Information processing by students' background (H_1)

The main assumption was that arousal as an indicator for the depth of information processing differs depending on students' ethnic background and social status. Following some empirical findings showing accurate judgments of minority students

Table 1 Descriptive statistics and bivariate correlations of implicit attitudes and oculomotoric data by student background

		M (*SD*)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1)	Implicit attitudes	0.58 (0.33)	-								
Oculomotor data for the case vignette representing a non-immigrant and high-status student											
(2)	Blink	0.05 (0.12)	-.09	-							
(3)	Pupil pos. AOIs	−0.06 (0.11)	-.02	-.24	-						
(4)	Pupil neg. AOIs	−0.06 (0.11)	-.03	-.21	.86**	-					
Oculomotoric data for the case vignette representing a non-immigrant and low-status student											
(5)	Blink	0.08 (0.15)	.05	.69**	.17	-.15	-				
(6)	Pupil pos. AOIs	−0.06 (0.09)	.00	-.18	.63**	.50**	-.16	-			
(7)	Pupil neg. AOIs	−0.07 (0.11)	.01	-.11	.60**	.56**	-.14	.92**	-		
Oculomotoric data for the case vignette representing a non-immigrant and high-status student											
(8)	Blink	0.09 (0.14)	.08	.71**	-.08	-.08	.75**	.01	-.00	-	
(9)	Pupil pos. AOIs	−0.04 (0.12)	-.17	.04	.40**	.27	-.00	.39**	.32*	-.09	-
(10)	Pupil neg. AOIs	−0.03 (0.10)	.11	.03	.28	.22	.01	.33*	.28	-.04	.87**

Notes. $N=45$

** $p<.01$. * $p<.05$

and an overestimation of majority students (e.g., Glock & Krolak-Schwerdt, 2014; Kaiser et al., 2017; Ready & Chu, 2015; Ready & Wright, 2011; Tobisch & Dresel, 2017) it was assumed that information processing is more controlled when judging minority students and more automated when judging majority students (H_1).

An increase in pupil diameter as well as a higher blink rate were used as indicators of an activation of the sympathetic nervous system and, therefore, also for cognitive arousal and, thus, for more effortful processes which might indicate more controlled information processing.

4.2.1 *Pupil diameter as indicator for depth of information processing*

Results showed a main effect of the different text passages in the case vignettes, $F(6.621,291.333)=15.671$, $p<.001$, $\eta^2=0.26$. Pupil diameter became smaller in the course of reading the verbal report in all case vignettes (Fig. 1). Analyses also showed a small main effect of students' background, $F(1.747,76.857)=2.482$, $p<.05$, $\eta^2=0.05$. A priori Helmert contrast analyses showed no effect of social status, $F(1,44)=1.833$, $p=.09$, $\eta^2=0.04$, but of ethnic background, $F(1,44)=2.840$, $p<.05$, $\eta^2=0.06$. Pupil diameter was significantly larger when reading the vignettes of students with an immigrant background compared to the vignettes without an immigrant background. Analyses by each text part of the case vignettes (verbal report) showed differences in

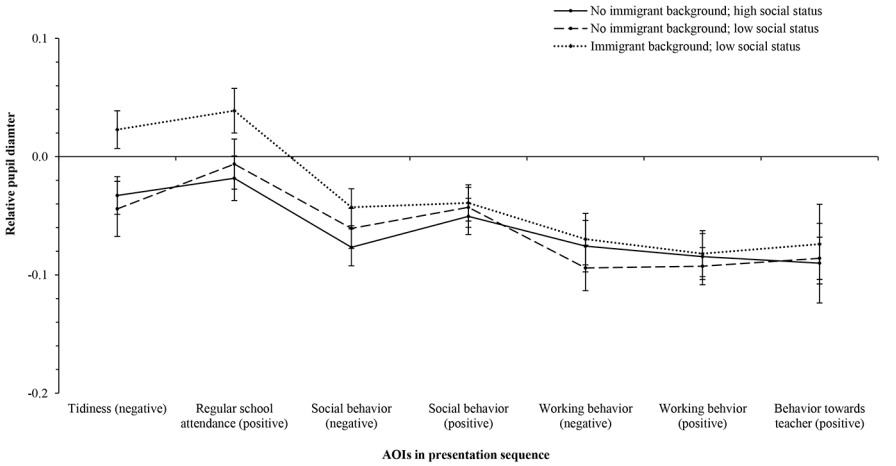

Fig. 1 Means and standard errors of pupil diameter (in relation to the baseline) by students' background and text parts in the verbal report

Table 2 Results of ANOVAs with repeated measures of text parts in the case vignettes (AOI) by students' background

AOI	*F*	*df*	df_{error}	*p*	η^2
Students behavior (verbal report)					
Negative tidiness behavior	3.478	1.989	87.531	.02	0.07
Positive regular school attendance	3.064	1.899	83.546	.03	0.07
Positive social behavior	0.186	1.797	79.083	.40	0.00
Negative social behavior	1.440	1.793	78.909	.12	0.03
Positive working behavior	0.189	1.663	76.177	.39	0.00
Negative working behavior	0.702	1.700	74.786	.24	0.02
Positive behavior towards teacher	0.161	1.421	62.512	.39	0.00
Students' grades (numeric report)					
German	2.675	1.957	86.105	.04	0.06
Mathematics	0.054	1.901	83.636	.47	0.00
Social studies	2.227	1.839	80.936	.06	0.05
English	2.421	1.783	78.438	.05	0.05
Religious education	1.844	1.989	87.525	.08	0.04
Music	2.955	1.958	86.152	.03	0.06
Art	0.293	1.807	79.511	.36	0.01
Handicrafts	2.680	1.824	80.245	.04	0.06
Physical education	1.804	1.958	86.158	.09	0.04
Grade point average main subjects	0.397	1.810	79.623	.33	0.01
Grade point average all subjects	1.338	1.751	77.049	.13	0.03

Notes. $N=45$. *df*: degrees of freedom were corrected with Greenhouse-Geisser correction

the first two text passages "negative tidiness behavior" and "positive regular school attendance" (Table2). For both text parts, contrast analyses showed differences for ethnic background (negative tidiness behavior: $p<.05$; positive regular school atten-

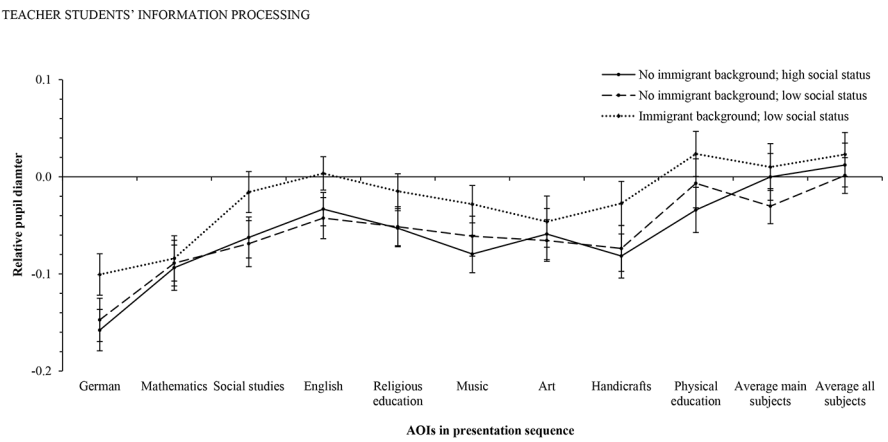

Fig. 2 Means and standard errors of pupil diameter (in relation to the baseline) by students' background and grades in the numeric report

dance: $p < .05$). Effects of social status were only significant for "positive regular school attendance" ($p < .05$) but not for "negative tidiness behavior" ($p = .18$). All significant results showed the same pattern that pupil diameter was greater when reading the case vignettes of minority students compared to case vignettes of majority students and in one AOI a significantly smaller pupil diameter when reading the case vignette of a high-status student compared to low-status students. This indicates a more automatic information processing when reading the vignettes of students without an immigrant background and a more controlled processing when reading the minority student vignette.

When reading the numeric reports in the case vignettes, pupil diameter showed significant differences in the subjects of German, English, music and handicrafts (Table1; Fig.2). A significant contrast for ethnic background showed up in the subjects of German ($p < .05$), English ($p < .05$) and handicrafts ($p < .05$). Only for the subject of music, there was an effect of social status ($p < .05$). Comparable to the results of the verbal report, pupil diameter was greater when reading the vignette of a minority student compared to pupil size when reading the case vignette of a majority student. Also, one AOI had an effect of social status, and showed a smaller pupil size in participants when reading the vignette of a high-status student compared to low-status students.

4.2.2 *Blink rate as an indicator for depth of information processing*

As blink rate cannot be analyzed by text parts, it was analyzed for each case vignette as a whole. Results showed significant differences according to students' background, $F(1.959,86.210) = 3.888$, $p < .01$, $\eta^2 = 0.08$. Teacher students' blink rate was higher for students with low status compared to the high-status student ($p < .01$), but in contrast to pupil diameter, results did not show a difference by ethnic background ($p = .36$). When reading the case vignette of the ethnic majority student with high social status,

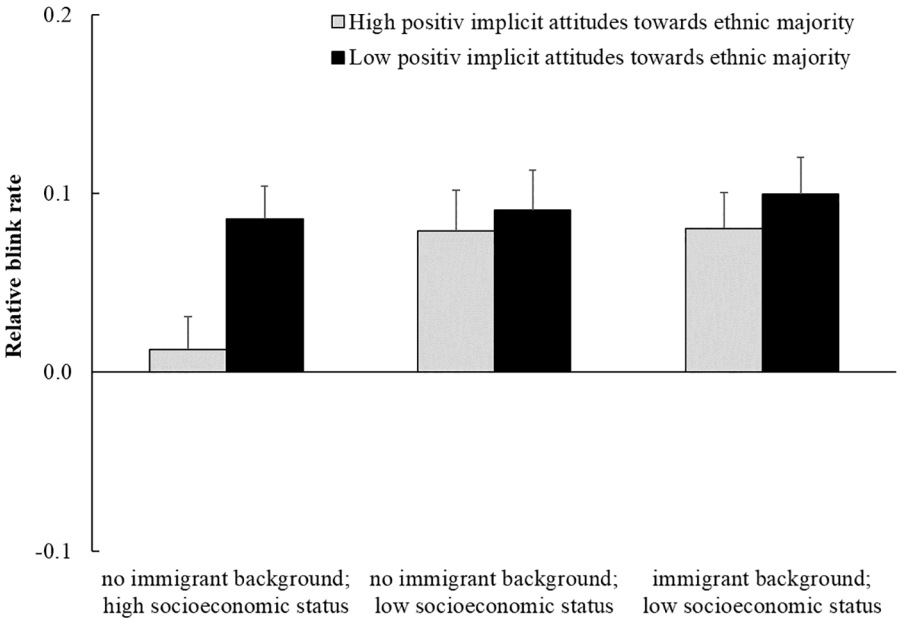

Fig. 3 Means and standard errors of blink rate (in relation to the baseline) by students' background and teacher students' implicit stereotypes towards ethnic majority

participants showed the lowest blink rate. This could be an indicator of more automatic information processing.

4.3 Implicit attitudes and information processing (H_2)

Our second hypothesis assumed that participants' implicit attitudes towards an ethnic minority as compared to the ethnic majority can influence information processing when reading case vignettes of students with different backgrounds. The results of an ANOVA with repeated measures and implicit attitudes as a between-subject factor (dichotomized at the median) showed no significant interaction effect of students' background and implicit attitudes towards students of different backgrounds on pupil diameter, $F(1.751,75.250)=0.278$, $p=.36$, $\eta^2=.01$, but a significant interaction effect of students' background and participants' implicit attitudes on blink rates, $F(1.962,84.373)=2.374$, $p<.05$, $\eta^2=.05$. Contrast analyses showed a significant effect of social status ($p<.05$) (Fig.3): Participants with strong positive implicit attitudes towards the ethnic majority showed a significantly lower blink rate when reading case vignettes of majority students compared to case vignettes of minority students. Teacher students with a lower preference for the ethnic majority did not differ in their blink rate with regard to students' background.

5 Discussion

Based on the continuum-model of impression formation (e.g., Fiske & Neuberg, 1990), the present study analyzed processes of judgment formation of teacher students concerning minority and majority students by means of eye-tracking data indicating physiological arousal which is associated with modes of information processing. It was assumed that teacher students process information about ethnic minority students in a more controlled manner and information about majority students in a more automated manner. This assumption is based on previous research that has shown an overestimation of high-status students without immigrant background and accurate judgments of low-status students with immigrant background dependent on stereotype-fit of the information about the students (e.g., Glock & Krolak-Schwerdt, 2014; Kaiser et al., 2017; Ready & Chu, 2015; Ready & Wright, 2011; Tobisch & Dresel, 2017). In an experimental eye-tracking study with a within-subject design, each teacher student read three fictitious case vignettes with experimentally varied social status and ethnic backgrounds of male primary school students. Case vignettes represented students that had rather good grades and, although, the description of students' behavior also included some more or less negative attributes, overall, a rather positive pupil picture was presented. This might be more stereotypical for majority students with high-status compared to minority students with low-status. Participants were asked to form an impression of the students while their pupil diameter and blink rate were measured to draw conclusions about arousal as an indicator for more or less automated or controlled information processing. Furthermore, implicit attitudes towards the ethnic majority and minority were measured with the IAT (Greenwald et al., 1998).

As pupil diameter and blink rate increase due to arousal, it was assumed that an increase of these measures would be an indicator of a more controlled information processing. Results showed a bigger pupil diameter in some AOIs and a higher blink rate while reading the vignette of an ethnic minority student with low social status compared to the vignette of a high-status majority student. This outcome pattern indicates more arousal of teacher students when judging minority students than majority students. Blink rate was lower for majority students with high-status across the entire vignette. This suggests lower cognitive arousal compared to the arousal during impression formation concerning minority students. The relatively smaller pupil size and the lower blink rate indicate lower arousal and thus a more automated and category-based processing of information about the majority high status student. This leads to the conclusion that the first hypothesis can be at least partly accepted, although the difference in pupil diameter was not significant for each AOI.

As attitudes can influence information processing, it was also assumed that teacher students with high positive associations of ethnic majority students with positive attributes tend to process majority student information more automatically, as case vignettes presented more positive attributes. This could be more in line with the perceptions of teacher students with implicit positive attitudes towards majority students. Therefore, the implicit preferences for the ethnic majority (vs. minority) was measured, the results showing a strong preference for the ethnic majority across all participants. Teacher students with a stronger implicit preference for the ethnic

majority showed a lower blink rate when judging the majority student of high status compared to teacher students with lower implicit preferences for the ethnic majority. For teacher students with lower implicit preferences towards the ethnic majority, results showed no differences of blink rate depending on students' background. For pupil diameter, there was no significant difference between participants' depending on their implicit attitudes. This leads to the conclusion that hypothesis two cannot be accepted completely, although blink rate results support the assumption. Though, blink rate and pupil diameter are both indicators of information processing, they react in different phases of information processing. As pupil diameter was analyzed on the level of AOIs and blink rate at the level of whole vignettes, this might also explain the different results. Future studies should investigate cognitive processes in smaller steps to examine if this might be an explanation. Although, the results are not overall significant, the pattern indicates different arousal and thus different cognitive processes depending on majority and minority status. However, this needs replication in future studies with a larger sample.

It is conceivable that teacher students are motivated to act without prejudice and, therefore, have a higher cognitive activation when reading minority students' case vignettes as they try to get as much individual information as possible. As consequences of positive attitudes towards majority students are much less discussed–compared to consequences of negative attitudes towards minority students–teachers and teacher students are not that much aware of positive judgmental distortions. In particular, the interaction effect of blink rate and implicit attitudes supports the assumption of more controlled processing of teacher students with more positive implicit attitudes towards the ethnic majority, which might not trigger a motivation to regulate information processing because positive attitudes do not seem to be problematic at first glance. It should also be discussed that, although case vignettes included positive and negative aspects, the vignettes rather represented a more positive image. Especially for students who stronger associate majority status with positive attributes, the positive vignettes might be in line with their positive implicit attitudes towards the ethnic majority. No deeper processing seemed to be necessary for these teacher students when reading a positive vignette with a name indicating majority status. Accordingly, more controlled processing of information about the minority students could emerge because teacher students' picture of minority students did not fit the rather positive vignettes and therefore the information needed to be processed more accurately. More automated processing of information about a non-immigrant high-status student–fitting the stereotype of a good student–and more controlled processing of information about an immigrant and a low-status student–that does not fit the stereotype of a good student–show that processing information is not determined by students' background as such nor by context information (i.e., negative or positive valence of information) alone. So, we cannot assume that preservice teachers process information about majority students always automated and information about minority students always controlled. We can rather assume that stereotype consistent student information activates automated processing and stereotype inconsistent information is more likely to lead to a more controlled information processing of preservice teachers, which would be in line with Fiske and Neuberg (1990).

5.1 Limitations

Besides the strength of experimental studies with regard to internal validity and the possibility to draw causal conclusions, it should be kept in mind that the results of this study cannot be easily transferred to teachers' information processing in real settings, like correction of exams or writing school reports, as teachers there are confronted with much greater complexity and a greater amount of student information. Though the examination of a real class context would be worthwhile, this study could show the underlying cognitive processes that can influence information processing and judgment formation and also might be activated in real teaching settings. However, because stereotype activation is context-dependent, it remains unclear to what extent these findings can be transferred to the class context. It is also relevant that the participants were teacher students, so it remains an open question whether the same result patterns would be seen with experienced teachers. Although Böhmer et al. (2017) saw differences in experts' and novices' information processing, it can be assumed that the underlying cognitive processes are the same when it comes to first impression formation about students. Therefore, teachers might also process information more or less automatically; at least some empirical results show differences in teachers' judgments according to students' backgrounds (e.g., Kaiser et al., 2017; Tobisch & Dresel, 2017), which could be explained by different cognitive processes. This would require further research that examines the information processing of experienced teachers.

Furthermore, some other limitations of this study need to be mentioned, e.g., the case vignettes only represented male primary school students with a German or Turkish background. To draw conclusions for majority and minority girls, students in secondary schools or with different ethnic backgrounds further research is needed. As ethnic background and social status were activated only through students' names, no vignette could be created for a student with an immigration background and high social status, as a Turkish background is still more associated with a low status, regardless of the names used. For a more detailed and differentiated analysis of ethnic background or social status variables, case vignettes should also include this background combination, which could be implemented with additional background information. In addition, it must be noted that the manipulation of students' ethnic background and social status via names cannot only trigger associations concerning students' background, but also other characteristics like intelligence or attractiveness (e.g., Kleen & Glock, 2020). Although, there was no significant effect, it needs to be discussed that social status might not be exactly the same for the German and Turkish low-status name. It could be assumed that ethnic effects are not completely controlled for social status.

As the results for implicit attitudes towards ethnic minority and majority students indicate that implicit attitudes might also play an important role, further studies should also include implicit attitudes towards a high and low social status, as this might also influence information processing. It could also be assumed that implicit attitudes towards ethnicity might also include associations and thus preferences for status. Of course, it needs to be discussed if physiological arousal only occurs because of cognitive processes. Especially, when social categories and associated stereotypes are

activated, also emotions or emotion regulation could be a relevant influential factor of arousal. Therefore, future studies should also take emotional factors into account. A link between oculomotor data and other data such as questionnaires or a face reader could be promising.

5.2 Conclusion

Despite some limitations, this contribution provides empirical hints that arousal during judgment formation differs depending on stereotype consistency of the information given about students with their minority or majority status and that teacher students' implicit attitudes might be important as well. Moreover, this study supports the idea of measuring teacher students' arousal as an indicator for information processing with physiological data, which could complement self-reported data and the analysis of judgments. Furthermore, assumptions about a more controlled processing of information about minority and a more automated processing of information about majority students (which has been reported in some existing research) can be supported by data that focus on the processes of impression formation. The use of oculomotor data seems to be a valuable method to avoid social desirability in participants' response behavior and to get closer to actual cognitive processes. Accordingly, future studies are needed that combine participants' self-reported data with physiological measures (of course under consideration of potential moderators or mediators) and replicate oculomotor results during impression formation. This might be an option to get closer to the actual process of impression formation.

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