Students’ Basic Psychological Needs in Learning Science:
The Role of Teacher Autonomy Support and Classmate Support

Gülşen Koçak, Yasemin Tas, and Sundus Yerdelen

Abstract
This study examined the predictive effect of students’ perceptions of science teacher’s autonomy support and classmates’ support on their basic psychological needs (i.e., relatedness, autonomy, and competence) in science. 1,018 middle school students from 9 public schools in Turkey completed self-report surveys. Hierarchical multiple regression analyses showed that while controlling for students’ gender and previous achievement, both teachers’ autonomy support and classmates’ support positively predicted students’ basic psychological needs and teacher autonomy support emerged as a better predictor than classmates’ support. The amount of explained variance was .41, .38, and .33 in the relatedness, autonomy, and competence aspects, respectively. It can be concluded that students tend to feel more autonomous, related, and competent in science classes where science teachers consider their ideas, encourages them ask questions, and give opportunity to make choices about the lesson and where classmates pay attention to them, treat them nicely, and spend time with them.

Keywords: science education, teacher autonomy support, classmate support

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The word “motivation” originated from the Latin verb of “movere” (to move); which is defined as “the process whereby goal-directed activity is instigated and sustained” (Pintrich & Schunk, 2002, p. 5). There have been a lot of theories put forward to better understand the concept of motivation. Self-determination theory emerged in the 1970s, and early studies first conducted by Edward Deci and Richard Ryan are another representative of this theory. It is related to experiencing a sense of choice of the individuals in initializing and organizing their own behaviors (Deci et al., 1989). Self-determination theory (Deci & Ryan, 1985a; Ryan & Deci, 2000; Ryan & Deci, 2008) is a theory built on the basic psychological needs of people and also it is one of the detailed and well-studied theories (Evelein et al., 2008). It was found that basic psychological needs are closely related to many student outcomes such as motivation (e.g., Dincer, 2014; Lavigne et al., 2007; Zhou et al., 2019), subjective well-being (e.g., Balaguer et al., 2012; Su et al., 2021; Tian et al., 2016), student engagement (e.g., Authors, 2018; Zhou et al., 2019), and achievement (e.g., Wang et al., 2019).

There have been studies conducted with a view to dealing with the roles of different social factors such as the family (parents), teacher and friends, regarding the meeting of basic psychological needs of individuals (e.g., Amorose & Anderson-Butcher, 2007; Grolnick et al., 1991; Zhou et al., 2009; Zhou et al., 2019). In those studies, especially the importance of teacher’s autonomy support stands out (e.g., Kiefer & Pennington, 2017; Maulana et al., 2016; Wu et al., 2014). However, there are few studies dealing with the effects of friends on students’ motivation (Núñez & Jaime León, 2015). It was found that perceived peer support in middle school is positively associated with school satisfaction in high school (Muscarà et al., 2018). Considering the power of teacher and peer supports especially in middle school years, investigating the effects of those supports on student motivation is quite important (Wentzel et
In this study, the predictive effect of middle school students’ perceptions of autonomy support of the teacher and support of classmates on their basic psychological needs in science class will be investigated.

**Basic Psychological Needs**

Basic psychological needs in the theory of self-determination consist of three components: competence, relatedness and autonomy. Competence is defined as the self-infusion of the fact that the person has the factors of skills, power and knowledge required to achieve a certain task (Deci & Ryan, 1985a). Individuals having a high level of competence can interact with the people around them and also have the tendency to influence those people and to display their own capacities (Kowal & Fortier, 1999; Ryan & La Guardia, 2000; Vlachopoulos & Michailidous, 2006). The second factor, relatedness, is defined to be the state of having a connection between oneself and his/her social circle and also having supportive relationships with them (Deci & Ryan, 2000). It also encompasses the meanings of sensitivity, warmness, sentimentality and acceptance (Andersen et al., 2000). Skinner and Edge (2002) stated that the removal of the need of relatedness would lead to some dangerous situations such as withdrawal and depression (as cited in., Evelein et al., 2008). The last sub-dimension of the basic psychological needs is autonomy. It is defined as the initialization of an individual’s own actions, organization of his/her own behaviors and experiences, self-check of his/her own decisions and making choices (Deci & Ryan, 1987; Ibarra-Rovillard & Kuiper, 2010; La Guardia & Patrick, 2008). In other words, it is the self-feeling of the individual at the center of his/her actions (Kowal & Fortier, 1999). Since autonomy is the concrete state of the theory of self-determination, autonomy has special importance in terms of representation of the theory of self-determination (Deci & Ryan, 1985b).
Teacher Autonomy Support

The most important channels for the sense of autonomy are autonomy supportive attitudes of social environment such as the family, teacher and friends. Namely, if the environment in which the individual exists and perceives behaves in an autonomy supportive manner, then this situation leads to a satisfaction of basic psychological needs (Deci & Ryan, 1985b). Alongside with autonomy, social support is also important for the satisfaction of other two components of basic psychological needs (Calp & Bacanlı, 2016). Teachers and classmates are important sources of social support for the students. (Tian et al., 2016).

According to the theory of self-determination, for a healthy development of individuals, it is important to meet the psychological needs. Learning environments in which the students are supported by their teachers and peers contribute to satisfaction of those needs (Deci & Ryan, 2000). If a teacher provides autonomy support to his/her students, then he/she gives importance to the interests, desires, choices and preferences of the students, tries to understand their feelings towards learning activities, and motivates them continually so that the intrinsic motivation of the students is supported (Cai et al., 2002; Reeve et al., 1999). When the teacher behaves in an autonomy supportive manner, he/she considers students’ opinions and provides them choices (Patall et al., 2013). Thus, a teacher providing autonomy, can help meet the basic psychological needs of the students (Liu et al., 2020). Instead of supporting autonomy, contrarily, if a teacher begins controlling the students’ behaviors, then the students might feel pressured to change their behaviors and start questioning their abilities. They might feel refused or disliked by the teacher and thus they might experience disappointment in terms of autonomy, competence and relatedness (Deci & Ryan, 1985a; Haerens et al., 2015).
Classmates’ Support

Another social agent in science learning environment discussed in this study is classmate (or peer) support based on the perceptions of the students. Contemporary adolescent teens spend more time in peer groups, compared to teens in the past. Any peer group plays a very important role in the psychological development of adolescent teens, independent of its structure and norms (Küdür-Çırpan & Çınar, 2013). Social support provided by classmates contributes to formation of close peer relationships (Tian et al., 2016). Classmates provide a sense of confidence in students (e.g. Hamm & Faircloth, 2005), a sense of belonging to school (Kiefer et al., 2015) and a higher school satisfaction (Epstein, 1981). Earlier studies have demonstrated that the support of teachers and classmates is related with many variables such as academic achievement (Chambers et al., 2006; Ghaith, 2002), student engagement (Jang et al., 2010), self-esteem and depression (Ibarra-Rovillard & Kuiper, 2011; Siyez, 2008).

Relationships between Social Agents and Basic Psychological Needs

In the literature, there are some studies that investigate the effect of different social supports such as family, teacher and friends on student motivation from the perspective of self-determination theory (e.g., Amorose & Anderson-Butcher, 2007; Chirkov & Ryan, 2001; Grolnick et al., 1991; Zhou et al., 2009; Zhou et al., 2019). In these studies, basic psychological needs of students were generally examined in relation to the family support (e.g., Kurt, 2016; Marbell & Grolnick, 2013; Ratelle et al., 2005; Soenens & Vansteenkiste, 2005) and teacher autonomy support (e.g., Cox & Williams, 2008; Soenens & Vansteenkiste, 2005). For instance, Authors (2018) found that parents’ educational aspiration, parental communication, parents’ participation, and parental autonomy support positively predicted middle school students’ basic
psychological needs in science. However, there is need to investigate the effects of other social supports just like the peer support in the studies.

Another study (Zhou et al., 2009), which was conducted with children in 4th, 5th and 6th grades in rural China showed that autonomy support of parents, friends and teachers positively predicted the students’ basic psychological needs. As for the students with a higher level of basic psychological needs, it showed that their level of motivation and engagements were higher. The findings of the study supported that autonomy was very important in collectivist societies in the east such as China and also in individualistic cultures in the west. In their study with high school students (n= 1476), Tian et al. (2016) examined the relationships among school related support as measured by teacher support and classmate support, basic psychological needs (i.e., autonomy, relatedness and competence), and school-related subjective well-being. They found that basic psychological needs mediate the relationship between school related support and school-related subjective well-being. In the literature, there are some studies investigating the social support factors such as the family, teachers and friends altogether (Zhou et al., 2019; Ricard & Pelletier, 2016), while some studies address them one by one; such as teacher or coach autonomy support (Adie et al., 2008) and family support (Grolnick, 2009). For instance, Lavigne et al. (2007) focused on teacher autonomy support and they investigated the relationships among teacher autonomy support, perceptions of competence, perceptions of autonomy, science motivation and intentions to pursue science education in a group of high school students (n= 728). Structural equation modeling analysis showed that teacher autonomy support is positively linked to perceptions of competence and autonomy, which in turn positively predicts science motivation. Additionally, perceptions of competence and autonomy and science motivation all positively predict students’ intentions to pursue science education. However, research has
focused truly little on the effect of peers on student motivation (Núñez & Jaime León, 2015). In a transition study, it was found that the relationship between affective involvement in middle school and school satisfaction in high school was mediated by the perceived peer support in middle school (Muscarà et al., 2018). Considering the power of different effects of teacher and peer support especially in middle school years, it is important to examine the interactive effects of teacher and peer support together on student motivation (Wentzel et al., 2010). Moreover, there have been very few studies investigating the common effects of autonomy support from teachers, parents and peers on the student motivation and learning activities, within the framework of theory of self-determination (Zhou et al., 2019).

**Purpose of the Study**

This study aimed to investigate the predictive effect of middle school students’ perceptions of science teacher autonomy support and classmates’ support on their basic psychological needs in learning of science. Because the earlier studies revealed that gender and prior achievement factors are connected with students’ basic psychological needs (e.g., Amorose & Anderson-Butcher, 2007; Brown et al., 1995; Harvey & Retter, 2002; Navarro-Patón, 2018; Tian et al., 2016; Wang et al., 2019), the effect of these variables will be controlled in statistical analyses. Therefore, the research question of the study is:

Do middle school students’ perceptions of teacher’s autonomy support and peers’ support predict their needs for autonomy, competence, and relatedness, after controlling for the effect of gender and prior achievement?
Method

Design

This is a cross-sectional quantitative study which aims to investigate the relationship between students’ perceptions of teachers’ autonomy support and classmates’ support in science learning environment and their basic psychological needs in science learning. In this study, correlational research method was utilized and data were collected through self-report questionnaires. Before launching the questionnaire, information about the study was given to the participants and it was declared that data would be anonymized and not shared at the individual level. Also, due measures were taken to make sure that the classmates would not see each other’s codifications. Students took part in this research on a basis of volunteering and it took about 20 minutes to fill in the scales.

Sample

In the study, convenience sampling was used and the sample included 1,018 students in nine middle schools located in one of the biggest cities in eastern Turkey. In terms of the age of participants, 33.8% were 6th graders, 36.4% were 7th graders and 29.8% were 8th graders and 51.1% were boys and 47.6% were girls. Fifteen students did not answer for their genders. Science lesson average mark of the participants for the previous year was 4.37 out of 5 (SD = .78) and average age is 12.75 (SD = .99).

Instruments

Basic Psychological Needs

“Basic psychological needs scale” developed by Gagné (2003) was used to measure the basic psychological needs of the students. The scale was adapted to Turkish aiming at mathematics by Durmaz (2012) and there has been some findings indicating that the Turkish
version of the scale is a valid and reliable tool to measure the basic psychological needs of Turkish high school students. Durmaz (2012) reduced it to 5-point Likert scale (1= strongly disagree, 5= strongly agree) from a 7-point Likert, considering the age range of the participants in the research. In this version of the scale, there are six items for relatedness, eight items for competence and seven items for autonomy. In the study carried out by Durmaz (2012), Cronbach alpha’s internal consistency reliability coefficients were found to be .72 for autonomy, .72 for relatedness, and .65 for competence. Later on, Authors (2018) also used the Turkish version of the scale for measuring the basic psychological need of middle school students in science lessons. The following are the sample items for the sub-dimensions of the basic psychological needs: Sample item for relatedness: “I really like the people I interact with in science class”, for competence: “I have been able to learn interesting new skills recently in science class”, and for autonomy: “I generally feel free to express my ideas and opinions in science class” (Authors, 2018, p. 186). In the present study, Cronbach alpha coefficients were calculated .66 for autonomy, .70 for competence and .72 for relatedness.

**Teacher Autonomy Support**

In order to measure the teachers’ autonomy support, Learning Climate Questionnaire developed by Williams and Deci (1996) was used. In this unidimensional scale, there are 15 items regarding the relationships of students with their teachers. A sample item is as follows: “I feel that my teacher provides me choices and options.” The scale has a 5-point response ranging between “strongly disagree” and “strongly agree”. The scale’s adaptation to Turkish and its reliability and validity studies were carried out by Dincer (2014) who decided to remove one item from the scale as a result of factor analysis. Cronbach alpha coefficient for the remaining 14
items was calculated as .95. In the present study, Cronbach alpha was calculated as .94, indicating high internal consistency of the scores obtained from the instrument.

**Classmates’ Support**

Classmates subscale of Child and Adolescent Social Support Scale (Malecki & Demaray, 2002) was used. This subscale consists of 12 items and one sample item is as follows: “My classmates treat me nicely.” Frequency gradation of the scale is arranged in 6-point Likert form as follows: never (1), almost never (2), sometimes (3), most of the times (4), almost always (5) always (6). Cirik (2010) made the adaptation of the scale into Turkish. In the Turkish adaptation study, 5th, 6th, 7th, and 8th graders were participants and Cronbach alpha reliability coefficient for the sub-dimension of classmates was calculated as .96 (Cirik, 2010). In the present study, Cronbach alpha coefficient for classmates’ support was calculated as .94.

**Results**

Descriptive statistics were conducted to examine the level of students’ perception of their science teacher’s autonomy support, and classmates’ support, as well as their basic psychological needs (see Table 1). Results showed that mean values for students’ perceptions of autonomy support from science teacher ($M = 3.89$, $SD = .89$), classmates’ support ($M = 4.23$, $SD = 1.27$), and basic psychological needs components of relatedness ($M = 3.77$, $SD = .74$), competence ($M = 3.66$, $SD = .81$), and autonomy ($M = 3.70$, $SD = .72$) were above mid points of the scales. Furthermore, students’ perceptions of both teacher autonomy support and classmates’ support were positively and significantly related to all aspects of basic psychological needs.
Table 1

Descriptive Statistics and Bivariate Correlations

<table>
<thead>
<tr>
<th>Variables</th>
<th>M</th>
<th>SD</th>
<th>Possible range</th>
<th>Classmates’ support</th>
<th>Relatedness</th>
<th>Competence</th>
<th>Autonomy</th>
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<td>Teacher’s autonomy support</td>
<td>3.89</td>
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<td>.42**</td>
<td>.59**</td>
<td>.50**</td>
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<td>Classmates’ support</td>
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<td>.28**</td>
<td>.30**</td>
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<tr>
<td>Relatedness</td>
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<td>1-5</td>
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<td>.65**</td>
<td>.71**</td>
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<tr>
<td>Competence</td>
<td>3.66</td>
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<td>Autonomy</td>
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Note: ** \( p < .01 \)

In order to examine whether students’ perceptions of teacher autonomy support and classmate support predict their basic psychological needs, three hierarchical multiple regression analyses were conducted by using each component of basic psychological needs as criterion variables. Assumptions of no multicollinearity and outliers, and normality, linearity, homoscedasticity, and independence of residuals were met. As the first step of the hierarchical multiple regression analysis, gender and prior science achievement were included in the model in order to control for their effects. Afterwards, as the second step, teacher’s autonomy support and classmates’ support were included (see Table 2).

The first model was set by defining the relatedness as outcome variable. Results of the first step of this analysis showed that both gender (\( \beta = .08 \)) and previous year science grade (\( \beta = .28 \)) emerged as significant predictors of relatedness. Girls and students with higher previous science grade reported higher levels of relatedness than boys and lower achievers. In the second step of the hierarchical multiple regression analysis, students’ perceptions of the science learning
environment as measured by teacher’s autonomy support and classmates’ support were entered into the model. Both teacher’s autonomy support ($\beta = .46$) and classmates’ support ($\beta = .20$) positively predicted the outcome variable. The explained variance in the relatedness was found to be 40.8%.

In the second model, autonomy was the dependent variable. Both, gender ($\beta = .13$) and prior achievement ($\beta = .35$) were found to be significant and positive predictors of autonomy. Girls and students with high prior achievement reported feeling more autonomous than boys and students with low prior achievement, respectively. In the second step, both teacher’s autonomy support ($\beta = .46$) and classmates’ support ($\beta = .08$) emerged as significant and positive predictors of autonomy. The predictor variables together explained 38.3% of the variance in the autonomy.

The third model was built by using competence as the outcome variable. In the first step, only previous year science grade ($\beta = .38$) was found to be a significant predictor of competence while gender ($\beta = .02$) was a non-significant predictor. Students with higher previous science grade reported higher levels of competence than lower achievers. In the second step of the hierarchical multiple regression analysis, both teacher’s autonomy support ($\beta = .41$) and classmates’ support ($\beta = .07$) positively predicted the outcome variable. These predictors explained 33.4% of the total variance in the competence variable.

Results showed that the $R^2$ change from step 1 to step 2 was statistically significant for each model, indicating that the models were improved at the second stages of the analyses. Accordingly, teacher’s autonomy support and classmates’ support are important predictors of students’ basic psychological needs. Based on the standardized coefficients ($\beta$), it can be said that teachers’ autonomy support is a better predictor of basic psychological needs than classmates’ support.
<table>
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<th>Step 1</th>
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<td>Classmates’ support</td>
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Note: *p < .05, **p < .01, ***p < .001. Gender coded 0 = Boy, 1 = Girl.
**Discussion**

In this study, after controlling for prior achievements and genders of the students, predictive effect of teacher’s autonomy support and classmates’ support on the basic psychological needs of the students were tested. According to hierarchical multiple regression analysis, results conducted for each basic psychological need, teacher autonomy support in science lesson positively predicts all of the basic psychological need components (i.e. relatedness, competence and autonomy). These results indicate that the students who receive an autonomy support from the teacher of the science lesson, tend to experience a feeling of self-sufficiency and successfulness during the class. They also get on well with the people in their interaction circle and enjoy a feeling of affinity towards them and feel a freedom in expressing their opinions and views and in deciding how to study. Consequently, teacher’s regardfulness of students’ points of view and offering them options, are apparently important for satisfying their basic psychological needs.

Results of similar studies are in compliance with the result that there is a positive relationship between the teacher autonomy support and basic psychological needs (e.g., Adie et al., 2008; Amorose & Anderson-Butcher, 2007; Lavigne et al., 2007; Reeve et al., 2008; Wu et al., 2014). For instance, Lavigne et al. (2007) found that teachers’ autonomy support positively predicts high school students’ perceptions of autonomy and competence which in turn positively predict students’ motivation in science and intentions to pursue science education. When students receive a sufficient autonomy support from their teachers, they are more interested in the course (Tsai et al., 2008) and they conduct their studies in their own ways (Jang et al., 2016). On the other hand, when the students are pressured by the teacher in a way to make them think, feel or behave in the direction determined by the teacher, they might tend to be less autonomous,
less competent and less related (Reeve, 2009). Reeve (2006) summarized the features of a teacher who provides autonomy support during class, in nine items as follows: (1) attentive listening; (2) creating opportunities for the students to study; (3) providing speaking opportunities to students; (4) arranging learning materials and creating learning mediums for the students enabling them to manipulate the objects and speeches, rather than rendering them passive listeners and onlookers; (5) encouraging effort and sustainability; (6) extolling their improvements and proficiency; (7) providing them clues when they are in dire need; (8) responding to their questions and comments; (9) providing a clear feedback to their points of view. In this way, the teacher may support the inner motivational resources of the students (Reeve, 2006).

Another result obtained in this study is that, classmates’ support positively predicts the basic psychological needs. Thereby, the students who are cared about, who are supported by better relationships and whose feelings and views are liked by their friends tend to have a higher level of autonomy, relatedness and competence. It has been considered that the students who think that they are being cared about by their classmates and being liked by them (Goodeenow, 1993), and also who have close and nurturing relationships with their classmates, have a sense of school belonging (De Wit et al., 2010). Moreover, peer influence gains more importance beginning from late childhood (Ntoumanis et al., 2012). The finding of positive association between support of classmates and the basic psychological needs of the students seems to be consistent with the results of similar studies (e.g., Ricard & Pelletier, 2016; Tian et al., 2016; Zhou et al., 2019). For example, Zhou et al. (2019) conducted a study regarding the support offered by classmates to the students, and showed that this support positively predicted the psychological needs of 3rd, 4th, 5th and 6th graders.
The findings obtained in this study support the fact that both teacher autonomy support and classmates’ support undertake important roles in predicting the basic psychological needs of the students. However, according to the results obtained in this study, teacher’s autonomy support is a stronger predictor on the basic psychological needs, compared to classmates’ support. Likewise, Ricard and Pelletier (2016) showed that, for the basic psychological needs, teacher support is more predictive than classmate support. Besides, they also stated that class friendships play an important role in predicting the academic motivation, but teacher support has more important effects in terms of meeting the students’ basic psychological needs. This might be explained by the fact that in school students primarily place the figure of a teacher as the first important other person and also the teacher may even have an influence on the class environment, daily student affairs and peer relations. (Tian et al., 2016) Moreover, when a student receives consent from his/her teacher due to his/her ideas, feelings and behavior (Reeve, 2009), and also feels that he/she is loved by their teachers (Wentzel & Asher, 1995), this could be effective in explaining why these factors are important predictors in students’ intrinsic motivations. However, besides the fact that teacher support is very necessary, it does not suffice on its own for the school development of the student. It is recommended that it must be considered together with other types of social supports such as classmate support and parent support (Rosenfeld et al., 2000).

Despite the fact that the variance values explained by teacher autonomy support and classmate support in the components of basic psychological needs (varying between .33 and .41) are close to each other, the considered learning environment variables explain the variance mostly in the variable of relatedness among the components of basic psychological needs. This finding complies with most of the studies in the literature, (Adie et al., 2008; Standage et al.,
2006; Wu et al., 2014; Zhou et al., 2019), however, in some other studies teacher autonomy support predicts autonomy the strongest (Amorose & Anderson-Butcher, 2007; Tian et al., 2016). For example, Tian et al. (2016) found in their study that while the best predictor of autonomy was teacher autonomy support, the best predictor of relatedness variable was classmate support.

Limitations of this Study and Suggestions for Future Studies

There are some limitations in this study that must be mentioned. First of all, this study is based on cross-sectional data and is a correlational study which restrains the causality claims. In future studies, it might be possible to establish cause and effect relations between the learning environment and basic psychological needs by using longitudinal and experimental designs. Next, in the present study, the perceived science learning environment is limited by the teacher’s autonomy support and classmates’ support. In future studies, it could be possible to investigate the effect of features of different science learning environments on basic psychological needs of students. Moreover, in order to put forward more details, together with self-report questionnaires, classroom observations focusing on the interactions between students-teacher and students-students, and interviews with students and teacher can be included in data collection methods. Another limitation is about the certain age range of the sample. The obtained results can be generalized to groups having similar features. Because of the fact that students from different age ranges might have different developmental features, for example they might have different levels of being influenced by their teachers and friends, in future studies, students from different age ranges can be selected as sampling and relationships among the variables can be compared.
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