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Research article

Assessment of university students' energy saving behavior by integrating stimulus-organism-response (SOR) and the theory of planned behavior (TPB)

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ABSTRACT

Concerned about balancing issues of global warming and economic growth, the growing needs of energy consumption in contexts with limited production and resources have created a serious challenge for developing countries like Pakistan. Research approaches that focus mainly on the production or purchase of environmentally friendly products or assessment of the stance of employees and households are not seen as sufficient to present the full picture of any society regarding energy saving behaviors (ESB). The attitudes and behaviors of the student population have generally not been sufficiently presented in energy saving studies to reflect current or emerging realities. Two leading behavioral theories, stimulus-organism-response theory (SOR) and the theory of planned behavior (TPB), and their relevant variables are integrated in this study to unpack the ESB of university-going students in Pakistan. Through an online survey, 410 university students from the four main urban cities of Pakistan participated in the study. The findings revealed that media and organizational climate have significantly created both a sense of social pressure and responsibility among students to cultivate stronger intentions and actions toward saving energy. The results further indicated that these behavioral intentions do indeed have a strong impact on students reported ESB. Overall, the students appeared to have been effectively influenced to be more active in saving energy for their society and country. The findings also validate the selected energy-related constructs and predictive paths in the proposed integrated SOR and TPB model. This study shows the potential for the further testing and application of the variables and this model in other contexts with other populations as the world grapples with energy shortages and global climate change issues.

Keywords: energy saving behaviors; behavioral intensions; stimulus-organism-response; theory of planned behavior; Pakistan; university students

1. Introduction

In this age facing challenges of how to advance economic growth yet reduce impacts on global warming climate change, energy saving is not only a burning issue of the developing economies or countries, but rather a universal concern due to the rapid rise of energy consumption. Despite limited resources, energy saving

behavior (ESB) is crucial for all countries of the world to attain sustainability[1]. Energy saving involves actions that attempt minimal energy use when it is not required to help alleviate both energy shortages and related environment issues[2]. Many companies have introduced environmentally friendly products and various countries are encouraging their populace to use them with one primary goal being to reduce energy consumption[3]. Energy consumption has also been slightly reduced by considering energy efficient technologies and encouraging households to find ways to save energy[4]. These initiatives might not yet appear as long-term sustainable goals unless people can be motivated and socially responsible enough to perform such behaviors that can save energy in their daily routine toward reducing energy consumption[5].

Research was reviewed that highlighted the exploration and identification of multiple factors that can influence people's energy saving behaviors (ESB)[4–6] through different theoretical standpoints. Recent research[1] asserted that these studies are mostly conducted in developed (United States and Europe) and fast developing (China and India) countries. This focus fits reports noting that almost 58% of the world's electricity has been generated by five main countries: China (26.7%), the United States (16.8%), India (5.9%), Russia (4.2%), and Japan (4%), specifically with around 44% produced by China and the United States[7]. To balance this focus, some of the world's developing countries are increasingly investigated, especially to inspect ESB of their populations[1,4]. Yet, countries like Pakistan where energy production and consumption are at both at an alarming stage have not attracted enough research attention. Therefore, considering the cultural context of Pakistan and assessing the behavioral choices of its citizens could provide a new dimension to understand the nature and scope of ESB in an understudied location and also by adopting different means and measures.

Over the last two decades, Pakistan is facing a very severe energy crisis and the condition is getting worse day-by-day[7]. Out of around 210 million people, more than 140 million people could not regularly access electricity and 66 million people are without electricity in Pakistan[3]. Even though companies are investing much to produce and foster the use of environmentally friendly products to reduce the usage of electricity[8], still the country faces many challenges that require more efforts. One possible approach is developing ESB among the populace that help them consume less energy in their daily routine activities. However, in recent years, energy consumption has increased dramatically among residential sector, especially the during COVID-19 pandemic due to the lockdowns, working from home, online learning, and government-imposed restrictions imposed on social gathering[4], with evidence that households in Pakistan used more energy than previously[9]. Yes, due to national efforts, better products, and growing awareness, the overall energy consumption has been reduced slightly by about 15% (most of that improvement coming, up to 40%, from among the residential areas of Pakistan)[10].

It is observed that researchers are paying more and more attention to the three key streams of ESB: residential areas[4,7,11], purchasing behaviors[8,12,13], and the workplace[5,6,14]. While the examination of households and employees have contributed much to understand the dynamics of ESB, however, the attitudes or behaviors of students seldom appear. Yet, students are both heavy consumers of energy, and their consumption patterns have a big influence on their family, society, and country[15], therefore there is a clear need to study their ESB. In addition, students' energy saving activities differ greatly from employees and households because they generally consume energy within their institutions, assuming it is a free part of their study system. There is thus a tendency that students can waste energy and have less sensitivity[15] while others must pay for it. This study seeks to adopt and integrate two widely used social response theories to explore the phenomena of ESB among university students in Pakistan.

A review of the literature on energy saving research indicates that the theory of planned behavior (TPB) remains active and the most cited among scholars of different perspectives[16]. Numerous efforts have been made to incorporate and expand TPB in different contexts to address the predictability of the theory[5,11,14].

TPB assumes that various factors such as attitudes, norms, perception, and intentions have the potential to shape people's desire to perform certain actions[17,18]. In a similar vein, stimulus-organism-response (SOR) has remained a well-known and widely applied theory. SOR predicts that the stimulating (external) factors influence the organism (internally) to further response (action or behavior) to a specific issue or situation[19]. Both theories are providing lines of research related to energy issues. Despite some noted similarities[4,6,7,9,11], until now, it is difficult to find specific research that focused on TPB and SOR simultaneously Toward broader insights and identification of the significant factors affecting ESB, it seems important to evaluate the interactions of outcome domains highlighted in TBP in concert with the specific (media, organizational, social, personal) influences addressed in SOR. Therefore, the current study seeks to address this limitation in the existing research and aims to integrate these two theories.

This study therefore adopts the theoretical model of SOR (and pertinent variables like media publicity, organizational energy saving climate, perceived energy saving responsibility, and social pressure)[6] with the predicted outcomes of TPB (intention to save energy and ESB)[4,9,11]. And since previous efforts in the context of Pakistan have been dominated by the perspective of the residential sector[7,9], university-going students from the four key developed cities of Pakistan are considered in this study. The following section includes the supportive details of SOR and TPB along with the relationships among the variables of the study.

2. Literature review

Consideration of the important literature is divided into two major segments. In the first section, the overview of SOR theory is discussed proceeding with the relationship between the variables with the formulation of hypotheses. In the second section, TPB is thoroughly discussed with a focus on its pertinent linkages with SOR and the strong emphasis on variables exploring ESB.

2.1. Stimulus-organism-response (SOR) theory

The SOR theory is basically driven from the behavioral psychology of Mehrabian & Russell[19] which predicts three major states affecting individuals: the stimulus, organism, and response. The external or environmental factors stimulating individuals and influencing their emotional and cognitive states are conceptualized as stimulus in SOR theory[20]. These factors are not confined to a limited number of factors; in fact, there can be many situational factors that can stimulate individuals[21]. The organism aspect focuses instead on the internal process which can further influence the individuals to take certain actions or responses based on the stimulating factors[19,22]. The response is then considered as the final action taken by the individual concerning the need, and it can be either a positive action or averting behavior[19]. SOR theory has been effectively considered in the literature of consumer and organizational behaviors[23,24] and thus seems relevant to apply to future consumers like students who are currently in university institutional structures.

The current study integrates SOR and TPB to address the ESB of the university-going students in Pakistan. The SOR variables emerging from energy-related studies include media publicity (MP), organizational energy saving climate (OESC), perceived energy saving responsibility (PESR), and social pressure (SP). In simple words, MP and OESC are the stimulating factors while PESR and SP are the factors of organism as addressed in SOR theory[6]. On the other side, intention to save energy (ISE) and ESB are derived from TPB[4,9,11]. The following paragraphs discuss the hypotheses development and rationale concerning the selection of specific variables in this study.

MP denotes the consumption of public information about energy saving directed to their social and organizational environment[6]. A study in China reported that the residents of Beijing tend to present save energy behaviors when they are exposed to information about such energy saving[25]. In normal routine matters

of energy consumption, more than ten percent of the energy can be saved if the masses are provided with the information and education about the ESB[26]. Research regarding energy-wasting recycling found that the publicity of information alone could not directly affect behavioral intentions of people; rather it can create a SP on the public, which will ultimately impact their intentions to behave[27]. There is a possibility that MP can create a sense of responsibility and to some extent exert SP on the students to save energy, therefore each factor needs to be considered. A noteworthy study[6] followed the same pattern and found that MP created the sense of responsibility (PESR) about the energy saving of the office workers in China but failed to create the SP on them. Therefore, by extending this effort the current study considers students as members in an organizational system to assess the role of MP on their energy saving.

Hypothesis 1. MP has a positive impact on the student's PESR.

Hypothesis 2. MP has a positive impact on the student's SP.

OESC is denoted as the environment, condition, setting, or a place created by the organization or institutes to create a perception of energy saving among their members. The climate of any organization is very susceptible of shaping the attitudes and behaviors[28,29] of the workers. It is found that energy saving climate created by the organization influenced the attitudes of the workers to save energy in the organization, but this climate could not fully create the intentions of the employees towards saving energy[14]. It is revealed that the pro-environment strategies or initiatives advanced by the organization helped the employees to create a green psychological climate that further strengthened the relationship between their green intentions and behaviors[30]. In a similar manner, a study on the employees revealed that energy saving climate introduced by the organization pushed the individuals to be responsible of energy saving (PESR) within the organization and significantly created the SP on them regarding energy saving activities[6]. For this reason, the present study seeks to examine the role of universities or institutions' energy saving climate in creating a SP and perception of energy saving responsibility (PESR) among their students.

Hypothesis 3. OESC has a positive impact on the student's PESR.

Hypothesis 4. OESCE has a positive impact on the student's SP.

2.2. Theory of planned behavior (TPB)

Ajzen is credited with the formulation of TPB. The theory has since become the most relevant theory in predicting and explaining the behavioral choices of the individuals among various disciplines[17,18]. TPB specifies that individuals must pass through two different phases to perform specific behaviors. In the first phase, the individuals possess attitudes towards behaviors, subjective norms, and perceived behavioral control[14]. Once they can possess those then they will enter the second phase, which includes intentions to perform certain behaviors[11]. After the successful completion of these two phases then individuals can behave in a specific situation, context, or setting[17,18]. Attitudes are positive most of the time, which means when people hold positive attitudes these can increase their intentions[5,11]. Subjective norms are considered as expectations of society or specific people that influence the individual in the form of SP to perform a specific behavior[5,31]. Perceived behavioral control is usually referred to as the perception of a person regarding the easiness or difficulty to perform a behavior and if they feel easy then they perform the behavior[32,33]. The following paragraphs entail a discussion regarding the impact of organism factors (PESR and SP) of SOR theory on intentions to save energy (ISE) besides the influence of ISE on ESB and the development of hypotheses.

Perceived energy saving responsibility (PESR) refers to the ease and difficulty for a person to execute the demanded behaviors. When a person has a high perception of responsibility, the person will be more intended

to display such behaviors. Some researchers referred to PESR as the attitudes and specific beliefs that make a person responsible for energy saving through less consumption of energy in routine matters[6,34,35]. In institutional structures, when the employees are highly socially responsible, then they tend to feel institutional pride which further increases their satisfaction regarding their job[36]. In a similar vein, it is found that the social responsibility of the employees contributed significantly towards their satisfaction about their job, which further shaped their loyalty[37]. The intentions to save energy are formulated when the individual feels that is easily possible to save energy[5] An study on the ESB of workers in an organization pointed out PESR as the psychological factor that can shape their ISE. The finding revealed that the workers having high responsibility regarding energy saving have greater intentions to save energy[6]. In this study, if the students feel that energy saving is there, as well as others, responsibility, then they will be more intentional to try to save energy.

Hypothesis 5. PESR has a positive impact on the student's ISE.

Social pressure (SP) is regarded as the perception of related expectations from specific individuals or a society. These expectations influence the person to perform required behaviors[31]. The SP is also included in the framework of TPB as subjective norms; both variables are almost same in terms of their conceptualizations. The closer and more important people are for an individual can shape the behavioral intensions of that person[38]. Literature confirms that the SP or social norms[6,11] impact the energy saving behavioral intentions of the people. An investigation on the Chinese customers regarding the purchase intentions of energy saving household goods revealed that the subjective norms, along with other potential factors, have created buyers' purchase intensions[39]. Conversely, an insignificant association was encountered regarding the relationship among social norms and the behavioral intentions of the workers in a Chinese organization[5]. Thus, there is an inconsistency among SP findings, and it remains unclear whether this relationship does prevail among the students or not, which merits further investigation in this study.

Hypothesis 6. SP has a positive impact on the student's ISE.

Since it was theorized, TPB has consistently highlighted the importance of behavioral intentions, as it is essential for actors in a system to perform expected behaviors. A line of research has proven the claim of TPB that behavioral intentions are the driving force behind any behaviors. It is found that individuals holding high behavioral intentions regarding the purchase of new energy vehicles are more prone to buy those vehicles[40]. In Pakistan, it is shown that the household's ISE was having a strong impact on ESB[4]. A study in the cultural context of China revealed that residents have increased intent to buy pro-environmental products and their intentions enabled them to buy such appliances that save more energy[12]. During the emergency of COVID-19 in Pakistan, while energy consumption among the residential sector was at its peak, it was shown that the populace that intended to save electricity in their homes were fond of saving energy[9]. On the other side, several previous studies focused only on the determination of ISE through certain personality, internal, external, or other factors and could not exactly unpacked the relationship between ISE and ESB[5,6,15]. Therefore, the current study extends such efforts in linking ISE with ESB specifically among the students in Pakistan, as they have been less examined in this cultural context.

Hypothesis 7. ISE has a positive impact on the student's ESB.

Figure 1 represents the integrated theoretical framework that combines the theorized constructs and related hypotheses of this study.
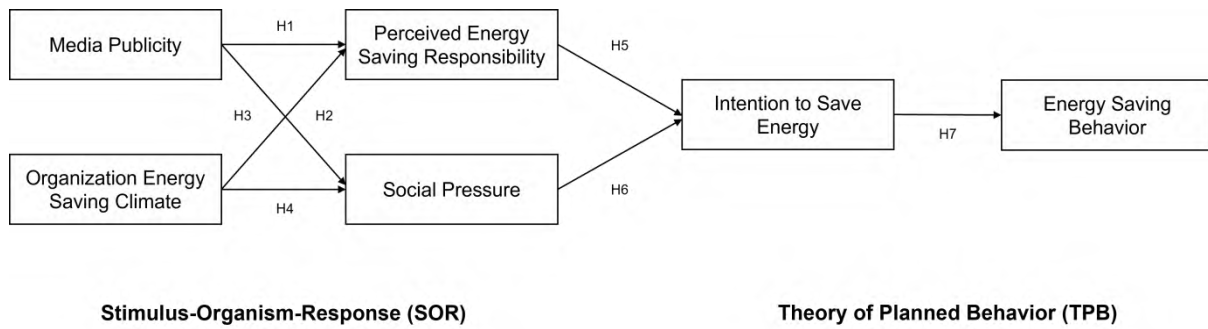
Figure 1. Integrated SOR+TPB theoretical framework.

3. Methodology

A quantitative research design followed by an online survey technique was considered in this study. The university-going students from the top four cities of Pakistan (Islamabad, Karachi, Lahore, and Faisalabad) were approached to participate in the current study. This sample was chosen because the top tier universities of Pakistan exist in these cities, the literacy rate of such cities is higher compared to others, and the media information, organizational, and social influence conditions assumed in both SOR and TPB theories are more present. This follows the approach of an earlier study concerning ESB that incorporated three influential cities of China[5] to recruit similar respondents, via convenience sampling techniques. To effectively ask university students of Pakistan to report about their ESB, a survey form with a total of 22 (4 demographic and 18 main) close-ended questions was prepared, comprised of seven main sections (including the demographics and six sections of established items for each of the six key constructs of this study).

3.1. Respondents

An online survey form through Google forms was shared with the students of four major cities of Pakistan through the prominent social networking sites (SNS) in Pakistan such as, WhatsApp, Facebook, and Email. Out of hundreds of invitations sent to the students, more than four hundred carefully filled out and completed the survey (this study secured a response rate of approximately seventy percent). This report has analyzed the usable responses from 410 respondents during the eight months of data collection starting from January 2022 until August 2022. This response from a sample of 410 was relatively higher compared to the previous line of studies[6,11,14] and therefore considered sufficient for the final data processing.

In section one, four questions (i.e., gender, location, age, and education) about the demographic information were asked from the research subjects. The frequencies and percentages of each question are shown in **Table 1**. The number of female students who participated in the survey ($n = 239, f = 58.3\%$) were slightly more than male students ($n = 171, f = 41.7\%$). The respondents shared their location details as Islamabad (34.4%), Karachi (27.1%), Lahore (22.9%), and Faisalabad (15.6%), which indicate more of the students were from the capital city (Islamabad) of Pakistan. Most of the participants belonged to the 20–30 age group ($n = 284, f = 69.2\%$). And around 46% of these students were enrolled in undergraduate degree and 54% were enrolled in postgraduate programs.

Table 1. Demographic information.

		Frequency	Percentage
Gender	Male	171	41.7%
	Female	239	58.3%

Table 1. (*Continued*).

		Frequency	Percentage
Location	Islamabad	141	34.4%
	Karachi	111	27.1%
	Lahore	94	22.9%
	Faisalabad	64	15.6%
Age	16–20	72	17.6%
	21–25	176	42.9%
	26–30	108	26.3%
	31–35	54	13.2%
Education	Undergraduate	189	46.1%
	Postgraduate	221	53.9%

3.2. Measurements

The measurement scales were adopted from the earlier studies reporting high validity with slight modifications (wording of few items) based on the context of current study. The entire survey questionnaire was in English. A seven-point Likert-type scale was incorporated to measure all items in the existing study ranging from strongly disagree to strongly agree. MP was measured by two-items partially adapted from a previous study[6]. The three-items to measure OESC were adopted from another robust study[14]. PESR was measured through three-items adopted from recent research[35]. The four-items scale of SP was adapted from another study[25] with minor modifications, i.e., the slight change of a few words in the items to better match the context of current study. ISE was measured by three-items adopted from a recent study[5]. Lastly, three-items were adopted from the previous research[11] to measure ESB of the students. The details of measurement items adopted for each construct are stated in **Table 2**.

Table 2. Measurement details.

Variable		Items	Loading
MP	MP1	I regularly see messages about energy saving on social media.	0.884
	MP2	I regularly see messages about energy saving on newspapers, television, and other media.	0.907
OESC	OE1	My university encourages energy saving.	0.971
	OE2	My university puts much value on energy saving.	0.900
	OE3	My university is concerned with becoming more environmentally friendly.	0.873
PESR	PE1	I am responsible for energy saving.	0.685
	PE2	Energy saving is the responsibility of governments, enterprises, and individuals.	0.858
	PE3	Everybody should share the responsibility to save energy.	0.752
SP	SP1	Most people who are important to me think I should save energy.	0.858
	SP2	My teachers expect me to save energy.	0.910
	SP3	My fellows expect me to save energy.	0.927
	SP4	I feel pressured due to the energy-saving activities of my peers.	0.935
ISE	IE1	I am willing to save energy for my university.	0.837
	IE2	I intend to engage in energy-saving activities in my university.	0.841
	IE3	I will make an effort to save energy in my university.	0.708
ESB	ES1	I always turn off electrical appliances when no one else is left in the room.	0.856
	ES2	I always turn electrical appliances off completely rather than to a standby mode.	0.880
	ES3	I have purchased energy efficient electrical appliances in the past few years.	0.898

4. Data analysis and results

The data analysis was done by deploying two statistical software packages (SPSS and AMOS). In SPSS, the descriptive data about the demographic information was processed to present the frequencies and percentages (see **Table 1**). In AMOS, two major steps were taken: the development of measurement and structural models. The measurement model was assessed to ensure the reliability and validity of the measurement tools against each construct and structural model was assessed to address the relationships between the constructs of current study.

4.1. Measurement model

The reliability of the constructs was assessed by examining the values of Cronbach alpha (α) and composite reliability (CR), both of which should meet the standard of more than 0.70[41]. As shown in **Table 3**, alpha values ranged between 0.824 and 0.952, and those for CR ranged between 0.811 and 0.949. This indicates that each construct has a good reliability, well above the threshold limit. The validity of the constructs was determined through average variance extracted (AVE) and discriminant validity. For every construct, the AVE should cross the minimum limit of 0.50[41]. **Table 3** shows that the AVE values ranged between 0.590 and 0.824, confirming the acceptance of convergent validity. All the square roots of AVE are bold and greater than the coefficients or off-diagonal elements in the corresponding rows and columns, hence establishing the evidence of discriminant validity (see, **Table 3**). The measurement properties of the constructs were also examined through confirmatory factor analysis (CFA). The results of CFA indicated that every item loaded significantly in their respective variable and exceeded the threshold value (see **Table 2**). Furthermore, the model fitness indices values indicated an acceptable fit ($\chi^2 = 432.583$, $\chi^2/\mathrm{df} = 4.081$, GFI = 0.906, NFI = 0.939, TLI = 0.932, CFI = 0.953, PNFI = 0.651, and RMSEA = 0.078) between the data set and measurement model.

Table 3. Reliability and validity.

	α	CR	AVE	MP	OESC	PESR	SP	ISE	ESB
MP	0.894	0.891	0.803	**0.896**	-	-	-	-	-
OESC	0.946	0.940	0.839	0.491***	**0.916**	-	-	-	-
PESR	0.824	0.811	0.590	0.636***	0.745***	**0.768**	-	-	-
SP	0.952	0.949	0.824	0.637***	0.546***	0.462***	**0.908**	-	-
ISE	0.827	0.842	0.642	0.677***	0.583***	0.654***	0.778***	**0.801**	-
ESB	0.892	0.910	0.771	0.390***	0.648***	0.714***	0.487***	0.782***	**0.878**

***$\rho < 0.001$.

4.2. Structural model

After the attainment of reliability and validity of the constructs in the current study, the measurement model was transformed into a structural model to evaluate the path coefficients and coefficient of determination (R^2). The findings revealed that MP was having a positive significant relationship with PESR ($\beta = 0.310$, $t = 9.066$, $p < 0.001$) and SP ($\beta = 0.472$, $t = 10.938$, $p < 0.001$). It is also found that OESC was having positive significant relationship with PESR ($\beta = 0.520$, $t = 13.660$, $p < 0.001$) and SP ($\beta = 0.359$, $t = 7.457$, $p < 0.001$). Furthermore, PESR ($\beta = 0.281$, $t = 7.389$, $p < 0.001$) and SP ($\beta = .585$, $t = 17.598$, $p < 0.001$) are having a positive significant relationship with ISE (see **Table 4**). Lastly, ISE was also having a positive relationship with ESB ($\beta = 0.641$, $t = 20.221$, $p < 0.001$).

On the other side, MP and OESC explained 52.9% of the variance in PESR and 42.3% of the variance in SP. In addition, the earlier mentioned four constructs explained 59.6% of variance in ISE. Most importantly, all proposed constructs of the current study explained 50.1% of variance in the ESB (see **Figure 2**).

Table 4. Regression analysis.

Causal path			β	S.E.	t	ρ	Status
MP	→	PESR	0.310	0.034	9.066	***	Significant
MP	→	SP	0.472	0.043	10.93	***	Significant
OESC	→	PESR	0.520	0.038	13.66	***	Significant
OESC	→	SP	0.359	0.048	7.457	***	Significant
PESR	→	ISE	0.281	0.038	7.389	***	Significant
SP	→	ISE	0.585	0.033	17.59	***	Significant
ISE	→	ESB	0.641	0.032	20.22	***	Significant

***Significance at the level of 0.001.
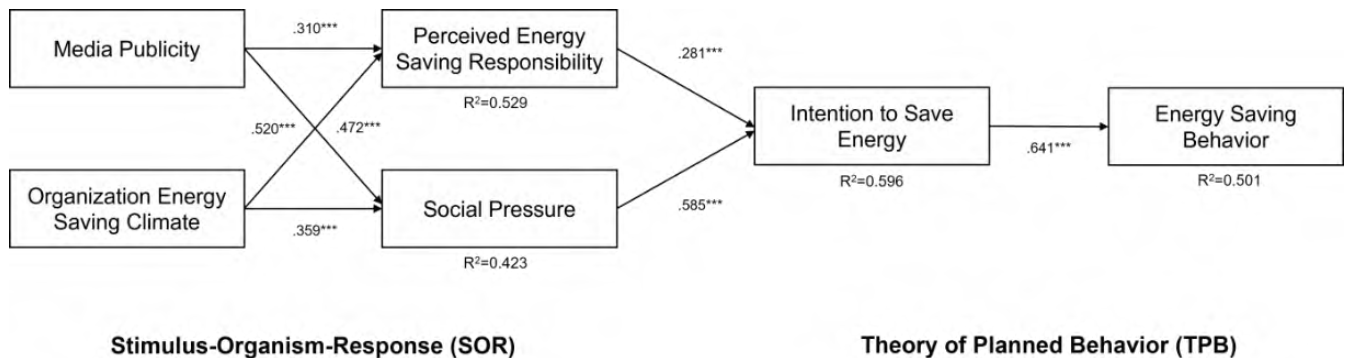
Figure 2. Results of the integrated SOR+TPB theoretical framework.

5. Discussion

The current study is designed to both explore and extend our understanding regarding the ESB of university students in Pakistan by considering the theoretical integration of SOR and TPB. The context of Pakistan and its students are considered in this effort, for the main reason that prior efforts have contributed a reasonable understanding about the determination of environment friendly decisions of employees, households, and consumers[5,12,25]. The students' behaviors are less presented, especially from a country like Pakistan where the major population is its youth. A novel approach considering the integration of two well-established behavioral theories (SOR and TPB) is included in the study to explore the relationship of important established constructs that might influence the ESB of the students.

The findings of the study have supported all seven proposed hypotheses. The systematic process of assessing ESB found that the information available on the different mass media platforms (MP) and the university's climate (PESR) have made the students responsible enough (PESR) to save energy. In addition, these media outlets and the institutional efforts regarding energy conservation have created an effective pressure (SP) on the students. The perception of social responsibility and societal expectations have further formulated the behavioral intention (the predicted influence of SOR factors on TPB outcomes) of the university students in Pakistan to minimize the use of energy in their daily routine matters. Most importantly, the behavioral intentions have significantly contributed to their actual behaviors about energy saving (TPB's predicted ISE to ESB link).

It is evident from the findings of the present study that the integration of SOR and TPB have indeed enhanced and extended our understanding regarding the dynamic nature of energy saving, especially from student samples. This study has supported the claim of the research[15] that the consideration of students can add value to literature. In terms of SOR, the findings of existing study are in line with previous efforts, which

established that stimulation factors (MP and OESC) can influence organisms (PESR and SP) of individuals[6]. TPB assumes that behavioral intentions are impacted by various factors, and the findings of this research supported that the organism factors (PESR and SP) of SOR can strongly affect ISE of students. Though earlier efforts have been confined to the assessment of behavioral intentions[5,14,39] and very few studies have explored the actual behaviors of energy saving[4,9,11]. These findings provide support to that minimal research and further establish that ISE could contribute to ESB.

5.1. Theoretical and policy implications

Several theoretical implications are directly linked with this study. In Pakistan, researchers have been mainly exploring the energy behaviors of households from the lens of TPB[7,9,10]. Even during the period of COVID-19 era, when the consumption of energy in households was at its peak, the people were still holding pro-environment behaviors[4,9]. The findings of the present study have extended the understanding of ESB especially from the perspective of students and found that they are equally participating (like households) to save more energy and to help their country face socio-economic challenges. Furthermore, it is evident that the environment provided by the universities or institutes for their students has helped them form these productive behaviors.

The prominent contribution in terms of theory is the combination of two noteworthy theoretical reasonings for peoples' behavior under certain conditions (SOR and TPB) and the testing of both construct validation and their predicted paths in a proposed integrated model. These are shown to be both valid and explanatory for predicting the energy-oriented intentions and behaviors of the students of Pakistan to expand upon past theoretical insights. To sum up, it can now be argued that two major segments of Pakistan's population (households and students) have developed ESB in their routine matters and, if adequately informed and involved, can contribute in important ways to greater environmental protection.

Policy makers could also benefit from these findings, noting that the cultural context of Pakistan seems to have played a vital role in formulating ESB of the university students through the media, societal pressure, universities' environment, and perception of responsibility. These highlighted indicators can be utilized to further develop the energy awareness and responsible responses of school-going students in Pakistan through clear and strategic policy making by the government. This study suggests it is necessary to formulate such policies for the new generation and target them during their early years of life so that they can increase the level of intentions and energy-related behaviors. Since the populace of Pakistan are mostly heavy users of social media, government entities can increase their effective use of media, to launch energy saving information and campaigns for the people living in rural and urban areas. These initiatives could bring good results through the long terms process and policies. Though this study adds the student view to the existing stance studied by residential households, there remain many population segments still not duly considered by existing research. Therefore, strategic polices following the findings of the current study can bring a larger population on board toward successful investigations and implementation of energy saving concerns for the future.

5.2. Limitations

Despite noteworthy findings and a novel integration of two popular theories, the present study is not without its limitations. The students were selected from the four key urban areas of Pakistan where the literacy rate is normally very high, as is exposure to a wide range of issues. However, the stance of rural area's public has not yet been covered in this effort; upcoming research needs to consider ways to fill this gap to provide new insights. Furthermore, energy saving studies among students are relatively very few and future researchers could compare the ESB of the students from two or more different countries at similar or differing economic

levels. The present study also addresses the saving of electrical energy and is limited to the students' behavior in the university context, but this behavior could also have been analyzed at the level of the students' residence as well, or examined as those students graduate and their attitudes are applied or adapted to life in companies. In addition, this study lacks confirmatory support for the causal relationship between or beyond the variables due to methodological constraints and it may limit the generalizability of the findings[42,43]. Continuing research could add more variables into this framework and apply it to other cultural contexts for the reconfirmation and validation of SOR and TPB predictions.

6. Conclusion

In this study, the aimed link between the factors of SOR with the outcomes of TPB are shown to address the adoption of ESB by students from Pakistan. This extends the literature that has thus far mostly focused on the perspective of consumers, employees, and households to now include perspectives affecting students' ESB. The findings are unique in showing that the students of Pakistan have both the intentions and practices to save the energy mitigated through relevant constructs and their interrelations predicted by the integration of SOR and TPB.

Further, the integrated SOR+TPB theoretical model (see **Figure 2**) suggests that the direction and influences of the behavioral tendencies of these students might be more vulnerable as compared to other populations (noting the higher statistical strength shown in the lines connecting Media Publicity with Social Pressure with Intentions to Save Energy). A possible reason behind these findings might be found in the cultural context of Pakistan, where the population are generally more highly influenced by media and social pressure. Whether these show evidence of collective thinking or other forms of social-cultural orientations need to be further explored.

Theoretically, this is an important starting point for examining energy-related attitudes and behaviors in a specified population from two different theoretical perspectives. This study has both shown the value of and validated the assumptions gained by integrating two leading behavioral theories (namely SOR and TPB). It signals the beginning of a long and intensive research series, which will require the reconfirmation and validation of this integrated SOR+TPB model in different cultures and populations. And this study provides important findings toward further exploring other energy-related issues in contexts where the outcomes of people's behaviors are affected by trajectories of national economic growth, environmental innovations, and their sustainability, and how media and organizations promote responsible energy attitudes and behaviors.

Author contributions

Conceptualization, MUN and IHB; methodology, MUN; software, AZ; validation, AZ, MAK and SJK; formal analysis, MUN; investigation, MUN and IHB; resources, AZ; data curation, MAK and SJK; writing—original draft preparation, MUN and IHB; writing—review and editing, AZ, MAK and SJK; visualization, IHB; supervision, AZ and SJK; project administration, MUN and MAK; funding acquisition, AZ and SJK. All authors have read and agreed to the published version of the manuscript.

Conflict of interest

The authors declare no conflict of interest.

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