

## Article

# Does Salience of Neighbor-Comparison Information Attract Attention and Conserve Energy? Eye-Tracking Experiment and Interview with Korean Local Apartment Residents

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**Abstract:** The purpose of this paper is to examine whether salience of neighbor comparison information attracts more attention from residents and consequently leads to significant energy conservation. An eye-tracking experiment on 54 residents in a local apartment complex in Korea found that the average time of attention to the neighbor comparison information increased to 277 ms when the size of the information was four times larger and the information was located to the far left. However, the interviews with the subjects suggest that salience of the information is seemingly unrelated to energy conservation, because most of them did not agree with the social consensus that individuals need to refrain from consuming energy when they know that they have consumed more than the neighbor's average. Utility data on 502 households in the apartments revealed that, of the households notified that they consumed more than their neighbors, only less than 50% reduced their energy consumption, which supports the interview results. Therefore, it was concluded that neighbor comparison information did not lead to significant energy conservation effects in the community, although salience of the information contributed to attracting more attention to the information. Unavailable household data remained as limitation to clarify the effect by households.

**Keywords:** salience; neighbor comparison; electricity consumption; eye-tracking experiment; energy conservation



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## 1. Introduction

It is widely accepted that enhancing energy efficiency is crucial for reducing greenhouse emissions. To persuade individuals and businesses to use less energy, public policy has been taking greater interest in using energy conservation programs that do not rely on changing energy prices, such as subsidies for those who switch to more energy-efficient appliances. Drawing on insights from cognitive sciences, such energy conservation programs typically carry certain information that nudges energy consumers to reduce their energy use.

One of the most successful of such energy programs is the neighbor comparison information that was run by the US company OPOWER. The US neighbor comparison information program began under the title of home energy reports (HERs) in August 2011. The comparison information played the role of a social norm, inducing people to practice energy and environmental conservation and contributed to a reduction in energy consumption by two percent on average. The effect is equivalent to that of a short-run electricity price increase of 11–20 percent, which translates to annual savings of USD 300 million [1,2]. Besides that, there exist sufficient results for how communicating a descriptive norm—how most people behave in a given situation—via information can induce conformity to the communicated behavior on energy resources as well as social beliefs [3–7].

By benchmarking the HERs program, the Korean government began the program of neighbor comparison information in 2012. The Korea Energy Agency (KEA), a government-

tal agency that carried out national energy policies for energy efficiency, officially began supervising the program in 2012 in order to expand it nationwide. KEA reported that 1 million households received neighbor comparison information in their utility statements in 2013 and announced an ambitious plan that the information would be provided to up to 5 million households by 2017.

However, a way of presenting the neighbor comparison information, such as its design, format, and size, is not officially standardized by the KEA but decided by each local community under its own preferences and budget conditions. Some local communities have been presenting the information in the form of bar graph in the middle section of the statement, and some others use customer-friendly designs such as speedometers, animal graphics, and locating it at the top of the statement to be easily visible (see Appendix A). Taking into account the standard format of the information with content saliency in the HER program, Korean programs lack saliency of information, even though saliency of information is central to faster and more effective perception of the information.

For a case study, this paper selects a local apartment complex which has been presenting this information in its monthly utility statement as shown in Figure 1. Not only does the size of the information picture seem to be small, but also the location of the information within the statement is not prominent enough for attracting attention. Because cognitive research suggests that the human eye travels from left to right as well as from top to bottom when they read or scan a simple paper sheet, it is assumed that the information in Figure 1 is not distinguished, thereby making it hard for the residents to perceive the information in the statement. Furthermore, it is assumed that the residents will become more prone to seeing and perceiving the information if the information is provided with a salient design, namely a larger size and the leftmost location, as shown in Figure 2.

It is meaningful for academic researchers as well as policy makers to awaken the importance of saliency of the neighbor comparison information. For academia, this paper is the first neighbor comparison information study dealing with the importance of saliency of the comparison information and its eventual effect on energy conservation. Recent studies on social comparison information expanded their scopes from energy to resources, such as water [7–9], but still did not consider the importance of saliency of the information. In fact, saliency of information is the main topic in the field of cognitive psychology to clarify how saliency is related to the perceptions of observers. We found that only a few examples of saliency research were conducted from a public policy perspective in recent years, (e.g., [10]). For policy makers, this paper provides the implication that a public program or policy which was effective in a certain society was not in other societies.

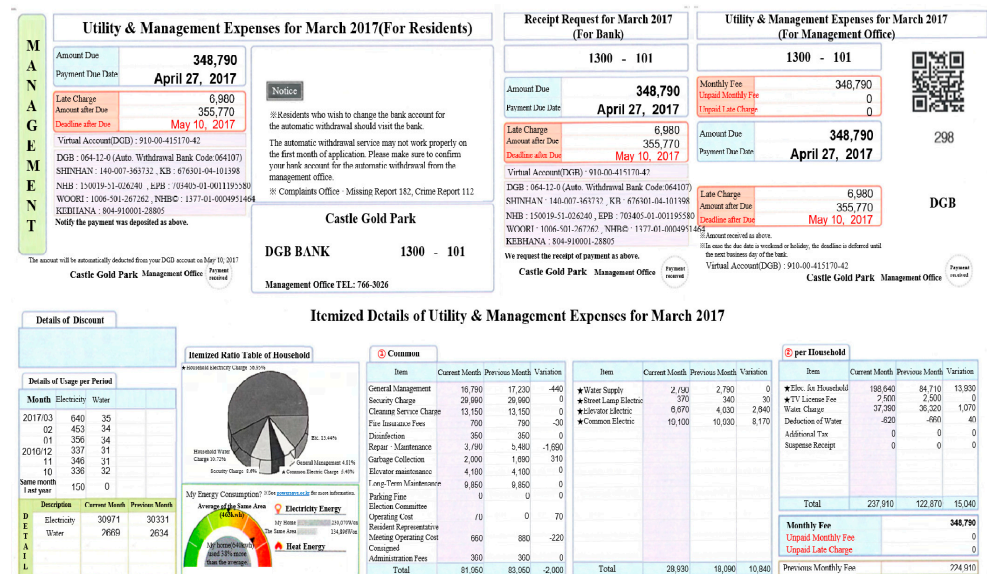


Figure 1. Statement-1: The real version (English translation).

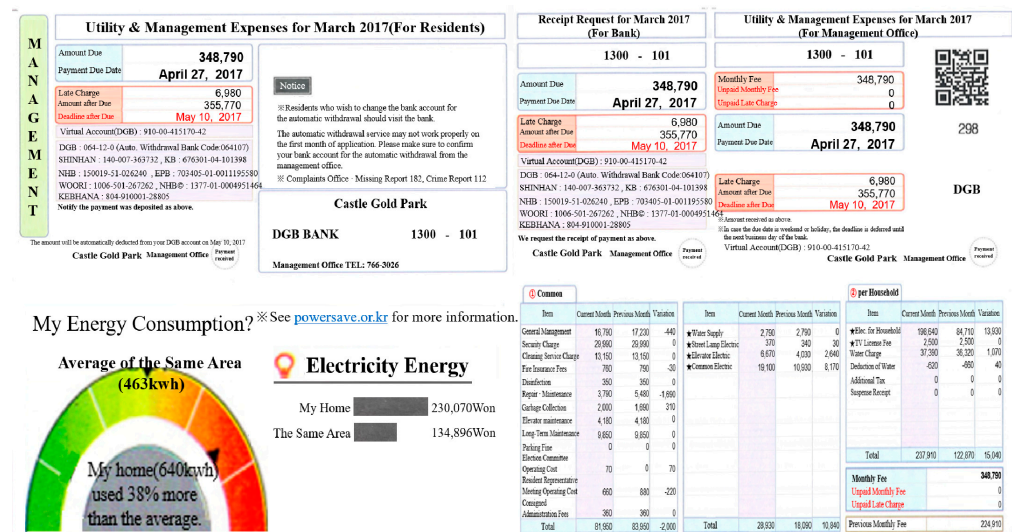


Figure 2. Statement-2: The controlled version (English translation).

Overall, the aim of this paper is twofold. The first aim of this paper is to check whether residents were more prone to seeing the neighbor comparison information when the statement was provided with salient information design. An eye-tracking experiment is employed for this methodology. The data collected from the experiments on 54 actual residents in the apartment complex will reveal their interests, which are measured by attention time on specific information in the monthly statements as shown in Figures 1 and 2. The second aim of this paper is to check whether these subjects considered the neighbor comparison information showing that “My home used 38% more than the average” as a significant determinant of their electricity consumption. Our in-depth interview with these subjects after the eye-tracking experiments will give an answer for the second question. In addition, this paper analyzes the actual utility data on 502 households in the apartment complex to confirm the results from the eye-tracking experiments and the interviews.

The remainder of this paper is organized as follows. The next section reviews existing relevant studies and points out the difference between this paper and the existing literature. Section 3 provides the eye-tracking experimental results on the moving patterns and duration time of eye-gazing points for two different information designs. Section 4 presents the post-experiment interview results. Discussion and implications are suggested in Section 5. Contribution, limitation, and further study are offered in Section 6.

## 2. Literature Review

The OPOWER case has been widely used by the pioneering studies evaluating the effect of neighbor comparison information on energy conservation in recent years [1,2]. After these works, social comparison has emerged as a nudge for behavior change, and the approach with this measure has been used to induce energy conservation [4,6]. Additionally, the social comparison approach was used for conserving resources such as water. It was examined in [7,9] that hotel guests reduced their water use when they were informed of a hotel’s stated social goal of water conservation, and [7] found that Sacramento households that received the social comparison report used 8.35% less water than similar households that did not receive the report. In addition, a field experiment in Texas found that informational interventions to encourage energy conservation were effective during summer peak load times [4].

Although the literature survey found sufficient empirical evidence showing a positive effect by the social comparison information on energy conservation, it is hard to find a study dealing with the importance of salience of the information, because salience of information is the field of cognitive psychology. Cognitive research focuses on salience of information as a factor of the stimulus-driven perception effect to compare other factors of the goal-driven

perception effect, which is not the primary research scope of this paper, even though a number of cognitive studies have been well documented [11–17]. Furthermore, it was observed that the Korean statement not only provided too much content but also carried the neighbor comparison information, which was not as salient as the HERs by OPOWER (see Appendix A). It becomes suspicious that such saliency-lacking information tended to attract less attention to the information and consequently lead to insignificant energy conservation, which is the research motivation of this paper.

Furthermore, in the domain of public policy, social comparison has been recognized as a cost-effective tool that can change collective behaviors. It is timely to find a more effective social comparison information program that induces changes in collective energy consumption behaviors. Saliency of the information for the energy conservation program is an appropriate target for testing whether the program will work better for changing the collective behaviors, too.

Therefore, by using the case of a Korean local apartment complex that has been reporting saliency-lacking neighbor comparison information, this paper investigates whether saliency of the information matters for attracting more attention from the residents. This investigation contributes to fill the void in the existing research with a lack of saliency of information, especially in the area of social comparison evaluation studies. In addition, this paper is the first study applying the cognitive experimental method to the area of social comparison evaluation, because all the evaluation research used panel data on residential energy consumption to find whether consumption was reduced after the information report. In addition to an eye-tracking experiment, this paper conducts in-depth interviews with the subjects after the experiment as a qualitative method and analyzes energy consumption data on actual residents in the apartment complex as a quantitative method in order to confirm the experiment's results and its implications.

### 3. Eye-Tracking Experiment Design

This paper focuses on the case of an apartment complex in Daegu, the third-largest metropolitan city in Korea, where the neighbor comparison information service began being provided to residents' monthly utility statements in 2015, as shown in Figure 1. "My neighborhood" was defined in the information as the households living in the same area of units as the resident in the apartment complex. The neighbor comparison information showed how much the resident have consumed more (or less) than their neighborhood in the last month. It is postulated that the information printed in the utility statement was not sufficiently salient for taking significant attention. The actual statement delivered to the residents had too much information to be scrupulously read. Moreover, the resident comparison information was quite small in size and was located in an ambiguous position to draw attention. Therefore, this paper made a controlled version of the utility statement with redesigned resident comparison information that amplified the saliency of the information as shown in Figure 2. For convenience, the actual statement in Figure 1 is labeled as Statement-1, and the controlled version in Figure 2 is labeled as Statement-2. The content of the information was identical for the two statements: "My home used 38% more than the average".

After passing the sufficient time for establishing the program in the community as of the start of the year 2015, it was necessary to check whether the information was operating well in the community, as well as whether more salient information could help gain greater attention from the residents. Two years was set as the sufficient time for establishment in the community. The analysis was designed by the following steps of surveys, eye-tracking experiments, and in-depth interviews, as shown in Figure 3.

For the first step, we recruited 54 residents of the local apartment community with normal or corrected-to-normal vision by following the method in Rayner's study [18]. They were voluntarily applied to the experiment after receiving an official recruiting announcement from the apartment service center and paid to KRW 10,000 (equivalent to approximately USD 10) for each participant. Most of them were females, because

the participating condition was to be the “person who is looking mainly at the monthly statement and in charge of paying it”. In addition, they were all naïve with respect to the purpose of the experiment and not requested to provide any privacy information that could be personally identified, such as age, occupation, earnings, or education, except for a couple of residence questions (e.g., how long your residence in this apartment has been and how many residence members you have) in Table 1.

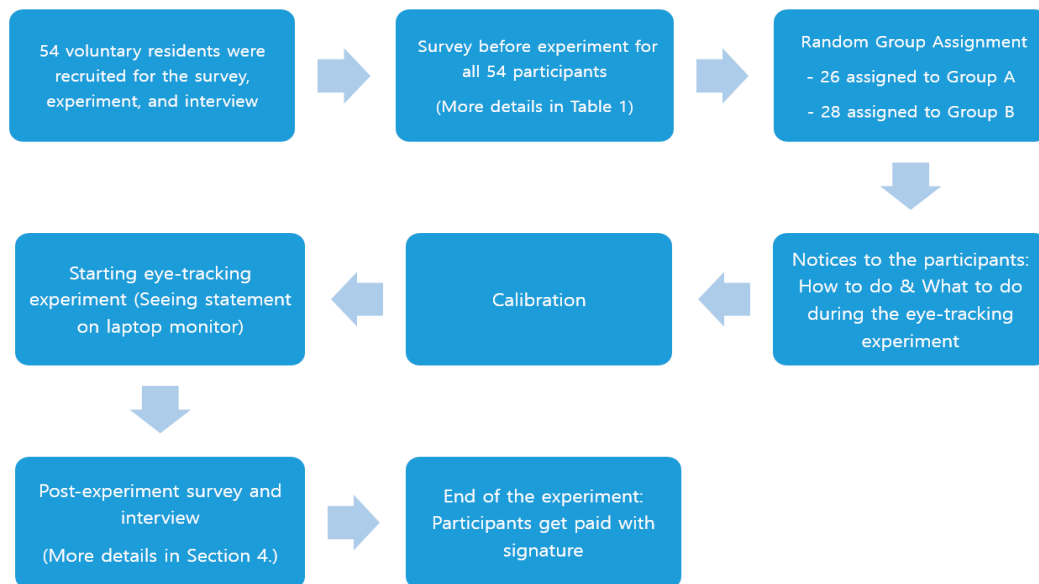


Figure 3. Research design for the surveys, experiments, and interviews.

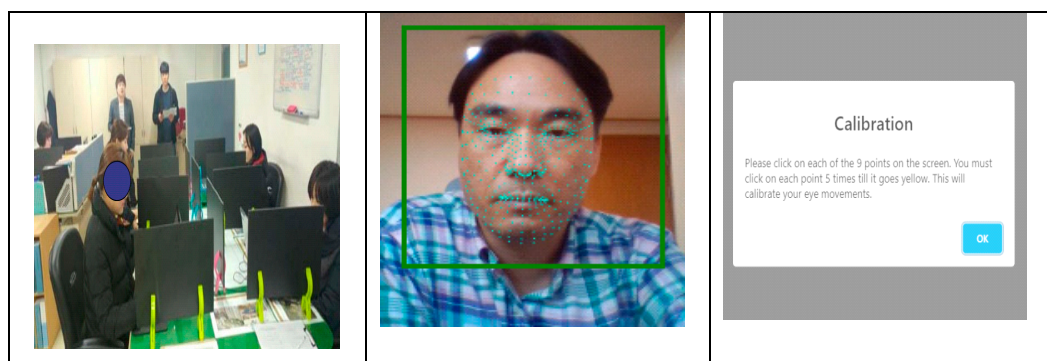
Table 1. Answers to the simple survey before the experiment.

Question	Answer	Group A	Group B
1. How long have you been staying in this apartment?	Less than 1 year	2 (8%) <sup>1</sup>	0 (0%)
	1–2 years	1 (4%)	2 (7%)
	2–3 years	1 (4%)	4 (14%)
	3–4 years	3 (11%)	4 (14%)
	Over 4 years	19 (73%)	18 (64%)
2. Are you in charge of the utility statement at home?	Yes	24 (92%)	27 (96%)
	No	2 (8%)	1 (4%)
3. How many family members are living together? (Including yourself)	1	1 (4%)	2 (7%)
	2	5 (19%)	6 (21%)
	3	5 (19%)	5 (18%)
	4	12 (46%)	11 (40%)
	5 and more	3 (12%)	4 (14%)
4. Write your interest(s) in your utility statement (If none, write “None”)	Total pay	17 (65%)	0 (0%)
	Electricity pay	0 (0%)	15 (54%)
	Water pay	8 (30%)	8 (29%)
	Management pay	3 (11%)	3 (11%)
	Month-on-month pay	4 (15%)	3 (11%)
	Common power pay	2 (7%)	2 (7%)
	Neighbor-comparison	2 (7%)	0 (0%)
	Electricity usage	0 (0%)	2 (7%)
	Everything	1 (3%)	1 (4%)
	None	0 (0%)	1 (4%)

<sup>1</sup> Numbers in parentheses are the percentage of the total answers for a group.

As the next step, the recruited participants were randomly assigned to either Group A or Group B, with almost equal numbers considered. Both groups were requested to answer survey questionnaires as in [19], collecting both questionnaire and eye-tracking data. The primary purpose of this survey was to record their general behavior while they were watching the statement, thereby inducing these behaviors to appear naturally during experiment. In addition, this survey helped for cross-checking whether their attention points on the statement collected by the eye-tracking experiment would be consistent with the answers in this survey, because the attention points were recognized as their interests. The survey questionnaire and the answers are summarized in Table 1. Most of the subjects were interested in payment amounts, such as the total payment, and payment details. Only two subjects of Group A responded with interest in the comparison information. These answers could be evidence that residents in the community consumed energy for their own satisfaction regardless of caring or not caring about social behavior. The survey was meaningful as the preliminary step for a smooth experimental process and for the background information of the subjects, because their private information was not allowed to be collected.

After the simple survey, Group A was requested to see the monitor showing Statement-1, reporting the less-salient information, and Group B was requested to see Statement-2, containing more-salient information. Notices about how-to-dos and what-to-dos were announced. For example, they were requested to use a mouse device, watch the laptop monitor until the end of experiment, and follow the message prompt on the monitor. Additionally, they were strongly recommended to turn off their cellphones to not disturb the ongoing experiment. For the technical equipment and programs for the eye-tracking experiment, this paper used WebGazer.js, created by the Brown HCI Group. WebGazer.js is an eye tracking library that uses common webcams to infer the eye-gaze locations of persons on a webcam in real time. WebGazer contains an automatic face-setting system without a head pedestal, as well as an easy calibration system (see Figure 4). The subjects each had their own seats with black bulkheads and individual laptops operating WebGazer. The subject's gazing points were recorded as a two-dimensional coordinate pixel in the laptop, and we present the recorded pixel gazing points on the statement through the Photoshop program. There are various ways to record and present the gazing points with WebGazer. More details about WebGazer are found on its website at <https://webgazer.cs.brown.edu> (accessed on 12 March 2021).



**Figure 4.** Notice to subjects, automatic face setting, and easy calibration procedure.

Eventually, the participants of each group were requested to see each statement assigned on their laptop monitors to test whether they paid significant attention to the information, and furthermore, whether they paid more attention to the more salient information than the less salient information. The eye-tracking experiment results are reported as follows. First, the representative pattern of the eyes on Statement-1 is shown in Figure 5. Subjects' eyes points in Group A were mostly located in the upper-left portion and the lower-right parts, meaning that their attention started in the upper-left part and moved

toward the lower-right part. The blue points became darker as the subjects' eyes focused on them more. Therefore, it was found that the subjects gave more attention to the total payment amount located in the upper left and the payment details in the lower right, which was consistent with the answers from before the survey. However, it appears that few residents' eyes fell on the resident comparison part, which was in the lower-left-most side. We deduced that residents normally did not see the resident comparison information in their monthly utility statements.

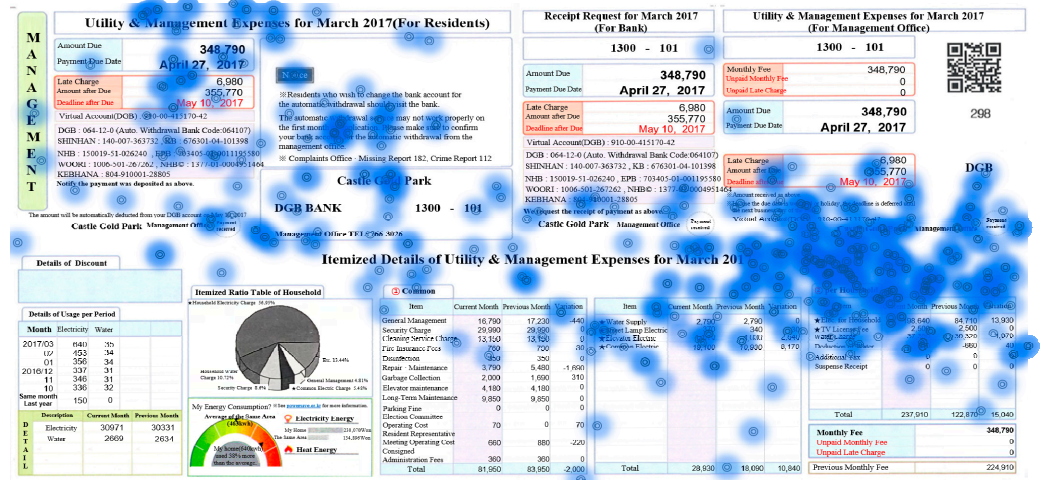


Figure 5. A common sample of Group A's gazing points for Statement-1.

Next, the representative sample of eyes on Statement-2 is displayed in Figure 6. It is found that significant attentions were paid to the neighbor-comparison information although they were not many, which is different from the Figure 5 showing no attentions to the information. Thus, it is argued that some subjects may have perceived the information when the information is much salient. The moving pattern of the eyes was similar in that most of the subjects' eyes gazed at the upper-left total payment and the lower-right payment details.

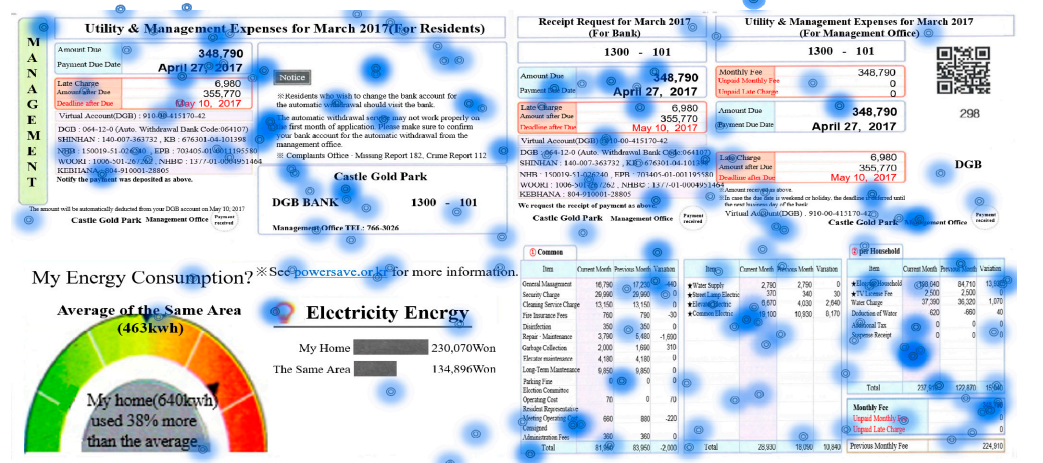


Figure 6. A common sample of Group B's gazing points for Statement-2.

Furthermore, to assess the difference in the average times of eye-gazing points among the sections of major information in the statement, we set up seven sections in Statement-1 and eight sections in Statement-2. We measured the average times of subjects' eye-gazing points for each section and conducted variance analysis. We defined the eye-gazing points in this paper as a fixation which was characterized by relative immobility (low position

variance), whereas a saccade was distinguished by a rapid change of position (high position variance) based on a position-variance method. This paper could objectively detect fixation and saccade by selecting an appropriate threshold value for position variance based on the method [16] (p. 190). Therefore, each subject’s fixation on the information was measured by the average time for the eye-gazing points within the identically sized sections.

Although 54 subjects (26 subjects in Group A and 28 subjects in Group B) were the initial participants in the eye-tracking experiment, we collected significant recorded results from 20 subjects in Group A and 17 subjects in Group B, since we eliminated the results from the subjects who violated our experimental rules and the results technically not saved by the system. The subjects were required to see the statement displayed on the monitor in their usual ways, but they were prohibited from turning their heads and doing something else before their experimental sessions were completed. Five subjects in Group A and three subjects in Group B belonged in the violation cases. Additionally, several subjects’ results were eliminated when the subjects failed the calibration tasks. Two subjects in Group A and six subjects in Group B belonged in the calibration case. Finally, the experimental results from two subjects in Group B were not saved in the WebGazer.js system due to unidentified technical problems.

The average times of the subjects’ eye-gazing points are summarized in Figures 7 and 8 for each statement with equally divided areas of interest (AOIs). Statement-1 had seven AOI sections, and Statement-2 had eight AOI sections, employing similar numbers of AOIs as prior studies, such as [20], which considered nine AOIs. For Statement-1, the AOI of Section 6, showing payment details for items such as household-level electricity, water, and broadcasting fees, took the longest time at 347 milliseconds (hereafter ms). Other payment details in Sections 5 and 7 and the total utility payment in Section 1 took the next-most attention at 130 ms, 124 ms, and 109 ms, respectively. However, the most important finding was that the neighbor comparison information located in the AOI of Section 4 in Statement-1 only commanded scant attention at 55 ms while the information located in Section 5 for Statement-2 took considerably greater attention at 277 ms, which shows how important salience of the information is for attracting people’s interest.

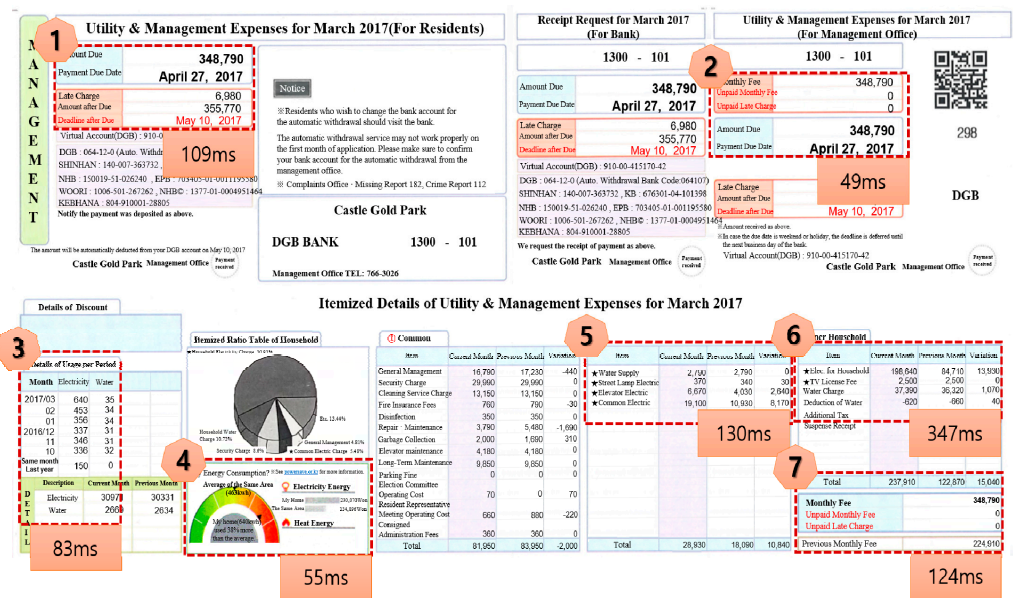


Figure 7. Average times of the gazing points for each area of interest in Statement-1.



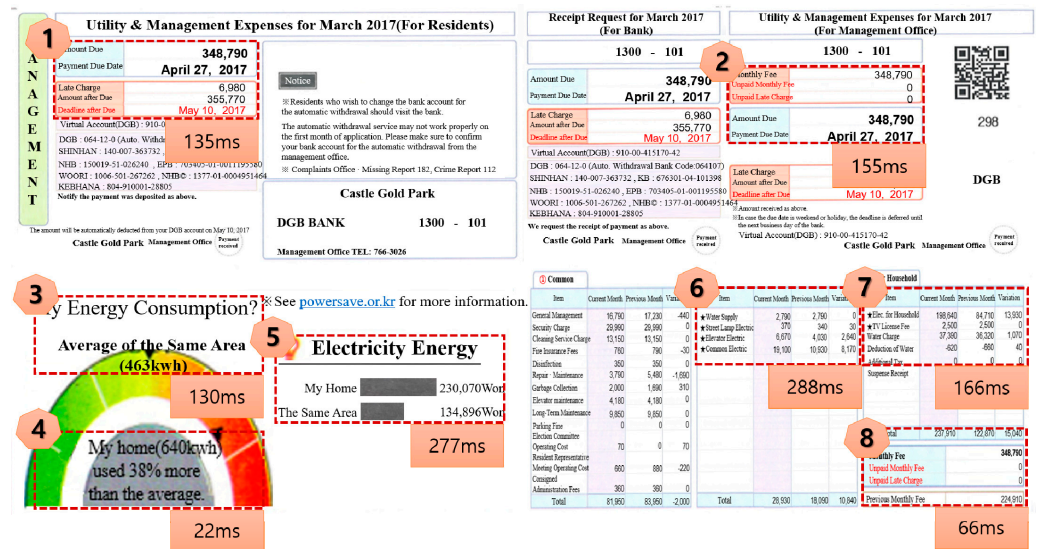


Figure 8. Average times of the gazing points for each area of interest in Statement-2.

These eye-tracking experiment results on the monthly utility statement are consistent with the well-established attention deployment argument that attention can be voluntarily controlled by the current goals of the observer (so-called goal-driven attention) and involuntarily driven by the physical salience of stimuli (so called stimulus-driven attention). In general, the attention of the residents was driven by a goal, because the attention in both Statement-1 and Statement-2 moved from the upper left to the lower right, as people usually read a book to find the gist of the information in it. The gist of the information in the statement they wanted to obtain was the payment information, because they paid sufficiently significant attention to the AOI sections containing payments for far more than 100 ms of gazing time, where 100 ms is the criterion of time for obtaining the gist of the information in a print document [14]. However, stimulus-driven attention happened when the size of the neighbor comparison information was four times larger in Statement-2 than in Statement-1. The AOI of Section 5 in Statement-2 (see Figure 8) attracted attention for 277 ms, but the AOI of Section 4 in Statement-1 (See Figure 7) attracted only 55 ms worth of attention. This finding is explained by the conclusion that a combination of these two types determines how attention is deployed in most cases [16] (p. 125).

Regarding the results shown in Figures 7 and 8, a question can be arisen: Do exactly same contents in the statement attract significantly different attentions? For example, the total payment per household content displayed in Section 7 for Group A attracted 124 ms of attention, but the same content displayed in Section 8 for Group B attracted only 66 ms of attention. The answer is no. The differences in attention times for the same content did not indicate different interests in the same content. The total payment per household information is displayed in three different locations over and over in a statement because it is pecuniary. As shown in Figures 7 and 8, Group A could see the total payment in the AOIs of Sections 1, 2, and 7, and Group B could see it in Sections 1, 2, and 8. For the AOI of Section 1, there was no significant difference in attention times between Group A at 109 ms and Group B at 135 ms. For Section 2, Group A’s gazing time was 49 ms, which was less than Group B’s 155 ms, whereas the time of attention of Group A to the last AOI section was 124 ms, which was more than Group B’s 66 ms. Thus, Group A and Group B had similar amounts of interest in the total payment information, although they saw a different location to check the information.

Using data on the time of fixation from the eye-tracking experiments, we made variance analyses to assess whether the times were statistically different across different sections. Tables 2 and 3 show the results for Statement-1 and Statement-2, respectively. A low *p*-value confirmed the statistically different fixation times for each section.

**Table 2.** ANOVA results for Statement-1.

Summary					
Group	Count	Summation	Average	Variance	
Section 1	20	2182.31	109.12	37,698.52	
Section 2	20	997.27	49.86	6396.75	
Section 3	20	1666.52	83.33	42,179.33	
Section 4	20	1115.51	55.78	4205.82	
Section 5	20	2603.59	130.18	39,074.91	
Section 6	20	6959.76	347.99	25,133.10	
Section 7	20	2484.47	124.22	84,850.99	
ANOVA					
Source of Variation	SS	df	MS	F	p-Value
Between Groups	1,241,699	6	20,6949.8	3.110	0.007
Within Groups	8,849,050	133	66,534.21		
Total	10,090,749				

**Table 3.** ANOVA results for Statement-2.

Summary					
Group	Count	Summation	Average	Variance	
Section 1	17	2304.65	135.57	34,159.64	
Section 2	17	2646.45	155.67	26,297.93	
Section 3	17	2217.05	130.41	35,012.48	
Section 4	17	387.20	22.78	4298.40	
Section 5	17	4714.04	277.30	127,666.90	
Section 6	17	4899.79	288.22	176,106.40	
Section 7	17	2832.25	166.60	54,824.69	
Section 8	17	1137.73	66.25	15,243.28	
ANOVA					
Source of Variation	SS	df	MS	F	p-Value
Between Groups	1,004,031	7	143,432.90	2.423	0.023
Within Groups	7,577,756	128	59,201.22		
Total	8,581,787	135			

#### 4. Post-Experiment Interview about Neighbor Comparison as a Determinant of Individual Electricity Consumption

It is essential to check whether more attention to the neighbor comparison information led to energy conservation consequently. After a subject completed the eye-tracking experiment, this paper conducted an interview with the subject to check whether they perceived the neighbor comparison information during the experiment and were motivated to conserve energy as a reaction to the information. The three questions were as follows:

1. What content(s) did you see in the statement?
2. Did you see the neighbor comparison information in the statement?
3. What do you think of the neighbor comparison information “My home consumed 38% more than the average”? Can you suggest any response action(s) to the information as an energy consumer?

All 26 subjects in Group A answered payment contents, which was consistent with the answers for the fourth short survey question, “Write your interest(s) in your utility billing statement”, suggested in Table 1. Additionally, consistent with the short survey results, only two subjects in Group A answered that they saw the neighbor comparison information. However, they did not agree that they needed to reduce energy consumption to the neighbor’s average level. Because they thought that the personal energy consumption

amount was made due to individual's own reasons, such as income level and energy-consuming satisfaction, it was not serious information for them that their home used more energy than the neighbor's average and, therefore, they were not strongly motivated to reduce energy consumption for the next month.

The interviews with Group B also revealed that the neighbor comparison information was seemingly irrelevant with energy conservation behaviors. Although all 28 subjects in Group B answered that they saw not only the payments content, but also the salient neighbor comparison information in the statement, it was a surprising result that 26 subjects did not suggest any response regarding conservation. Only two subjects answered that the information about 38% more consumption than the average motivated energy conservation.

In summary, the post-experiment interview results showed that the neighbor comparison information did not seem to be a significant determinant of energy conservation in the apartment community, no matter how salient the information was in the statement. Considering that the neighbor comparison information worked as a social norm for energy conservation, the residents in the apartment community should have had a consensus that "I need to reduce energy consumption if my energy consumption is greater than similar neighbors". According to the interview, the consensus was not likely to be established in the community. Thus, this paper comes to a conclusion that salience of the neighbor comparison information could help attract more attention from the residents to the information in statement, but the information was not effective for encouraging significant electricity conservation in the community. Such ineffectiveness would be persistent as long as the social consensus has not been established, no matter how salient the information is.

## 5. Discussion

This paper examined whether salience of the neighbor comparison information in utility statements played a significant role in attracting more attention to the information and consequently led to energy conservation in the case of Korean local apartment complex residents. The attention data collected from the eye-tracking experiments on actual residents contributed to better understanding about their inherent interests in the information. More specifically, the eye-tracking experiments revealed that the information attracted more attention when its salience was enhanced by a larger size and a leftmost location, implying that human attention tends to pay more attention to the salient stimuli. However, although salience of the information was effective for attracting more attention, the information was seemingly not effective for energy conservation. Such seeming irrelevance of the information with conservation behavior was confirmed by the post-experiment interviews, showing that only a few of the subjects considered the neighbor comparison information as a determinant of individual electricity consumption.

This paper analyzed the utility data of 502 households in the apartment complex to confirm that the neighbor comparison information was not related to encouraging significant energy conservation from November 2016 to April 2017. As Table 4 shows the analysis results, this paper found that 1472 cases were reported "you have consumed more electricity than neighbor average in last month" during the period. Also, of the households receiving the report that they consumed more than their neighbor's average in the last month, what percentage of households reduced their electricity consumption the very next month? The data showed that only less than 50 percent (see 733 cases in the most low-right cell in Table 4) reduced their electricity consumption the very next month. If considering the total cases, including the notification of "less than neighbors", the effect of "more than neighbor" could be lowered to about 25% (733/3012). This simple calculation, although there still exist limitations in controlling other factors such as weather and socioeconomic characteristics, implies that the possibility of taking an actual energy-saving action in the entire community was not sufficiently high, which is the substantial background for our argument that energy saving action will not be made significantly as a consequence, although salience of the information attracted more attention from the residents in the community.

**Table 4.** Number of cases of reducing electricity consumption according to the percent of excess over the neighbor's average reported to the statement, among 502 households from November 2016 to April 2017.

Percent of Excess Over Neighbor's Average Reported to the Statement	Number of Cases of Delivering the Info about the Excess Percent	Number of Cases of Reducing Electricity Consumption after Notification
0–0.1	466	220 (47.2%) <sup>1</sup>
0.1–0.2	350	176 (50.3%)
0.2–0.3	229	115 (50.2%)
0.3–0.4	185	90 (48.6%)
0.4–0.7	187	102 (54.5%)
Over 0.7	55	30 (54.5%)
Total	1472	733 (49.8%)

<sup>1</sup> Author's own calculations. The numbers in parentheses are percentages.

The post-experiment interviews and utility statement data analysis helped support the conclusion about the limited role of the neighbor comparison information in consequently inducing significant conservation, although salience of the social norm information could help attract more attention from the residents. Therefore, the apartment community first should have the social norm that residents refrain from using energy when they knew that they used more energy than neighbors, if the community wants the neighbor-comparison information to bring the energy conservation effect. Without the social norm established in the community, the neighbor comparison information hardly brings the successful consequence of energy conservation no matter how salient the neighbor comparison information is in the monthly utility statement. This paper suggests having a process of prototyping to fulfill the resident's needs and interests, which will work as a cue for energy saving. Considering the results that the residents have greater interest in the amount of the payment, it is useful to give a monetary incentive to households that have used less energy than their neighbors, thereby using the incentive of an electricity tariff cut. The monetary incentive will encourage the residents to make efforts to consume electricity less than their neighbors. Because their efforts could be greater, especially as they are under higher electricity tariff schemes, the effect of the neighbor comparison information could be increased under the conditions of monetary incentives and an electricity tariff scheme.

In addition, the little conservation effect produced by the neighbor comparison information stimulates a debate over the issue of the usefulness of extrapolating the successful policies or programs from developed societies to developing ones. If the developing societies do not have similar institutional backgrounds to the developed societies, the successful social programs or public policies in developed societies may not work as well in the developing societies. Because the effect of a social program or policy can be different according to institutional characteristics across regions, this paper sheds light on the difference in social norms on energy conservation between a Korean local apartment complex and the states, although both receive the same neighbor comparison information. The program designer and policy makers in the local apartment complex in Korea should have considered enhancing the salience of the information as well as building a social consensus on energy conservation in the community. Furthermore, based on the experiment and interview results showing that the residents had significant interest in the amount of payment over energy consumption, pecuniary incentives should have been considered. The information linked with pecuniary incentives could cause them to be more responsive to the information and save energy. For example, increasing the electricity tariff may pressure them to conserve energy use, and the neighbor comparison information could work for stimulating conservation competition with neighbors if the residents were sensitive to the expenditure of electricity.

## 6. Conclusions

This paper achieved two objectives: (1) The eye-tracking experiment found that salience of the neighbor comparison information was effective for attracting more attentions of the residents. (2) The post-experiment interviews and household-level utility data analysis found that energy conservation was not significantly encouraged by the neighbor comparison information, although salience of the information was enhanced. Due to the second conclusion, this paper suggests that the residents did not seem to consider social norms as a significant determinant of individual energy consumption. Thus, policy makers and program designers should consider the institutional background in which the policy could be effectively operated in an advanced society rather than simply importing it from the advanced society.

This study has novelty in applying the cognitive research method to evaluating the effectiveness of social programs. This paper tracked the eyes of the residents to test whether their attention differed by salience of the social comparison information, which was the first attempt in the field of energy economics and policy studies. This application contributed to better understanding the role of salience of the social norm information. Also, the Korean case study of this paper suggests new evidence about salience of the social norm information and its effect on energy conservation in Asian society, while existing studies have been dealing with the cases of American or European societies. More specifically, the Korean study suggested an argument that it would not always be successful to extrapolate the social norm information of the US and European countries into Asian countries.

Further studies still remain. More detailed information on the sample households' demographic and socioeconomic characteristics would help detect whether the effect of the neighbor comparison information on household's energy consumption differed by education, gender, earnings, or political preferences. However, it is challenging work to obtain these individual characteristics because they are very strictly protected in Korea by personal privacy laws and Koreans' high tendency to hide this information. An effect identification analysis will be useful to determine the role of an electricity tariff scheme changes in influencing the effect of neighbor comparison information on energy conservation in a community where the residents have price-elastic electricity consumption. Additionally, expanding the experiment subjects and utility data sample to other metropolitan cities would help evaluate the nationwide effect of neighbor comparison information in Korea.

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## Appendix A. Four Samples of Neighbor Comparison Information in Various Communities

### 1. Bar-graph style in a local Korean community

고려남의 최근 (12개월) 월별 사용량 추이

Block #5, 5th Ave.

당월사용량 718 kWh

Block #5, 5th Ave. 평균사용량 618 kWh

Your Electricity Consumption was Greater than Your Neighbors' Average

### 2. Speedometer style in a local Korean community

2017년 12월분 납부할 금액 151,130 원

이제스마트프라이즈 102동 1402호 환영합니다.

에너지사용량 92,360 원

전기예너지 49,500 원

### 3. Polar bear referee style in a local Korean community

에너지 사용량이 너무 많습니니다!

남부 금액 391,490 원

2010년 12월분 레이안 아파트 999동 9999호 귀하

전기예너지 106,430 원

에너지 사용량 비교 그래프

YOU: 106,430 kWh (34% less than neighbors)

ALL Neighbors: 162,000 kWh

### 4. HER style in USA

UtilityCo

John Doe

Last Month Neighbor Comparison: You used 34% less than your efficient neighbors.

How You're Doing: GREAT (Good, More Than Average)

Spotlight on Cooling: You used 36% LESS energy on cooling than your neighbors.

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