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Analysis of the relation between a person's emotion and willingness to accept for leaks of personal data.

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Abstract

In this research, we performed AHP analysis on what sentiments or emotions have the capacity to affect the WTP and WTA required by consumers, with respect to personal information leaks during internet use.

The analysis results revealed differences in consumer sentiment and emotion during the following instances, despite their commonality in dealing with a personal information leak: a data leak while using online search services, while using a typical video streaming service such as YouTube, and while using a pornographic video service. Specifically, the user had relatively greater anger toward the business for data leaks encountered while using a typical video streaming service, and relatively greater self-shame for data leaks encountered while using pornographic video services.

1. Background

In recent years, the utilization of personal data has progressed in a variety of services. But on the other hand, alongside the utilization of personal data, attention has become focused on the important problem of leaks of this data. Within this sort of situation, Japan is in the middle of revising its law on protecting individual information and is also investigating a range of other measures relating to the utilization of personal data.

There is a large amount of legal research on personal data. However, there is little economic research covering, for instance, how much economic value is attached to personal data.

Based on the awareness of such issues, the authors of this paper have thus far advanced their analysis of the economic values of personal data.

2. Earlier research

First, we would like to discuss prior research related to the authors' analysis. Earlier research relevant to this study includes that in the area known as Economics of Privacy,

as well as empirical studies relating to privacy concerns.

Hui and Png (2006) and Acquisti et al. (2014), among others, have reviewed the Economics of Privacy. As for empirical studies on privacy concerns, Earp and Baumer (2003), and Dommeyer and Gross (2003) have shown, for example, that the level of such concern is influenced by age. Specifically, they have demonstrated that older people are more worried about this than younger people and are more cautious about revealing information.

However, these studies did not directly estimate the economic value of personal data. Such estimates have been attempted by Koguchi and Jitsuzumi (2015) and Jitsuzumi and Koguchi (2013).

3. Koguchi et. al. (2015)

The authors have advanced their analysis based on the aforementioned awareness of issues and prior research. Among the latest study is the ITS2015 Regional Conference @ Los Angeles (Koguchi et. al. (2015)).

Koguchi et al. (2015) featured video streaming services and revealed their economic value by representing them in terms of compensation amount of leaked personal data during service use.

For our analysis, an online questionnaire survey was conducted. It was conducted on April, 2015, after a pilot survey to determine the financial amounts for the scenarios in the survey. There were 1,264 respondents.

In the analysis, Willingness to Pay and Willingness to Accept were estimated with regard to three cases. The outline of each case are as follows:

- ① Basic Case: Name, email address and home address are leaked via the Internet.
- ② YouTube + Basic Case: On top of the personal data in the Basic Case, the past three years' YouTube use history is leaked.
- ③ Adult Movie + Basic Case: On top of the personal data in the Basic Case, the past three years' history of streaming adult movies is leaked.

Estimation was carried out using the Contingent Valuation Method. Single-bounded dichotomous choice questions were adopted, with each respondent asked six questions, i.e. questions about Willingness to Pay and Willingness to Accept in the three cases. The financial amounts in the questions were set at four levels: Y100 / Y500 / Y5,000 / Y15,000. These four levels were evenly allocated to the respondents.

In estimating, to render the three cases comparable, only the sample established via

the questions as having viewed both YouTube and adult movies was used. As a result, the size of the sample ultimately used in the estimation was 645. Also, Weibull regression was used in the estimation, as below.

S, the acceptance rate curve with regard to the amount offered, is defined as:

$$S(T) = \exp \left[- \exp \left(\frac{\ln T - \mu}{\gamma} \right) \right]$$

Here, T is the amount offered and γ and μ are the Weibull distribution parameters. Estimation was carried out, with this coefficient substituted in the following log likelihood function:

$$LL = \sum_{i=y} \ln S(T_i) + \sum_{i=n} \ln [1 - S(T_i)]$$

Here, y represents a set of individuals (i) who accepted the value offered (Ti) and n a set of individuals who rejected it at that amount.

Estimation results are as follows:

	Basic Case	YouTube + Basic Case	Adult Movie + Basic Case
WTP	3,799 yen (28 euro)	3,107 yen (23 euro)	3,754 yen (28 euro)
WTA	15,739 yen (117 euro)	14,636 yen (108 euro)	n/a

Looking at the results of the estimation, Willingness to Pay stood at 3,799 yen (28 euro) for the Basic Case scenario, at 3,107 yen (23 euro) for the Youtube + Basic Case scenario, and at 3,754 yen (28 euro) for the Adult Movie + Basic Case scenario. Meanwhile, Willingness to Accept stood at 15,739 yen (117 euro) for the Basic Case scenario, and at 14,636 yen (108 euro) for the Youtube + Basic Case scenario.

4. New Issue Awareness Arising from the Results

Interpretation is difficult for the results made clear in Koguchi et al. (2015), in that the WTP of the base case is larger than that of YouTube + base case. This is because there are more types of leakable personal information in the YouTube + base case than in the base case. From the perspective of damage caused by the data leak, the consumers' WTP and WTA should increase with the increase in types of personal data that can be leaked.

In this regard, the authors considered comments from the conference floor and conducted extensive subsequent investigations, and set up the following hypothesis. The hypothesis states that the WTP and WTA for the leakage of personal data are impacted by not only *the amounts and types of leaked information* but also *consumer*

sentiment and emotion during the data leak.

5. Framework of Analysis

Therefore, in this study we examine how consumer sentiments and emotion during a personal data leak vary based on the online service being used at the time of the leak.

Specifically, through interviews with consumers, this study addresses the following three sentiments/emotions experienced by consumers during a personal data leak:

- "Anger" directed towards the online service provider with regards to the leak
- "Shame" directed towards oneself for using the service that would result in the leak
- "Anxiety" that one's personal data would be used due to the leak

The study then verifies whether these sentiments and emotions vary for each of the following:

- a typical "online search service," such as Google
- a typical "video streaming service," such as YouTube
- A "pornographic video streaming service," such as XVIDEOS

6. Method of Analysis

In this study, we conduct AHP analysis. AHP analysis is a branch of operations research (OR) and a type of decision-making process. AHP analysis calculates the weighting of the evaluation criteria while utilizing human subjectivity (intuition), thus making it possible to conduct quantitative analysis even for qualitative choices.

During AHP analysis, the respondents were asked to perform a paired comparison on degree of importance of each item. The relative importance of each item was derived by taking the geometric mean of the results. In the present study, we conducted a web survey and posed the question in the following manner.

Question:

Say that, while you are 【conducting a search on a search engine or streaming news】 , your name, email address, and physical address registered with that service provider are leaked as a set. Of the following feelings you may experience, such as "anger that your information was leaked," "self-shame for having used the site," and "anxiety that the leaked information will be exploited," select two as below, and compare which feeling you experience more strongly and by how much.

The above is an example of an *online search service*. This question was carried out also for *video streaming services* and *pornographic video streaming services*, and we verified differences in the relative importance of *anger*, *shame*, and *anxiety* among the services. In addition, for video streaming services and pornographic video streaming services, the assumption included a leakage of streaming history in addition to the name, email address, and physical address.

The web survey was conducted on March, 2016, and we collected 300 responses (samples). The basic attributes of the 300 samples are as follows.

		number	%	age	mean	48.4
sex	man	193	64.3		min	18.0
	woman	107	35.7		max	81.0

7. Analysis Results

The results of the analysis are as follows:

	Anger	Shame	Anxiety	
Online search service	0.417	0.228	0.355	1.000
Video streaming service	0.449	0.233	0.318	1.000
Pornographic video streaming service	0.379	0.271	0.349	1.000

In addition, when calculating the averages for relative degree of importance, we used only samples in which the responses did not contain inconsistencies. Specifically, we used a standard of less than 0.1 in the coherence index (CI), a general criteria for AHP analysis.

The results of the analysis showed that the proportion of sentiments/emotions were greatest in of the following order: anger > anxiety > shame for all services. On the other hand, it did become clear that the proportion of each sentiment/emotion varied for each service.

In this context, when we take a look at "shame," the proportions are largest in the order: pornographic video streaming services > video streaming services > online search services, and the variance analysis shows a significant difference in average values. With regards to the differences in average values, "anger" also showed a significant difference, but a significant difference was not observed for "anxiety."

8. Conclusion

In this study, we analyzed what types of sentiment or emotion impact the WTP and WTA required by consumers.

Of the analysis results, attention should be paid to the magnitude of "shame." Through the analysis, it was verified that the feeling of shame increased on a relative basis during the streaming of videos or pornographic videos. The authors' past studies showed that even when there are many types of personal information leaked, WTP and WTA decrease during the streaming of videos. There is a possibility that the feeling of "shame" may relate to this fact. In other words, even if more personal data is leaked, there is a sense of shame in that one's utilization of the service is a factor in the leak. The requested compensation amount may be small for this reason.

In this regard, when setting the compensation amount for personal data leaks, it is important to consider not only the consequences of the leak but also the sentiments of the consumers during the leak.

However, this study only compared sentiments in a relative magnitude. For a more stringent validation, it is necessary to capture the magnitude of the sentiments in absolute terms. In addition, in the present study, it was not possible to analyze each sentiment with a specific link to WTP and WTA. These will be our future challenges.

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