Scope Insensitivity in Child's Health Risk Reduction: A Comparison of Damage Schedule and Choice Experiment Methods.

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Abstract

The focus of this study is to explore the issue of scope insensitivity concerning two different elicitation formats with regard to differences in preferences distributions. For this purpose, we apply choice experiment (CE) and damage schedule (DM) methods to elicit preferences for different child's health risk reductions in school in Thailand. The data comes from 1,116 parents who have at least one child attending school from prepared kindergarten to grade 9. Empirical evidences first suggest that these two methods provide the same preferences of respondents on the most preferred and the least preferred of risk reduction issues. However, scope insensitivity occurs for some risk reductions issues elicited by CE. Namely, willingness to pay of higher level of risk reduction and those of lower level of risk reduction in the same issue are statistically indifferent. On the other hand, there is no occurrence of scope insensitivity in all risk reduction issues obtained by DM. This pattern is still unchanged even when the sample is separately analyzed by socio-economic factors such as education and income.

1. Introduction

To ensure the benefits of risk reductions from health intervention programs are truly reflected preferences of ones affected by the interventions, impacts of the programs should be cooperated into economic evaluations (Van den Berg and Ferrer-I-Carbonell, 2007). There are two methods that have usually been applied for economic evaluation of health risk reductions. The first one is the proxy good method relied on appropriate financial proxy that mirrors the gains or reduction of costs from the programs. However, this method would not fully reflect the preferences of people who involve in programs (Van den Berg et al., 2005). To account for the drawback of proxy good method, economists start to apply stated preference method such as contingent valuation (CV) and choice experiment (CE) to clarify preferences and values of health risk reduction programs.

However, stated preference method is still questioned due to the occurrence of scope insensitivity. Scope insensitivity was first described and discussed in environmental valuation and refers to the observation of willingness to pay (WTP) does not vary with the size of good being valued (Kahneman, 1986; Kahneman and Knetsch, 1992). Some previous studies related to valuation of health risk reduction have also reported that people's preferences and WTP for risk reduction are not fully sensitive to the extend of risk reduction (e.g. Hammitt and Graham, 1999; Bolt et al., 2006; Goldberg and Roosen, 2007; Mahasuweerachai, 2013).

There would be two reasons caused scope insensitivity in stated preference method. The first one is unfamiliarity of goods being valued. When people are asked to provide value for a good that they have no pre-existing fully defined preferences, it would be hard for them to value changes in it. They would then focus on particular characteristics of a good and ignore the changes of the good resulting in preference and WTP being less sensitive to the change of good. In addition to unfamiliarity people may lack understanding of risk especially when change in risk is small. If this happens, people may fail to distinguish between different size of risk changes and hence occurrence of scope insensitivity (Baron, 1997; Bolt et al., 2006; Andersson et al., 2016).

To mitigate the possibility of scope insensitivity especially caused by misunderstanding of risk changes several studies have followed processes of risk communication suggested by psychological studies in risk communication (e.g. Goldberg and Roosen, 2007; Alberini et al., 2011; Lew and Wallmo, 2011; Andersson et al., 2013). However, the evidences on this topic are still mixed, and call for more research and development of other methods to mitigate this issue still continue (Desvousges et al., 2012).

Damage schedule (DM), by far received limited attention, could also assess people's preference with respect to changes in goods. This technique was first described and applied in environmental and resource studies (e.g. Rutherford et al., 1998; Chuenpagdee et al., 2001; Quah et al., 2006). DM does not intend to provide monetary measures of value but tries to assess people's preferences through relative importance of different particular changes in goods. While in CE and CV methods people may have a difficult time to provide consistent answers of trading off between changes in risks and money resulting in scope insensitivity, they would be able to provide less demanding assessments of relative values with high level of consistency (Kahneman et al., 1998; Chuenpagdee et al., 2001). The latter would be the case of DM because people's preferences on risk changes could be derived from paired comparison where decisions of selecting choices of different risk changes of various issues are made.

Our focus is to explore the issue of scope insensitivity concerning two different elicitation formats with regard to differences in preferences distributions. For this purpose, we apply CE and DM to elicit preferences for different child's health risk reductions in school in Thailand[1]. Respondents are asked to evaluate health risk reduction programs in school that cover a reduced risk of three issues, lead contamination in school drinking water, diarrhea from school food contamination, and accident from outdoor playground. To our knowledge, this study would be the first study providing a systematic comparison of preference elicited from the CE and DM on health risk reduction and testing for scope insensitivity. Empirical evidences first suggest that the preferences on these risk reduction issues obtained from these two methods could be compared because both methods provide similar preferences of respondents on the most preferred and the least preferred of risk reduction issues. However, scope insensitivity occurs for health risk reductions of diarrhea from school food contamination and accident from outdoor playground in school elicited by CE. In contrast, there is no occurrence of scope insensitivity in all risk reduction issues obtained by DM.

The paper proceeds with design of the survey mainly discussed about designing CE

[1] Parents who usually assume the highest responsibility for well-being of children are the respondents in our study.

and DM questions in order to estimate and compare respondent's preferences of health risk reductions of three school health risks, lead contamination in school drinking water, diarrhea from school food contamination, and accident from outdoor playground, as well as explaining the details of data collection. The methodologies applied to elicit preferences out of CE and DM are explained before the empirical results of these two methods are presented. The elicited preferences are then used to compare the potential of these two methods for estimating preferences of health risk reductions and occurrence of scope insensitivity. Implications of findings from this paper are then outlined in the discussion and conclusion.

2. Survey questions and data collection process

To estimate the preference of parents on child safety in school programs, we introduce hypothetical child safety in school programs consisting of three issues of safety, lead contamination in school drinking water, diarrhea from school food contamination, and accident from outdoor playground. These three issues are the main concerns and closely monitored by the Office of the Basic Education Commission because their incidences are relatively high with serious effects on children health.

Real estimates of risks from diarrhea and accident from outdoor playground in school are not available for Thailand. We therefore gathered current incidence rates reported by some schools and calculated average incidence values resulting in 14 out of 1,000 students per year affected by diarrhea from food contamination and 6 out of 1,000 students per year suffering from an accident from outdoor playground in school. In the case of lead contamination in school drinking water, the risk was based on the data from the Office of the Basic Education Commission and Thai Health, which reported that in about 100 out of 200 days of children going to school lead contamination in school drinking water exceeded the safe standard level (Department of Medical Science, 2008).

After setting up the current situation of risks for these issues, we designed fictive risk reduction levels of each issue. As presented by table 1, the risk reductions of lead contamination in drinking water are somewhat different from those of other risk reduction programs. In particular, the highest risk reduction level of lead contamination in drinking water is 100 percent, while those of diarrhea and accident situations are 90 percent. This is due to the fact that lead contamination in school drinking water is only from the purified water dispenser coolers that use solders containing lead for soldering water container

(Department of Medical Science, 2008). Lead can be therefore completely eliminated by changing all water dispenser coolers with ones that are not soldered by solders containing lead.

However, the risks to diarrhea caused by food contamination and the hazards in an outdoor playground could not be completely eliminated even with the best measures. There were reasons cited by interviewed experts, physicians, teachers, and officers of Thailand health administration why children may still face some degree of these risks even if the environments in schools were already improved to the most secure condition possible. There are many food-borne microbes, for example, that may contaminate the food served to students during production and preparation, which the school could not have complete control. Another example is that even thought playground is covered by 12 inches deep of shredded rubbers or fine sand; students may still have risk to get spinal chord injury or paralysis from falling off equipments. As it is impossible to eliminate these risks by 100 percent, we decided to use reduction in risks by 90 percent as maximum bounds of diarrhea and accident issues.

These three risk issues and their risk reduction levels are applied for both CE and DM methods. An increase in tuition fee per year is only employed for the CE as the variable using for estimating monetary value of risk reductions[2].

[Table 1 about here]

2.1 Survey questions

Here, we describe the questions that are most important for this study, which are the questions of DM and CE methods. In addition, processes of data collection for both methods are also explained in this section.

Survey questions

Damage schedule

To clarify the preference of parents on child safety in school programs using DM, there are several techniques that can be applied to evaluate parent's preferences. The most wildly used technique is the technique of paired comparison (Chuenpagdee et al., 2001; Quah et al., 2006). Paired comparison is a well established psychometric technique for ordering

[2] For more details of specifying the level of an increase in annual tuition fee, please see Mahasuweerachai (2013).

preferences among choice sets (David, 1988). Given that paired comparison is not purposed or intended to provide any monetary value or monetary measures of value, the property of this technique shared with the CE is that it would be able to clarify ordering of preferences among the objects of interest, which could tell and compare the degree of important of attributes or situations generated from an individual preference (Chuenpagdee et al., 2001).

The technique elicits an individual preference on the issues of interest by presenting a set of binary choices for a set of issues. As presented in table 1, there are three issues of interest happened in school, and each object has three levels of risk reduction. In case of DM, the no risk reduction is used as baseline. Hence, only 50 percent and 90 percent (100 percent for lead contamination in drinking water) risk reductions in each issue are presented in the choice set. This creates six specific risk reductions situations for creating paired comparison survey. The details of risk reductions used for creating pair comparison in each issue are represented in table 2.

[Table 2 about here]

From table 2, the total number of possible pairs of six objects is 6(6-1)/2 = 15. However, three pairs with the highest risk reduction level compared to 50 percent risk reduction level in the same issue are dropped from the comparison set resulting in 12 possible pairs of six issues. Since, there are only twelve possible pairs, all of them are presented to the respondents. Figure 1 shows the example of pair comparison included into the questionnaire.

[Figure 1 about here]

Choice experiment

In case of choice experiment question, the four attributes with their levels create $3^4 = 81$ possible combinations. We reduce these possible combinations to 36 using fractional factorial design[3]. Next, we randomly pair them to form a choice set with each choice set contains two different combinations with another choice that allows a respondent to select if he/ she does not like the first two choices. This results in 18 different choice sets in total. To avoid information overload, we then randomly divide them to two groups with each group having

[3] The design has properties of orthogonality, balance, which each attribute's level occurs in the same or similar frequency as other levels. We used the macro, percentMktEx module, in SAS software to arrange this design (Kuhfeld, 2005).

nine choice sets. Thus we end up with two different sets of questionnaire that contains different choice sets, which are randomly distributed to respondents. Figure 2 presents the example of choice set asked in the questionnaire.

[Figure 2 about here]

2.2 Data collection process

The data for this study were collected from face to face interview in five provinces of North and Northeast regions of Thailand during the second week of April to the first week of November 2012. Sample of this study was parents who have at least one child attending school from prepared kindergarten to grade 9. Our sample was scoped to this group of student because children with this range of age had the highest vulnerable to these risks happened in school especially for lead contamination (Canfield et al., 2003; Rogan and Ware, 2003; Lanphear et al., 2005).

The survey was carried out at a place with high concentration of people around those provinces such as parks, shopping malls, and markets. Respondents were randomly selected in each place in which every third person was selected to conduct the interview. If an individual refuses to participate or has no children as the scope of study, the random process was restarted again. For an individual who agreed to participate, he/ she was given the information sheets contained the information of the issues consisted with baseline risk information, and damage that may occur to children if they encountered with these harm situations. Since the information sheet of each issue represented to the respondents consists with details of the issue, it may be possible that the respondents may pay most of their attention on the first issue but pay less or none attention to the last one. This may cause bias on their choice selection in which they may tend to select choices that favor the issue they read first and ignore the rest ones or vice versa. To avoid this problem, the orders of the information sheets given to the respondents were random. Some respondents, for example, started with lead contamination in school drinking water following with accident and food contamination in school, while other started in different directions. After participants read the information sheets, enumerators then asked them whether they understand or have any questions regarding to the situations as well as the meaning of risk of each issue given to them. If they still have questions or do not understand the issues and the meaning of risks clearly, the enumerators explain them again. After they clearly understand the situations, the information of risk reduction measures that would be able to reduce risks of situations along with three figures illustrated the influence of risk reduction on annual incidence rates on each issue are presented to the respondents[4]. The example of graph presented visual aid of decreasing annual incidence rate with varying risk reduction level is presented by figure 3.

[Figure 3 about here]

Respondents were then asked to answer either damage schedule questions or choice experiment questions[5]. Since, one respondent was only required to answer one type of question, DM or CE questions, the questionnaire given to respondents was systematically assigned. If the first respondent, for example, is assigned to answer DM questions, the next respondent will be asked to answer the CE questions and so on. This was done so to make sure that data of choice selections from these two methods come from respondents who have similar characteristics. After finished answering either DM or CE question, respondents were asked to complete the rest of the questionnaire consisted with socio – demographic information such as age, household income, and education level.

Following the steps of implementation, 1,116 participants participated in the survey with 735 and 381 respondents from Northeast and North regions, respectively. Among them 564 respondents answer DM question and another 552 answer CE question. Table 3 showed the characteristics of these respondents.

[Table 3 about here]

3 Empirical applications

Damage schedule

The preference score for each situation is used to evaluate paired comparison data. It is defined as the number of times that respondents select that situation over other situation in the choice set (Peterson and Brown, 1998; Song and Chuenpagdee, 2013). Each situation has therefore a maximum score of *(n-1)*N* where *n* is the total number of situations in the choice set, and *N* is the total number of respondent.

However, since the three pairs, which compare between the highest risk reduction and

[4] These figures were also presented to respondents during answering CE and DM questions to make sure they understand the outcomes of risk reductions in each issue.

[5] Respondents were allowed to go back and change their responses to the choice questions, both CE and DM, to make them consistent. This was done so to make sure learning process of respondents on responding to the questions was not ignored.

the moderate risk reduction of the same issue, were excluded from the survey, the maximum score of each situation is *(n-2)*N*, which generates the maximum score for each situation equal to 2,256, (6-2)*564.

The individual preference scores for each situation are obtained from choice made out off paired comparison questions and aggregated among all respondents. The variance stable rank method is employed to summarize the respondent's choices among the pairs (Quah et al., 2006). Following this method, the number of times each situation is selected relative to the maximum number of times it is possible to be selected by all respondents is calculated. The proportion calculated from this method presents the collective judgment of the relative importance of different risk reductions within the same situation as well as across situations. The proportion is scaled to 0 to 100 by multiplying proportion by 100.

In addition to calculate preference scores from entire sample, we also separately calculate them for respondents from different regions and socio-economic characteristics. This is done so to test whether the respondent's preferences from different characteristics are the same.

Choice experiment

Econometric model for choice experiment

We applied the conditional logit model to analyze the choice between alternative programs. Our conditional logit model is based on a random utility model (RUM) that the parents will choose the program that provides them with the highest utility. Indirect utility function of the parent denoted as V can be observed through choice experiment questions in which the choices are made. The utility can be represented as following

$$U_i = V_i + \varepsilon_i \tag{1}$$

where U is the utility function, ε is stochastic component of the utility that is unknown. Since, parents would select choice based on attributes, V can be expressed as a function of attributes accompanying each alternative

$$V_i = \alpha_i + \boldsymbol{\beta}_k \mathbf{X}_i, \qquad \forall_i \in C \tag{2}$$

where $\mathbf{X}$ is the vectors of k attributes, $\boldsymbol{\beta}$ is a coefficient vectors, α is alternative specific constant (ASC), and i is an alternative in choice sets C. The probability that choice i will be selected by a parent is equal to the probability that the utility gained from selecting choice i is greater than that from other choices. Assuming the distribution of stochastic component is independently and identically distributed (IID) according to Gumbel random variable, so the probability of choosing choice i among those available (1, 2,…,k) ϵ C can be expressed in closed form as

$$\mathrm{P}_i = \frac{exp\big(\mu(\alpha_i + \boldsymbol{\beta}_k\mathbf{X}_i)\big)}{\sum_{k\epsilon C} exp\big(\mu(\alpha_k + \boldsymbol{\beta}_k\mathbf{X}_k)\big)} \qquad (3)$$

where μ is a scale parameter, which is inversely related to the variance of the error term. The scale parameter, μ, is typically set equal to 1 if there is only one data set because it is unidentifiable within any particular data set (Haener et al., 2001; Boxall et al., 2003; Lusk et al., 2003). However, in our case there are two data sets, which were collected from different regions. Therefore, the scale parameter could be identified. In addition, identification of the scale parameter is important in our study because we may not be certain to assume the equivalent preference between two regions respondents. This due to the fact that without accounting for the scale factor, if the estimated results represent preference's heterogeneity between regions, we cannot certain whether differences in parameter estimates are a result of differences in scale factor or differences in true underlying preferences. We therefore employ the combined data set estimation purposed by Louviere et al. (2000) to account for the relative scale factors, which the likelihood function of the combined data model is the sum of the conditional log likelihoods of Northeast and North regions that is showed as following[6]

$$L_j = \sum_{r=1}^{2}\left(\sum_{n=1}^{N}\sum_{P_i\epsilon C_n} y_{in}^{r}\ \mathrm{ln}P_{in}^{r}(\mathbf{X}_{in}^{r}|\boldsymbol{\alpha}^{r},\boldsymbol{\beta}^{r},\mu^{r})\right) \qquad (4)$$

where y_{in}= 1 if a respondent selects choice i, = 0 otherwise, n represents the index of respondents from CE data, and r represents with two regions, North (*N*) and Northeast (*NE*). Full information maximum likelihood method is employed to simultaneously optimize equation (6) with respect to all parameters including relative scale parameters of North, μ^N.

[6] In order to find the relative scale parameters, we normalize the inclusive value of parameter associated with Northeast data to unity.

In case of WTP estimation, following Hanemann (1999), welfare measures obtained from the conditional logit random utility model can be calculated as a marginal rate of substitute (MRS) between interested attribute and marginal utility of income presented as follow

$$WTP = -\frac{\beta_k}{\beta_p} \tag{5}$$

where β_p is the marginal utility of income, and β_k is coefficient of interested attribute.

Scope insensitivity test

To test scope insensitivity using data from DM and CE, the expected utility maximization paradigm is employed. Assume that person knows with certainty the utility they derive from situation of their kids sick or healthy. If a sick outcome occurs, they derive utility as $U_s(Y, H_s)$, and they derive utility as $U_h(Y, H_h)$ if a healthy outcome occurs, where Y denotes the individual's wealth and H is a health state, where $H_s = 0$ and $H_h = 1$. The utility derived from the healthy outcome is higher than that from sick outcome, denoted as $U_h(Y, H_h)>U_s(Y, H_s)$ for all levels of Y, and U is increasing in Y.

Despite knowledge of the utility derived from sick and healthy outcomes, they do not know with certainty whether what outcome would occur. Given baseline risk of sick outcome, p, the expected utility result as

$$E(U) = pU_s(Y, H_s) + (1-p)U_h(Y, H_h) \tag{6}$$

If the person is offered the opportunity to reduce the health risk by r, the utility gain can be presented as following

$$(p-r)U_s(Y, H_s) + (1-p+r)U_h(Y, H_h) > pU_s(Y, H_s) + (1-p)U_h(Y, H_h) \tag{7}$$

Equation 7 also implies that the person would preferred higher health risk reduction to same health issue with lower risk reduction, such that of 90 percent health risk reduction would be always preferred to 50 percent risk reduction of the same health risk issue. This concept would be tested using data from DM.

In case of CE, the test is also based on equation 7, where the WTP, which is defined by the reduction of wealth that leaves the person indifferent between before and after health risk reduction, is added to the expected utility function.

$$(p-r)U_s(Y-WTP,H_s)+(1-p+r)U_h(Y-WTP,H_h)=pU_s(Y,H_s)+(1-p)U_h(Y,H_h) \quad (8)$$

Taking the total differential of equation 8 with respect to *r* and *WTP* yields the WTP in response to a change in risk as (Goldberg and Roosen, 2007)

$$\frac{dWTP}{dr}=\frac{U(Y-WTP,1)-U(Y-WTP,0)}{(1-p+r)U_h'+(p-r)U_s'}>0 \quad (9)$$

Equation 9 shows that WTP for health risk reduction is always positive and increasing in risk reduction level[7]. Specifically, WTP for 90 percent health risk reduction, for example, would always higher than those obtained from 50 percent health risk reduction from the same health issue.

4. Empirical findings

Damage schedule

The results of the paired comparisons from 564 respondents who completed the survey are presented in table 4 in which all scale values of the six risk reductions are listed for total sample and each sub-sample. The finding is very interested. Firstly, there is no in-group inconsistency preference occurs for each issue. In another word, respondents could provide clear preference on different risk reductions for each issue. Respondents, for example, prefer completely eliminating lead contamination in school drinking water than just partial eliminate lead from drinking water. They also prefer 90 percent risk reductions to 50 percent risk reductions for both diarrhea and accident from outdoor playground issues.

Secondly, there is the close correspondence of the scale values across the different sub-samples. Not only respondents in North and Northeast regions provide very similar scale values, but also those provided by respondents with different education and income levels did not widely vary. All sub-group considered 100 percent risk reduction of lead contamination in school drinking water and 50 percent risk reduction of accident from outdoor playground to be the most preferred and the least preferred risk reduction issues, respectively. In addition to that most sub-samples gave very similar rank for each risk reduction level and issue. Only

[7] Goldberg and Roosen (2007) called this test as weak scope insensitivity test.

the ranks of the 50 percent risk reduction level of lead contamination in school drinking water and 90 percent risk reduction of diarrhea are different in some sub-samples. This can, for example, see in the sub-samples of region where 90 percent risk reduction of lead contamination in school drinking water is ranked the second and 50 percent risk reduction of diarrhea is ranked the third for the sub-sample from the Northeast region, while the order is switched for the sub-sample from the North region.

This relative close agreement is further indicated by the high Kendall's W value, which measures the degree of agreement among sub-groups. The null hypothesis of no agreement among the respondents (Kendall's W = 0) is rejected from the very small associated asymptotic *p-value* ($p < 0.01$). It is therefore good consensus among respondents in the ranking of the relative importance of child health's risk reductions.

The close correspondences of the scale values and their rank of six risk reductions among sub-samples are also further evident in the high Kendall's Tau correlation coefficients presented in table 5. The null hypothesis of no correlation is rejected at the 5 percent significance level of all sub-sample pairs. The close correspondence of ranking in all six risks reduction issues between respondents from Northeast and North regions, for example, is very close indicated by high correlation coefficient of 0.867. Further, consensus of relative importance, through ranking, of six risk reduction issues is also evident in some pairs of sub-samples. This can be seen, for example, by the perfect correlation coefficient of respondents with education level of high school and those with at least college degree.

From the results of Kendall's W and Kendall's Tau tests, the judgements of the relative important among sub-samples do not differ greatly. This high level of agreement among sub-samples makes it possible to pool the responses from all respondents as a basis for a single importance scale. Since, the scale values are normalized, they could be arrayed on a 0 to 100 importance scale, which the scale value of each risk reduction issue could be directly compared to perform the scope insensitivity test.

To perform the scope insensitivity test, the critical range test and scale ability index are used. These tests are performed to quantify the ability of different groups of people to distinguish among these risk reduction issues (Dunn-Rankin, 1983; Chuenpagdee et al., 2001). If the difference in the aggregated preference scores of any two choices of risk reductions is greater than the critical range at the accepted level of probability, the two choices can be taken to be significant different. However, if the difference is not significant greater than the critical range, this suggests they share some common features and can be grouped together as having similar importance scores. It does not, however, mean that they are otherwise equal. These tests could help us to clarify whether there is scope insensitivity occur from scale values provided by DM method.

The scale ability index is high, 0.85, and out of 12 pairs there is only one pair that the preference scores of two choices are fell within the critical range. This pair is the comparison between 50 percent risk reduction of lead contaminated in drinking water and 90 percent risk reduction of diarrhea from food contamination, which are the different risk issues. From the results, we conclude that respondents would be able to distinguish the importance of the issues. In addition, they would be able to provide clearly and consistently preference for different degrees of risk reductions for each issue. In another word, respondents clearly prefer higher health risk reduction to the same health issue with lower risk reduction as suggested by equation 7. There is therefore no sign of scope insensitivity from DM method. As the scale values are normalized and pool together from all respondents, they could be arrayed on a 0 to 100 importance scale, which is presented by figure 1. Figure 1 shows the different risk reductions for each issue and the judgments of their importance.

[Figure 4 about here]

We now move to the CE method. The initial step is to test for preference regularity between the regions. The null hypothesis is $\boldsymbol{\beta}^{NE} = \boldsymbol{\beta}^{N}$. First, separate models for each region were estimated and log likelihood values, L_r, were recorded, which were -8859.2923, and -6673.3783 for Northeast and North regions, respectively. Next, all data were pooled and equation (4) were estimated with imposing parameter equality between regions, but allowing for differences in scale parameters between regions. The log likelihood, L_j, for this model was -15548.209. Following Louviere et al. (2000), the test for preference regularity is $-2(L_j - \sum L_r)$, which is distributed χ^2 with $\mathrm{K}(\mathrm{M} - 1)$ degrees of freedom, where K is the number of restrictions and M is the number of data sets. The test result strongly rejected preference regularity between the regions ($p = 0.01$) suggesting that differences in parent's preferences of risk reductions on school environment between the two regions are not simply because of differences in variances of the data sets, but they are actually different in true underlying preferences.

According to reject preference regularity, we then estimated the models to elicit the marginal utility of each attribute separately for two regions. However, accounted for differences in variances, log likelihood functions of North region was multiplied by the relative scale parameters identified by combined data model, which is 1.121. This value represents smaller error variances for the Northeast regions relative to the North region responses. Table 6 shows the estimated results of regional models.

For each region, the coefficient of tuition fee and other attributes are as expected. Since risk reduction attributes have three levels, none, 50 percent, and 90 percent (100 percent), the none level was applied as reference for every attributes. Therefore, the coefficients of each attribute level presented in table 6 reveal changes of respondent's utility due to reduction of risks relative to that of no risk reduction applied.

Started with risk reduction in lead contamination in drinking water, both levels, 50 percent and 100 percent reduction in risk, are significant different from zero with positive attitude in all models meaning that compared to no risk reduction at all reduce risk in certain degrees would improve parent's utility. In addition, reduce risk by 100 percent seems to increase parent's utility more than that of just 50 percent because the coefficient of 100 percent risk reduction is significant higher than that of 50 percent reduction.

In case of diarrhea from food contamination and accident from outdoor playgrounds, the results are similar as lead contamination in school drinking water. In particular, parents would gain from risk reduction of both issues in both degrees provided in the choice experiment survey. However, difference in detail relative to lead contamination case, utility improved from 50 percent and 90 percent risk reductions seems to be indifferent. We applied test to test whether differences in risk reduction levels cause differences in changes of preferences of parents in both cases or not. The test results revealed that coefficients of 50 percent and 90 percent risk reduction levels in both issues were insignificantly different in both North and Northeast models suggesting that utility gains from 50 percent risk reductions and that of 90 percent risk reductions are not different[8]. This situation reveals the sign of scope insensitivity in which respondents did not sensitively respond to improvement of risk reduction.

We then calculated WTP for each risk reduction issue in each region model to test scope sensitivity indicated by equation 9. Table 7 presents the results of WTP for each degree of risk reduction issue.

The WTP was estimated by delta method, which provided 95% confident interval of

[8] Wald test was applied to test the equality of these two coefficients. In case of diarrhea from food contamination the chi – square tests are: χ^2 = 0.09 and 1.69 for North and Northeast models, respectively. Similarly, the chi –square tests of risk reductions of accident from outdoor playground are as follow: χ^2 = 0.12 and 1.22 for North and Northeast models, respectively. Hence, from test results, we fail to reject the null hypothesis of no difference between two coefficients at 5 percent significant level in both models.

the values. Generally, the WTP for risk reduction in each level for all issues are significantly different from zero suggesting that parents in both regions are willing to pay some amount of money to reduce the risks for their kids. The WTP ranges from 2,060 – 5,600 Baht per household per year depending on risk reduction levels and risk issues. Parents in Northeast region, for example, on average are willing to pay about 3,500 Baht for reduce the risk of lead contaminated in drinking water by 50 percent and will pay additional 2,100 Baht for completely eliminating lead in drinking water. However, WTP of risk reductions for diarrhea and accident from outdoor playground seem ambiguous. The WTP from 50 percent and 90 percent risk reductions are very close and in many cases WTP of 50 percent risk reduction is slightly higher than those of 90 percent risk reduction, again, the sign of scope insensitivity.

To test scope insensitivity, we conduct the test on these results based on equation 9. The WTP passes the scope test if the WTP increases with increasing risk reduction. Table 8 presents the *p*-values of the χ^2-test statistics of the WTP from different risk reductions levels. In the case of reducing risk of lead contaminated in school drinking water, the *p*-value of 0.001 indicates the equality of WTP of reducing risk by 50 percent (Le 50% reduction) and WTP of reducing risk by 100 percent (Le 100% reduction) is clearly rejected. WTP in this case is therefore increasing in the risk reduction. However, there is opposite story in the risk reductions of diarrhea from food contamination and accident from outdoor playground. Specifically, the *p*-values are above 0.05 in both issues suggesting that the equality of WTP for reducing risk by 50 percent and those of reducing risk by 90 percent in both issues is fail to reject. WTP in both issues does not hence pass the scope sensitivity test.

5. Discussion and Conclusion

The main focuses of this paper are to present a systematic comparison of preference elicited from the CE and DM on child's health risk reductions in school and testing for scope insensitivity. Respondents who answer DM and CE questions were provided the same set of information and visual aids to understand the health risk issues and changes in risks before answering either DM or CE questions. This allows us to directly compare the ability of both methods on eliciting respondent's preference on child's health risk reductions.

The evidences suggest that in case of DM method, generally, respondents could provide clear preference on child's health risk reductions. In addition, each sub-sample with difference in socioeconomic characteristics reveals very similar preferences for the health risk issues and their risk reduction levels. There is no sign of scope insensitivity from the DM method as the important scores of higher risk reductions are clearly higher than those of lower risk reductions in the same health issues.

The results from the CE method are similar in which respondents prefer health risk reductions in all issues. However, only WTP for risk reductions of lead contamination in drinking water is significant different between higher risk reduction level and lower risk reduction level. The WTP for higher and lower risk reductions of diarrhea and accident from outdoor playground, on the other hand, are insignificant different indicating scope insensitivity.

Scope insensitivity issue may occur when people do not have clear preference on goods or the goods are unfamiliar for them. If this is the case the magnitudes of risk reductions would be overlooked. In our case, however, the health risk issues presented to respondents are actually being familiar for them as many of respondents experienced their children sick from these health issues before, especially for diarrhea and accident from outdoor playground. They are still unable to provide consistent preference in the CE resulting in scope insensitivity. Some may also argue that as our CE design contains 100 percent risk reduction of lead contamination in drinking water, which creates certainty effect. Respondents may hence pay attention on this attribute and ignore the others. However, this situation is not happen in the case of DM where respondents were also asked to classify the same risk reduction levels from the same health risk issues, and 100 percent risk reduction of lead contamination in drinking water is also one of them.

Another category that may pose the problem to respondents is the probabilities. People have sometimes a difficultly of understanding the probabilities especially when the probabilities are small (Andersson et al., 2016). Therefore, if risks are not communicated in a meaningful way, it would be difficult for people to distinguish between different sizes of risk reductions. In this study respondents were provided and trained about meaning of risk before starting to answer either CE or DM questions. In addition, visual aids of risk changes in each issue were presented to respondents for entire survey. They can always use them to compare the risk changes in each choice set presented by either CE or DM formats. Respondents were also allowed to go back and change their responses to the choice questions, both CE and DM, to make them consistent and to make sure learning process of respondents on responding to the questions was not ignored. We therefore have confidence that our risk communication strategy was meaningful for them as suggested by no sign of scope insensitivity from the results of DM method.

From the results, the unfamiliarity of goods and lack of understanding the probability would not be therefore the main issues of the scope insensitivity in this study. It seems to us that respondents would actually be able to classify the important of health risk issues and also their risk reduction levels. This is because people are good to identify what is the most and the least preferred things to them. And, the results of this study show that both DM and CE methods provide the same preferences of respondents on the most preferred and the least preferred of risk reduction issues suggesting that they would actually know what they are up to. The main suspect cause for scope insensitivity occurred in CE method in this study would be the monetary value. Respondents could deal with multi-issues of health risk changes; however, it would be too difficult for them to consistently convert those changes to monetary term. To deal with risk changes and monetary values in CE, respondent's decision may be heavily influenced by their intuitive system, which hence lead them to overlook the objective dimensions of the risk changes being offered resulting in WTP being insensitive to the magnitude of risk changes. This situation can be observed through the results from DM method where respondents were not required to give monetary values for trading off with the risk changes. They can provide, with no difficulty, consistent preference following standard choice theory where the higher risk reduction levels are always higher than those of the lower ones from the same health risk issues.

In sum, our results suggest that even the health risk issues are familiar and the risk changes are meaningful to them, respondents still could not construct the fully defined preference for trading off between the risk changes and money, which we think this is the main cause of scope insensitivity occurred in CE method in this study. The conclusion mentioned prior is confirmed by the results of no scope insensitivity from the DM method where respondents were asked to classify different level of health risk reductions with no money involved. In term of policy dimension, the DM method would be alternative preference elicitation method that could be used when the monetary values of the changes are not the main agenda especially when the outcomes of the risk reduction programs are with the stakeholders for entire life.

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Table 1. Attributes and attribute levels

Attributes	Level
Risk reduction of lead contamination in drinking water	None
	50 percent
	100 percent
Risk reduction of diarrhea due to food contamination	None
	50 percent
	90 percent
Risk reduction of accident from outdoor playground	None
	50 percent
	90 percent
Increase in annual tuition fee	1,000 Baht
	1,500 Baht
	2,000 Baht

Table 2. Risk levels of objects presented in damage schedule survey

Option	Level
(A) 100 percent risk reduction for lead contamination in drinking water	School drinking water is completely free from lead contamination or at least lead contaminated in drinking water does not exceed standard level.
(B) 50 percent risk reduction for lead contamination in drinking water	From 200 day per year students go to school there are 50 days that lead contamination in drinking water exceeds the standard level.
(C) 90 percent risk reduction for diarrhea from food contamination	For every 1,000 students there are 2 students per year gotten diarrhea caused from food contamination.
(D) 50 percent risk reduction for diarrhea from food contamination	For every 1,000 students there are 7 students per year gotten diarrhea caused from food contamination.
(E) 90 percent risk reduction for accident from outdoor play ground	For every 1,000 students there is 1 student per year gotten accident from outdoor playground.
(F) 50 percent risk reduction for accident from outdoor play ground	For every 1,000 students there are 3 students per year gotten accident from outdoor playground.

Table 3. Characteristics of respondents

Characteristic	North	Northeast
Gender		
Male	30.98%	29.25%
Female	69.02%	70.75%
Age[a]	39.15	40.31
Number of children under 18[a]	1.56	1.59
Education		
No Education	7.61%	1.26%
Primary School	22.83%	27.99%
High School	21.74%	31.13%
Vocational school	6.52%	9.12%
Collage degree	28.26%	26.10%
Master degree	3.26%	3.77%
> Master degree	0.00%	0.63%
Other	9.78%	0.00%
Occupation		
Paid job	81.52%	77.04%
Unemployed	2.17%	1.57%
Retired[b]	1.09%	3.46%
Other[c]	15.22%	17.92%
Monthly Household income (Baht)		
<10,000	14.68%	20.82%
10,001-20,000	30.44%	28.39%
20,001-30,000	14.67%	18.93%
30,001-40,000	14.67%	13.56%
40,001-50,000	7.06%	6.62%
>50,000	18.48%	11.67%

Note: [a] Average numbers.
[b] Retired people in our sample have taken care their grandchildren due to their parents migrated to other cities.
[c] Most of other occupation is housewife.

Table 4. Scale values of risk reduction

Risk reduction	Total	Region		Education			Household income		
		North	Northeast	Elementary	High/ Vocational	College	Low	Middle	High
Lead_100 percent	70	73	69	68	71	70	69	69	72
Lead_50 percent	58	62	56	62	56	56	63	53	57
Dia_90 percent	57	59	57	52	59	59	51	59	61
Acci_90 percent	51	52	50	50	52	50	49	54	49
Dia_50 percent	43	43	44	45	43	43	45	42	43
Acci_50 percent	28	21	30	29	27	29	29	30	26
Number of observation	564	147	417	161	247	156	186	188	190

Table 5. Kendall's Tau correlation coefficient

Kendall Tau	Region		Education			Household income		
	North	Northeast	Elementary	High/ Vocational	College	Low	Middle	High
North	1.000	.867*	1.000***	.867**	.867**	1.000***	.733**	.867**
		(.015)	(0.000)	(.015)	(.015)	(0.000)	(.039)	(.015)
Northeast		1.000	.867**	1.000***	1.000***	.867**	.867**	1.000***
			(.015)	(0.000)	(0.000)	(.015)	(.015)	(0.000)
Elementary			1.000	.867**	.867**	1.000***	.733**	.867**
				(.015)	(.015)	(0.000)	(.039)	(.015)
High/ Vocational				1.000	1.000***	.867**	.867**	1.000***
					(0.000)	(.015)	(.015)	(0.000)
College					1.000	.867**	.867**	1.000***
						(.015)	(.015)	(.015)
Low income						1.000	.733**	.867**
							(.039)	(.015)
Middle income							1.000	.867**
								(.015)
High income								1.000

Note: *p*-values are in parentheses. ***, ** and * are significant level at 1%, 5%, and 10%, respectively

Table 6. Estimation result of choice experiment

	North	Northeast
Choice A	-0.357*** (-0.001)	0.173 (-0.119)
Choice B	-0.247** (-0.045)	0.201* (-0.097)
Risk reduction in lead contamination		
50 percent reduction	0.528*** (0.000)	0.626*** (0.000)
100 percent reduction	0.762*** (0.000)	0.995*** (0.000)
Risk reduction of diarrhea from food contamination		
50 percent reduction	0.462*** (0.000)	0.395*** (0.000)
90 percent reduction	0.446*** (0.000)	0.332*** (0.000)
Risk reduction of accident from outdoor playground		
50 percent reduction	0.566*** (0.000)	0.366*** (0.000)
90 percent reduction	0.548*** (0.000)	0.425*** (0.000)
Increase in annual tuition fee	-0.0002*** (-0.005)	- 0.0002*** (0.000)
Scale factor	1.121	1.000
Number of choice	6318	8586
Log likelihood	-6673.3783	-8859.2923

Note: *p*-values are in parentheses. ***, ** and * are significant level at 1%, 5%, and 10%, respectively

Table 7. WTP for health risk reductions

Risk reduction	North	Northeast
Lead contamination		
50 percent	3481.94***	3522.61***
	(1004.87-5959.02)	(1460.90-5584.31)
100 percent	5012.75***	5595.89***
	(1447.79-8577.72)	(2466.38-8725.39)
Diarrhea from food contamination		
50 percent	3045.67***	2222.20***
	(857.28-5234.05)	(838.02-3606.38)
90 percent	2942.98***	1869.05***
	(833.97-5001.99)	(641.16-3096.95)
Accident from outdoor playground		
50 percent	3734.52***	2059.75***
	(1256.34-6212.71)	(640.47-3479.04)
90 percent	3616.67***	2387.51***
	(1165.95-6067.38)	(913.65-3861.37)

Note: WTP are calculated using delta method. The numbers in parentheses are the 95 percent confident interval. *** is significant level at 1%.

Table 8. Tests for scope insensitivity of choice experiment

Test	*p*-value North	*p*-value Northeat
WTP (Le 50% reduction) = WTP (Le 100% reduction)	0.021	0.001
WTP (Dia 50% reduction) = WTP (Dia 90 % reduction)	0.768	0.218
WTP (Acc 50% reduction) = WTP (Acc 90% reduction)	0.729	0.271

Note: Le 50% and Le 100% are the 50 percent and 100 percent risk reductions of lead contamination in drinking water. Dia 50% and Dia 90% are the 50 percent and 90 percent risk reductions of diarrhea from food contamination. Acc 50% and Acc 90% are the 50 percent and 90 percent risk reductions of accident from outdoor playground.

Figure 1. Example of pair comparison question

Option A	Option B
100 percent risk reduction for lead contamination in drinking water: School drinking water is completely free from lead contamination or at least lead contaminated in drinking water does not exceed standard level.	*90 percent risk reduction for diarrhea from food contamination*: For every 1,000 students there are 2 students per year gotten diarrhea caused from food contamination.

Which option would you prefer? (please choose only one)

☐ Option A ☐ Option B

Figure 2. Example of choice experiment question

Attribute	Choice A	Choice B	Choice C
Reduce risk of lead contamination in drinking water	100 percent	50 percent	I would not want either choice A or B.
Reduce risk of diarrhea due to food contamination	50percent	90 percent	
Reduce risk of accident from outdoor playground	None	90 percent	
Increase in tuition fee per year	2 000 Baht	1500 Baht	
I would choose (please select only one)	☐	☐	☐

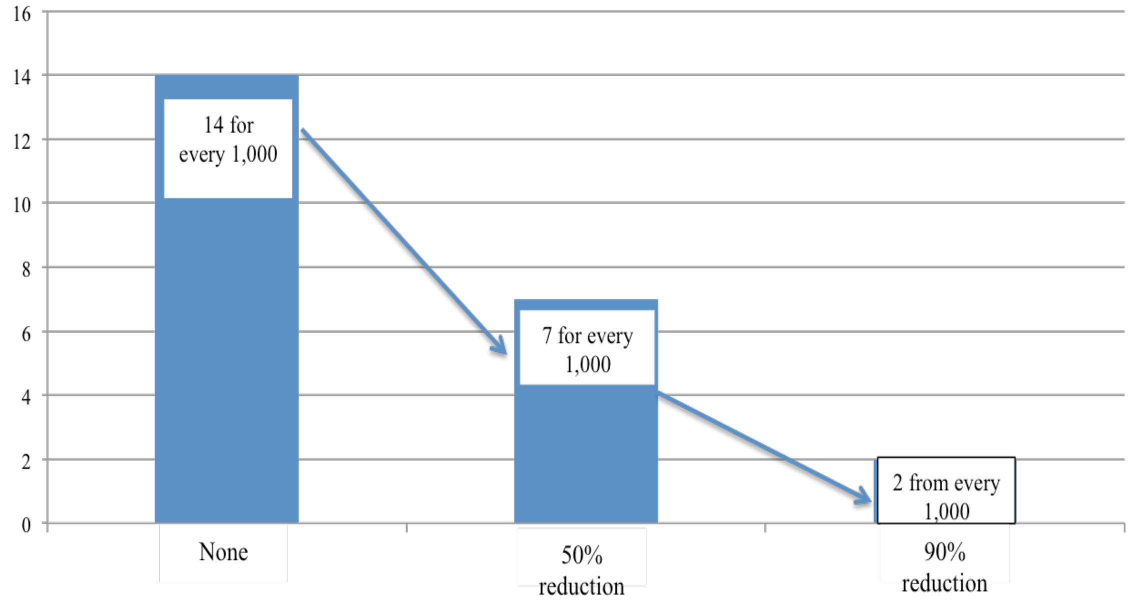

Figure 3. Example of visual aids for diarrhea risk reductions

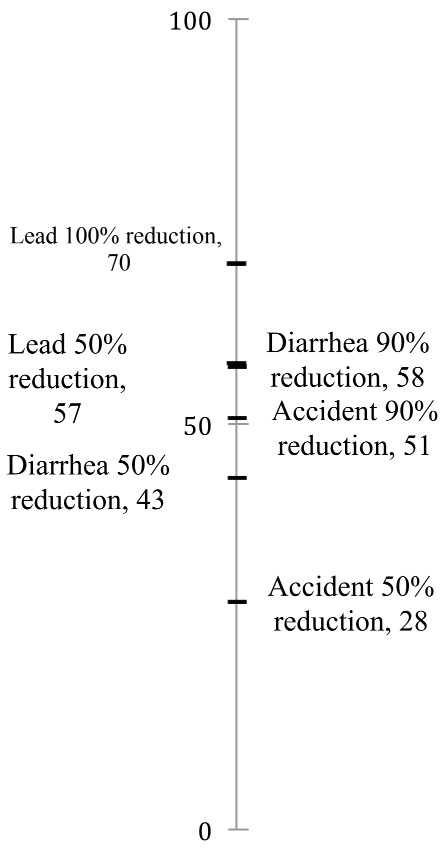

Figure 4. Scale of importance of school health risk reduction