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Example for Implementing PPS: Preferential Probabilities Translated from Survey under Principle of Maximum Entropy

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Example for Implementing PPS: Preferential Probabilities Translated from Survey under Principle of Maximum Entropy

This report develops a new simulation approach for translating the surveys to preferential probabilities under the principle of maximum entropy [1, 2] so that these preferential probabilities can be compared with those found using PPT [3]. The principle of maximum entropy is chosen because it gives the least biased distribution with the given information. In this method, it does not assume a distribution *a priori*. The distribution and the parameters are calculated while maximizing the information entropy. This approach also considers the boundary constraint while applying the principle of maximum entropy, which generates distinctive distributions when the stated ratings are at the different positions in the range.

For simplicity's sake, the approach established in another report [3] for extracting the preferential probabilities from the transcript is called "PPT" (Preferential Probabilities from Transcript), and the approach proposed in this report for translating survey rating preferences into preferential probabilities under maximum entropy principle is called "PPS" (Preferential Probabilities from Surveys)

PPS assumes the preference ratings can be random for both individuals and the team, and applies the principle of maximum entropy on both individual ratings and group ratings. A simulation is run to collect statistical results for estimating the preferential probabilities. As an explicit counterpart of the implicit PPT, PPS is a practical way to quantitatively evaluate the preferential probabilities extracted with PPT.

There are 3 steps to translate the individual ratings into group preferential probabilities, with more details given in the subsections:

(1) Construct a probability distribution for each individual rating preference for each alternative (details in Section Chapter 11);

(2) Construct a probability distribution for the group rating preference for each alternative (details in Section Chapter 12);

(3) Generate the group preferential probabilities through simulation (details in Section Chapter 13).

1 Construction of Probabilistic Distribution for Individual Preferences

A designer's or design team's preferences may not always be clear cut. In research in how choices are made, it has been observed that individuals do not select the same alternative when faced with the same situation more than once [4, 5]. In this work, a distribution was constructed to map individual ratings into a range of possible values. The assumption of the mapping is that the rating a designer gives is the expected value of the distribution and is one of the conditions that this distribution needs to satisfy. In this study, the distribution of choice is determined by maximizing the entropy of the distribution with the given data. In surveys, all the rating values are bounded. For example, this work used a range of [0, 1] for these ratings and the higher the value chosen, the higher the preference rating for the alternative. Suppose *l* is the lower bound, *u* is the upper bound, and *r* is the expected value (average) of the distribution. Let *f(x)* be the distribution function, the entropy of the probability distribution function is:

$$-\int_l^u f(x)\ln(f(x))dx \tag{1}$$

with the constraints

$$\int_l^u f(x)dx = 1 \tag{2}$$

$$\int_l^u xf(x)dx = r \tag{3}$$

Equation (2) guarantees that the total probability between the bounds adds up to 1, and Equation (3) means that the rating value given by the designer is exactly the expected value of the distribution.

Using a Lagrange Multiplier and Euler Lagrange, the maximization of the entropy with the above two constraints becomes:

$$\frac{\delta}{\delta f}\{-f(x)\ln(f(x))+\lambda_a f(x)+\lambda_b x f(x)\}=0 \tag{4}$$

Or

$$f(x)=e^{-1+\lambda_a+\lambda_b x} \tag{5}$$

Let $\begin{cases}\lambda_1=\lambda_b\\ \lambda_0=e^{-1+\lambda_a}\end{cases}$

Then *f(x)* can be modified as shown in Formula (6).

$$f(x)=\lambda_0 e^{\lambda_1 x}\ \ (l\le x\le u) \tag{6}$$

where λ_0 , λ_1 are the parameters of the distribution which are determined by the constraint of the bounds and the average value.

Substitute f(x) in (2) and (3) with (6), then λ_0 and λ_1 can be solved from the set of equations (2) and (3) using Newton's Method [6]. In this study, Matlab tools were employed to solve this set of equations.

When *r<(l+u)/2*, i.e., the expected rating is smaller than the middle of the range, λ_1 will be negative, and the distribution of rating is a truncated exponential distribution decaying from the lower bound to the upper bound; when *r>(l+u)/2*, λ_1

will be positive, and the distribution becomes a mirrored truncated exponential distribution decaying from the upper bound to the lower bound. There are three more extreme cases: (1) when $r=(l+u)/2$, λ_1 will become 0, and the distribution is reduced to a uniform distribution between the lower and upper bounds; (2) when $r=l$, λ_1 will be negative infinity, and the distribution is reduced to a Dirac delta distribution at the lower bound, which means the alternative is not accepted; (3) when $r=u$, λ_1 will be positive infinity, and the distribution is reduced to a Dirac delta distribution at the upper bound, which means the alternative is accepted for sure. Figures 1-5 show the the distribution instances under the principle of maximum entropy for the stated rating 0, 0.2, 0.5, 0.8, and 1 when the bounded range is [0, 1].

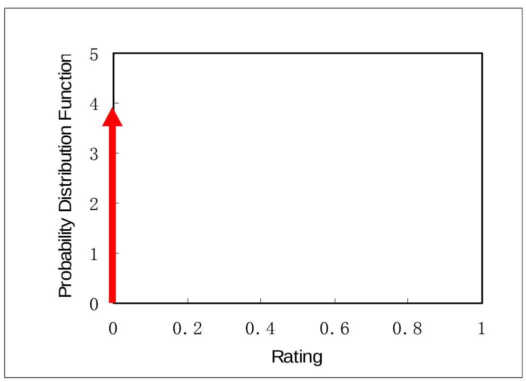

Figure 1 Rating Distribution with Stated Rating=0

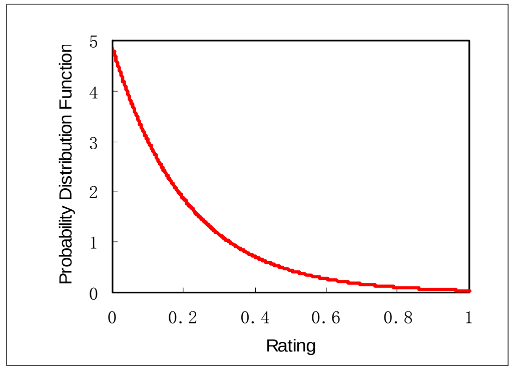

Figure 2 Rating Distribution with Stated Rating=0.2

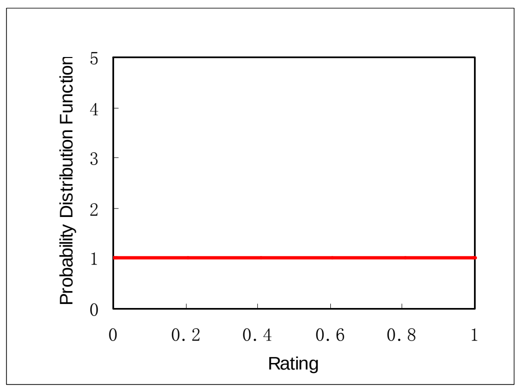

Figure 3 Rating Distribution with Stated Rating=0.5

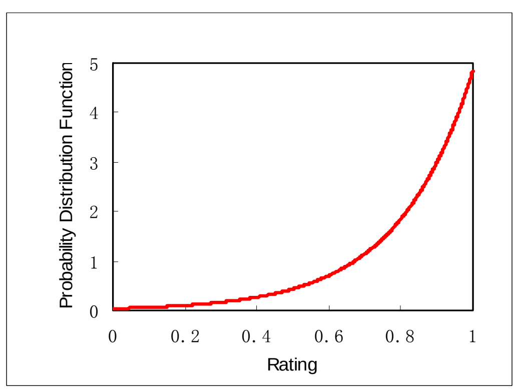

Figure 4 Rating Distribution with Stated Rating=0.8

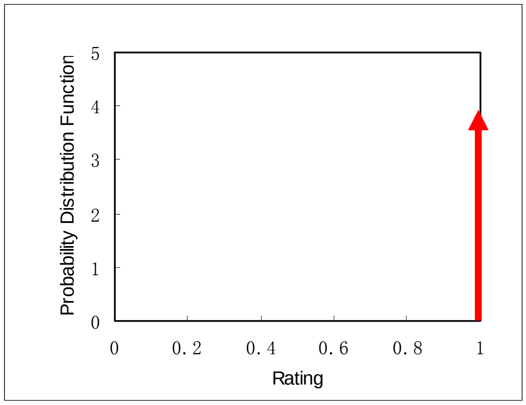

Figure 5 Rating Distribution with Stated Rating=1

However, in some survey cases, the ratings are given in a relative way rather than an absolute way. For example, the sampling from the distribution function may have an implicit constraint that the sampling ratings from the probability distribution should sum up to a certain value, such as when designers have 10 points to allocate among the alternatives.

Suppose an individual designer is given W points among N alternatives. The relative ratings the designer assigns are r_1, r_2, … r_N. The possible relative values for Alternative i ($1 \le i \le N$) are in the range [l_i, u_i]. Let x_1, x_2, … x_N be the sampling variable for the relative ratings for each alternative. The joint distribution function can be represented by

$f(x_1, x_2, \ldots x_N)$

With the constraint that $x_1+x_2+ \ldots +x_N = W$, the function can be reduced to

$f(x_1, x_2, \ldots x_{N-1})$

Similarly, by maximizing the entropy of the joint distribution function with the constraint that the expected value on variable x_i is r_i, $f(x_1, x_2, \ldots x_{N-1})$ can be represented as in the Equation (7).

$$f(x_1, x_2 \ldots, x_{N-1}) = \begin{cases} \lambda_0 e^{\lambda_1 x_1 + \lambda_2 x_2 + \ldots + \lambda_{N-1} x_{N-1}} & \begin{array}{l} if \;\; W - u_N \le \sum_{k=1}^{N+1} x_k \le W - l_N \\ and \;\; l_i \le x_i \le u_i \;\; \forall \; i \in [1, N-1] \end{array} \\ 0 & \text{otherwise} \end{cases} \tag{7}$$

The above distribution function shows that the joint exponential distribution is only meaningful when all the sample variables are in the possible ranges, otherwise it is zero.

$\lambda_0, \lambda_1, \ldots, \lambda_{N-1}$ can be solved from the following N equations.

$$\int_{a_1}^{b_1}\int_{a_2}^{b_2}\cdots\int_{a_{N-1}}^{b_{N-1}} f(x_1,x_2\ldots,x_{N-1}) = 1$$

$$\int_{a_1}^{b_1}\int_{a_2}^{b_2}\cdots\int_{a_{N-1}}^{b_{N-1}} x_1 f(x_1,x_2\ldots,x_{N-1}) = r_1$$

$$\int_{a_1}^{b_1}\int_{a_2}^{b_2}\cdots\int_{a_{N-1}}^{b_{N-1}} x_2 f(x_1,x_2\ldots,x_{N-1}) = r_2$$

$$\vdots$$

$$\int_{a_1}^{b_1}\int_{a_2}^{b_2}\cdots\int_{a_{N-1}}^{b_{N-1}} x_{N-1} f(x_1,x_2\ldots,x_{N-1}) = r_{N-1}$$

The first equation guarantees that total probability is 1 integrated over the possible rating ranges for the joint distribution, and the next N-1 equations set the requirements for the expected values for variable x_1 to x_{N-1}. The expected value for variable x_N is met tacitly because $E(x_N)=E(W-x_1-x_2-\ldots x_{N-1})= W-r_1-r_2-\ldots r_{N-1}= r_N$.

Figure 6 shows the rating distribution for 3 alternatives with average 0.1, 0.2 and 0.7 in the range [0, 1]. There is no constraint on the sum of the samples from the distributions. While Figure 7 shows the case when a constraint holds that the sum of the three sampled ratings from these three distributions must be 1. In comparing Figure 7 with Figure 6, it is observed that in Figure 7, the distribution drops down near the upper bound, and is especially obvious for distributions with high expected values. In this case, the sampled rating for one alternative is determined by the sampled ratings for all other alternatives. If the sum of the ratings for all other alternatives is greater than 1, then the set of samples is invalid and has to be disregarded because it does not meet the constraint. With this constraint, points with higher values in the distribution are more likely to be dropped.

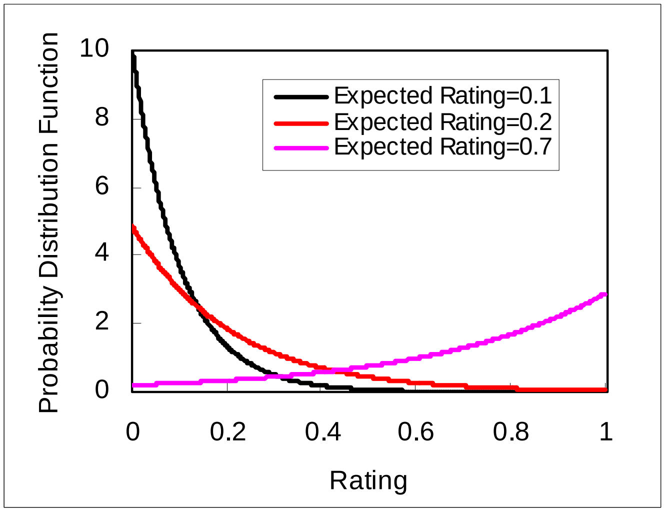

Figure 6 Instances of Rating Distribution without Sum Constraint

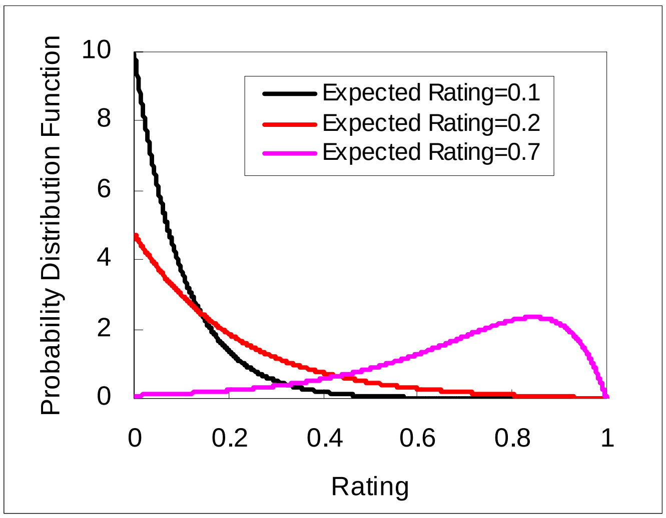

Figure 7 Instances of Rating Distribution (Sum of Three Sampled Ratings = 1)

2 Construction of Probabilistic Distribution for Group Preferences

Understanding a team's preferences is useful for design, and often the case that members of a team have different preferences. Determining a team rating from individual ratings is challenging for a number of reasons, and two are considered here. One is that any individual rating given can be uncertain, either due to fuzziness (does the person think of a rating of 0.3 or 0.4 as roughly the same?) or simple human error. The second challenge is the role of team organizational issues and social dynamics. There may be differences in opinion among individual designers which may lead to different group ratings. There is a rich literature on decision-making styles in groups and how the opinions of team members and team leaders may be aggregated , such as Pairwise Comparison Charts (PCC) [7], Axiomatization with Cardinal Utility and Distance-Based Collective Preorder Integration [8].

In this research, it is assumed that group ratings are bounded somewhere between the highest individual rating and the lowest individual rating. The construction of the distribution for team ratings is similar to the approach described in Section 1, and includes information about the lower bound, the upper bound and the weighted average rating. The weighted average rating can be estimated in several ways. If there is no hierarchy and no apparent leader in the team, the weightings can be simply assumed equal or proportional to an individual's utterances in the discussion. Weightings may be adjusted to reflect information such as an individual's leadership, expertise, and member importance [9, 10].

3 Simulation of Group's Preferences

Monte Carlo simulation was used to determine the chances that one alternative has a higher group rating than any other alternative. In each round of simulation, individual ratings are sampled from the probabilistic distribution constructed in Section 1, and then group ratings for each alternative are found from the probabilistic distribution in Section 2. By comparing the group ratings of the alternatives, the most preferred alternative is determined. Repeating this process in simulation, the probability that one alternative is preferred over all other alternatives can be estimated from statistical results from simulation. The preferential probability for an alternative approximately equals to the proportion of rounds when this alternative has the highest group rating in the simulation.

When there is no constraint on the sum of the sampled ratings on all alternatives, the steps of the simulation process are as follows:

1. Construct a distribution for each individual member's rating for each alternative, as described in Section 1;
2. From each distribution, randomly select a sample as the "true" individual rating;
3. For each alternative, based on the sampled individual ratings, construct a distribution for the possible group rating, as described in Section 2;
4. Sample to get the group rating for each alternative;

5. Compare the group ratings to determine the most-preferred alternative;

6. Repeat Step 2-5 until the predefined maximum number of simulation runs is reached. The group's preferential probabilities can be estimated from the obtained statistical simulation results.

If there is a constraint that the total sampled ratings on all alternatives are fixed (e.g. designers allot a fixed number of points to the alternatives), then the joint distributions for both individual and group ratings are used as described in Section 1 and 2, and only *(N-1)* alternative ratings are to be sampled, the left one is determined by subtracting the sampled ratings from the predetermined sum, e.g., 1 when the ratings are normalized values as shown in this study.

In the simulation for this study, the rejection method [11, 12] can be employed to generate the samples for the distribution functions. The rejection method can generate sampling values from an arbitrary probability distribution function.

4 Experimental Study of PPT and PPS

4.1 Case Background

The design team is a team of 3 engineering graduate students. The team's task was to select a carafe component and a filter component for a coffee maker re-design project from a set of alternatives. This discussion was recorded and transcribed for PPT. During the same exercise, they were asked to fill out surveys expressing their preferences for design choices.

4.2 Survey Results with PPS

Five surveys were administered all along the design process, including one before the discussion started (Time=10:00), one after the discussion ended (Time=48.20), and three within the discussion (Time=20:06, 30:12, 40:00). The times are expressed as mm:ss. The three designers are coded as D_1, D_2 and D_3, and they were given total 10 points to rate the three alternatives, with a higher number representing a higher preference for an alternative. For computing convenience, the ratings are normalized. Tables 1-5 display designers' survey results in the experiment.

Table 1 Survey Ratings at Time = 10:00 (before Design Process)

Alternative / Designer	Carafe			Filter		
	Glass	Steel	Plastic	Gold tone	Paper	Titanium
Designer D_1	0.5	0.3	0.2	0.2	0.3	0.5
Designer D_2	0.4	0.5	0.1	0.2	0.7	0.1
Designer D_3	0.4	0.5	0.1	0.3	0.6	0.1

Table 2 Survey Ratings at Time = 20:06

Alternative / Designer	Carafe			Filter		
	Glass	Steel	Plastic	Gold tone	Paper	Titanium
Designer D_1	0.5	0.3	0.2	0.3	0.5	0.2
Designer D_2	0.5	0.4	0.1	0.2	0.7	0.1
Designer D_3	0.6	0.4	0	0.3	0.6	0.1

Table 3 Survey Ratings at Time = 30:12

Alternative / Designer	Carafe			Filter		
	Glass	Steel	Plastic	Gold tone	Paper	Titanium
Designer D_1	0.5	0.2	0.3	0.3	0.5	0.2
Designer D_2	0.5	0.4	0.1	0.2	0.7	0.1
Designer D_3	0.6	0.4	0	0.2	0.8	0

Table 4 Survey Ratings at Time = 40:00

Alternative / Designer	Carafe			Filter		
	Glass	Steel	Plastic	Gold tone	Paper	Titanium
Designer D_1	0.5	0.3	0.2	0.2	0.5	0.3
Designer D_2	0.6	0.3	0.1	0.2	0.7	0.1
Designer D_3	1	0	0	0	1	0

Table 5 Survey Ratings at Time = 48:20

Alternative / Designer	Carafe			Filter		
	Glass	Steel	Plastic	Gold tone	Paper	Titanium
Designer D_1	0.5	0.3	0.2	0.3	0.2	0.5
Designer D_2	0.6	0.3	0.1	0.3	0	0.7
Designer D_3	1	0	0	0	0.3	0.7

The surveys show that the designers had different opinions on the “best” alternative in the beginning, but reached a consensus when the design process was finished.

PPS was applied to convert these ratings into preferential probabilities. Since the ratings in the experiment were normalized relative preference ratings, there was a constraint on the fixed sum. The joint distributions descried in Sections 1 and 2 were used to for sampling the individual ratings and the group ratings for simulation. For example, in this case study with three alternatives, for a certain designer, if the sampled ratings for the first and the second alternative were 0.2 and 0.5, then the sampled rating for the third one would be 1-0.2-0.5=0.3 by default. And the sampled results would be dropped when the sum of the first two ratings was greater than 1 because it conflicted with the constraint.

The sampled individual ratings are imported for constructing the group rating distribution, and then a group rating is sampled from the distribution. The weighted average is one of the constraints for solving the parameters for the distribution. In this experiment, the designers were interviewed after the design about the contributed work, and the videotape was reviewed again for team dynamics analysis. It is noticed that all team members contributed almost equally, so equal weightings on the individual survey analysis were employed. The resulting values for each of the 5 time intervals are shown in Table .

The survey before the design process (Interval 0) shows that both the glass carafe and the steel carafe have a ~49% chance to be selected as the "best" or most preferred choice, while the plastic carafe has only a ~3% chance to be selected as the "best" or most preferred choice. From the above data, it can be inferred that, as a group, the glass and the stainless-steel carafes were preferred in the beginning, but that only the glass one was preferred in the end. For the filter design, the design team preferred the paper throughout the session until the very end when the Titanium filter became the most preferred choice.

Table 6 Group Preferential Probabilities from Surveys (PPS)

Alternative / Interval	Carafe			Filter		
	Glass	Steel	Plastic	Gold tone	Paper	Titanium
0	0.492	0.482	0.0259	0.131	0.719	0.150
1	0.654	0.322	0.0232	0.161	0.815	0.0240
2	0.680	0.272	0.0482	0.0977	0.885	0.0172
3	0.884	0.101	0.0149	0.0319	0.929	0.0390
4	0.885	0.101	0.0148	0.101	0.0693	0.830

4.3 Transcript Analysis with Initialized Preferences

The entire discussion of the team was audio- and video- recorded and transcribed. PPT was applied to the transcripts. The utterances of the six alternatives (three alternatives each for the two component selection problems) were collected in intervals of ~8 minutes (~10 minutes including survey filling) to match the intervals at which the questionnaires were administered. The initial preferences at the beginning of the design discussion can be given in several ways: 1) equally divided; 2) preference information collected from an earlier design process; 3) analysis on previous preference of similar designs; 4) conducting surveys before the design process. In [3], equal initial preferences were used. This time, the preferential probabilities were initialized with the probability values translated from the preference ratings on the survey which was done before the design process started. Table shows the results of preferential probabilities extracted from the discussion transcripts. The ones in Interval 0 mean the initial preferential probabilities for starting PPT.

Table 7 Group Preferential Probabilities from Transcripts (PPT)

Alternative / Interval	Carafe			Filter		
	Glass	Steel	Plastic	Gold tone	Paper	Titanium
0	0.492	0.482	0.0259	0.131	0.719	0.150
1	0.856	0.137	0.00658	0.131	0.719	0.150
2	0.958	0.0395	0.00199	0.162	0.750	0.0872
3	0.988	0.0120	3.34E-05	0.00883	0.961	0.0300
4	0.997	0.00211	3.51E-05	0.00309	0.00927	0.988

Figure 8 and Figure 9 show the evolution of the preferential probabilities according to the data in Table .

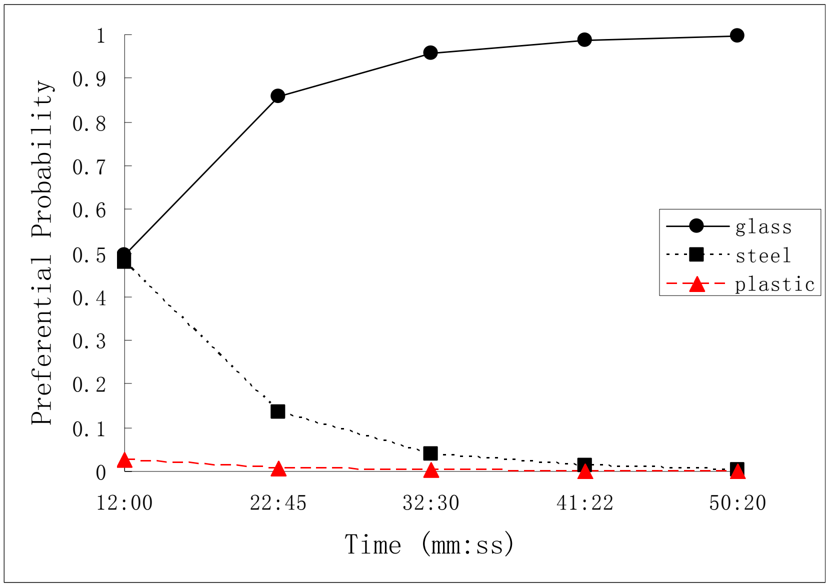

Figure 8 Design Process Evolution: Group Preferential Probabilities of the Three Alternatives for Carafe Selection (Initial Probabilities with Pre-design Surveys)

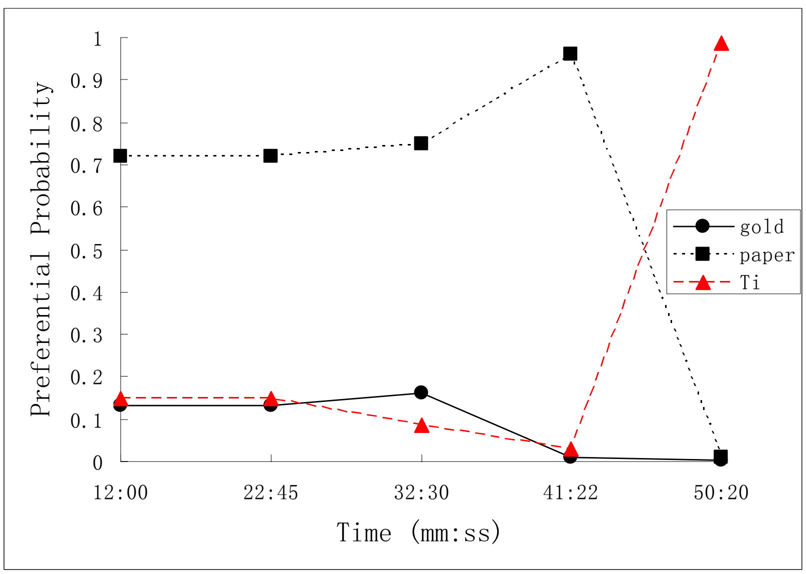

Figure 9 Design Process Evolution: Group Preferential Probabilities of the Three Alternatives for Filter Selection (Initial Probabilities with Pre-design Surveys)

5 Comparisons and Discussions

To better validate the probabilistic approach for extracting the preferential probabilities from the transcript, a comparison between the preferences from the transcript (PPT) and from surveys (PPS) was done in multiple ways: graphically, and through geometric distance, cosine similarity, and correlation.

Figure 10 through Figure 12 overlay the evolutions of the preferential probabilities from transcript analysis (PPT) and surveys (PPS) for the carafe selection. They suggest that the glass carafe dominates over the other two alternatives (stainless-steel carafe and plastic carafe) during the whole design process. Figure 13 through Figure 15 show the results for filter selection. They indicate that the team's preferential probability is highest for the paper filter until the last interval, in which discussion changed to the titanium filter.

The trends and the changes of the evolution are almost consistent in Figure 10 through Figure 15, which graphically indicate the transcript reflects the trends in the designers' preference in the case study. The conjecture from the charts is consistent with the qualitative reading of the transcript. The team changed their choice on the filter because further information was given in the design process that the glass carafe and the paper filter could not function together, and so they had to select again. They changed the filter option because they agreed that the filter was less important.

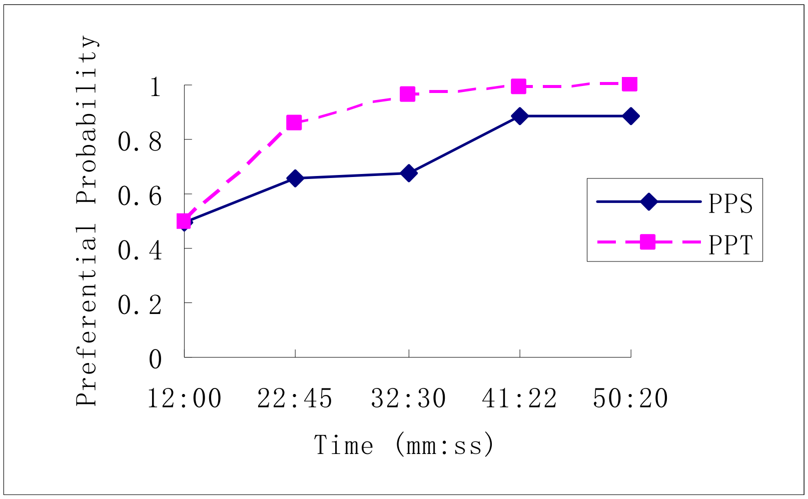

Figure 10 Comparison of Group Preferential Probabilities on Glass Carafe

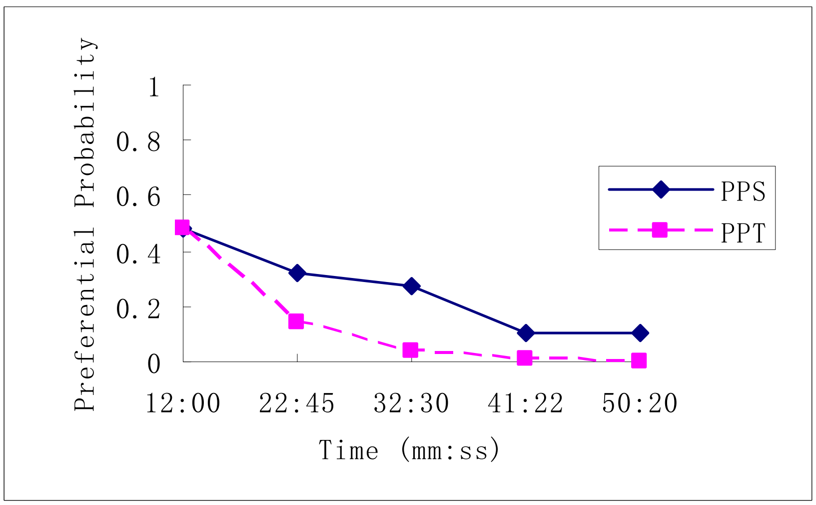

Figure 11 Comparison of Group Preferential Probabilities on Stainless-steel Carafe

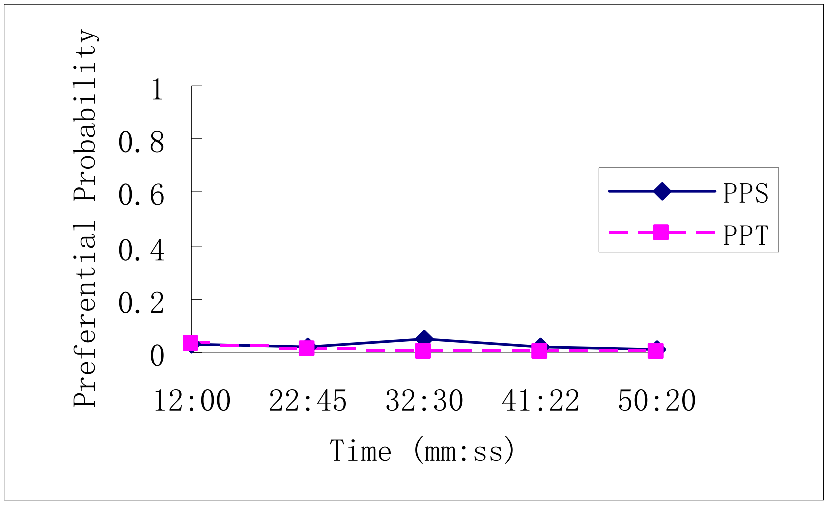

Figure 12 Comparison of Group Preferential Probabilities on Plastic Carafe

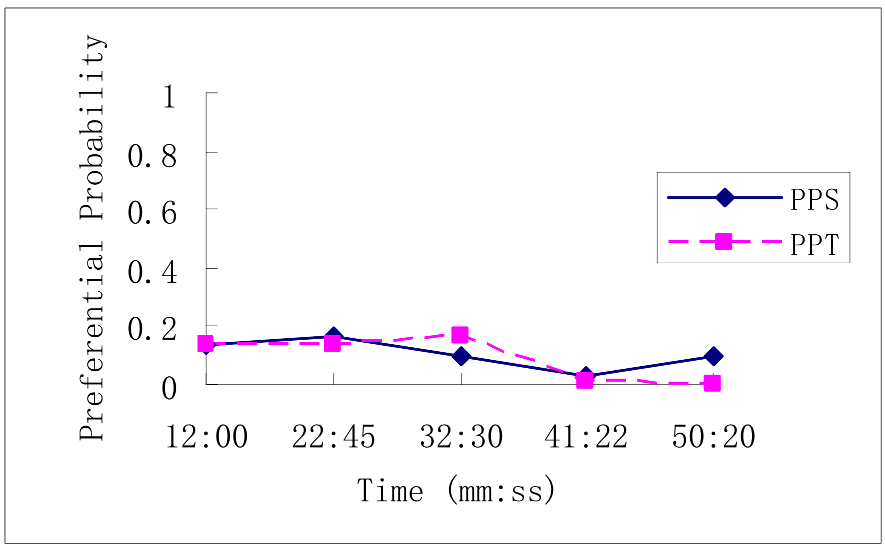

Figure 13 Comparison of Group Preferential Probabilities on Gold Tone Filter

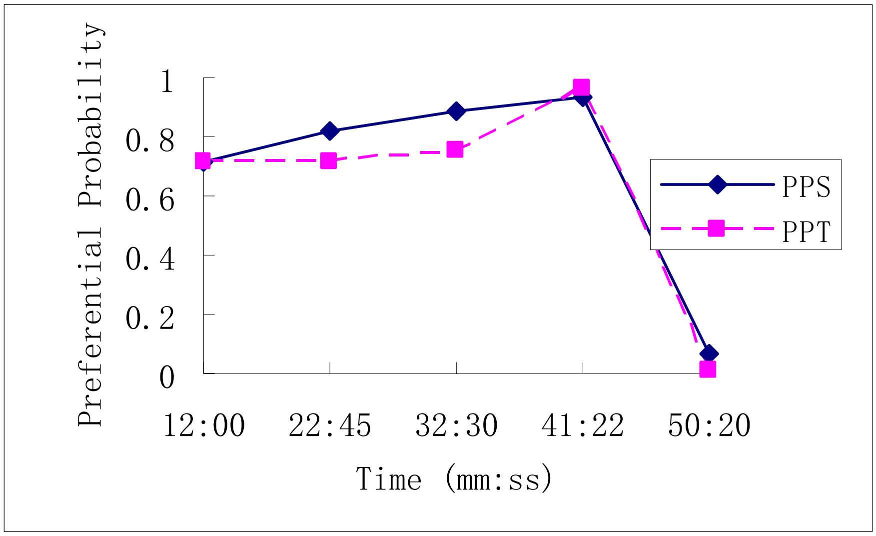

Figure 14 Comparison of Group Preferential Probabilities on Paper Filter

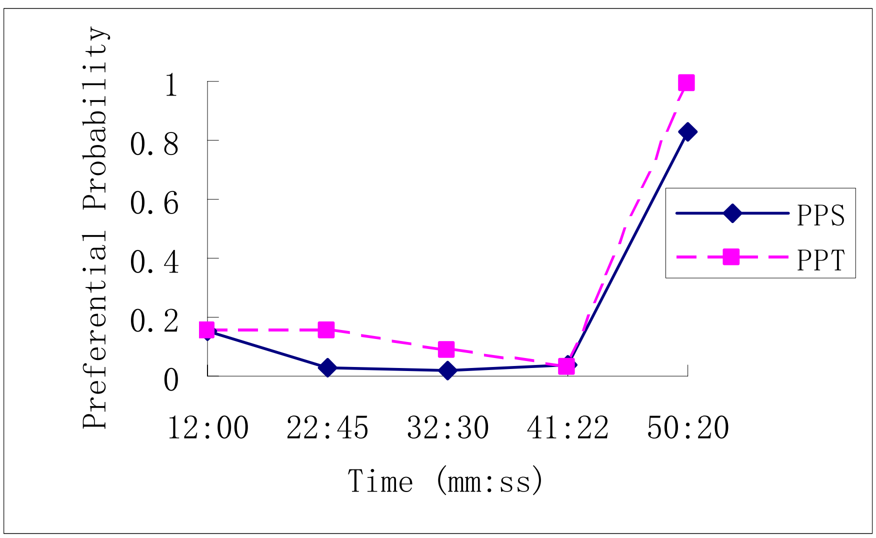

Figure 15 Comparison of Group Preferential Probabilities on Titanium Filter

6 Remarks

This report assumes the preference ratings could be random for both individuals and the team, and establishes a probabilistic approach (PPS) to translate preference ratings into preferential probabilities under the principle of maximum entropy. As an explicit counterpart of the implicit PPT, the preferential probabilities translated with PPS can be applied to quantitatively validate the preferential probabilities extracted with Approach PPT by computing the similarities (cosine similarity, Pearson product-moment correlation coefficient, Spearman ranks correlation coefficient) between the preferential probabilities of PPT and PPS. The consistent results of the case study further validate the effectiveness of the probabilistic approach (PPT) proposed in [3]. It is expected that the design preferences may oscillate in the design process, and it is verified both in the surveys and the transcripts in the experiment done for the case study in this report. The probabilistic ways to describe how a design team prefers an alternative over the others may lead to a novel way to understand the nature of a team's preferences over time.

The probabilistic approach (PPS) preliminarily tries the links between the traditional preference ratings and the preferential probabilities and may enlighten the research on converting the preferential probabilities to the traditional preference ratings. In this work, while applying PPS, the maximum entropy is employed to construct the rating distributions for the rating preferences. Truncated exponential distribution is used under the conservative way when a bounded rating value is given.

Since this method does not assume any distribution or parameter a prior, it is scalable when additional information is provided.

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Appendix A: Surveys Used in Coffee Maker Re-design Experiment

Question 1: Based on your own opinion and on the discussion so far, how would you rank the following three alternatives for the carafe selection problem? If you have 10 points totally, how would you allocate these points on the following three alternatives, with larger number meaning more preference?

Name/ID	**Glass coffee pot** **Glass coffee carafe** **Coffee pot A** **Carafe A**	**Steel coffee pot** **Steel coffee carafe** **Stainless-steel carafe** **Coffee pot B** **Carafe B**	**Plastic coffee pot** **Plastic coffee carafe** **Coffee pot C** **Carafe C**
Photo			
Rank			
Rating (sum to 10 points total)			
Rationale (the simple reason of your selection)			

Question 2: How would you rank the following three alternatives for the filter selection problem? If you have 10 points totally, how would you allocate these points on the following three alternatives, with larger number meaning more preference?

Name/ID	**Gold tone filter** **Filter A**	**Paper filter** **Disposable filter** **Filter B**	**Titanium filter** **Ti filter** **Filter C**
Photo			
Rank			
Rating (sum to 10 points total)			
Rationale (the simple reason of your selection)			

Appendix B: A Segment Sample from Discussion Transcripts of Coffee Maker Re-design (in XML File)


```
……………..
- <transcript>
  <time>16:00</time>
  <speaker>H</speaker>
  <text>Glass Coffee carafe seems to have the most capacity.</text>
  </transcript>
- <transcript>
  <time>16:10</time>
  <speaker>I</speaker>
  <text>" For the coffee pot A, the capacity says that it can be designed as wanted,
    available for 2 cups and 6 cups. So at least for this option A (glass pot), it has a lot
    of flexibility."</text>
  </transcript>
- <transcript>
  <time>16:25</time>
  <speaker>P</speaker>
  <text>" It is the same for the steel coffee pot, it says the same thing"</text>
  </transcript>
- <transcript>
  <time>16:32</time>
  <speaker>H</speaker>
  <text>The same for the plastic (plastic coffee pot)</text>
  </transcript>
- <transcript>
  <time>16:38</time>
  <speaker>I</speaker>
  <text>So it is not a constraint at all. We do not have to think about it.</text>
  </transcript>
- <transcript>
  <time>16:43</time>
  <speaker>P</speaker>
  <text>" OK, forget about capacity. Then what about weight? Because if you see the
    requirement, it says you are in good health, but you are not as strong or mobile
    as you were when you were younger. So maybe it's an old person, and he or she
    cannot deliver very heavy coffee pots."</text>
  </transcript>
```

- <transcript>
<time>**16:54**</time>
<speaker>**H**</speaker>
<text>**That's the weight and portability.**</text>
</transcript>
- <transcript>
<time>**16:58**</time>
<speaker>**P**</speaker>
<text>**" Yes, weight and portability, I think important factors. "**</text>
</transcript>
- <transcript>
<time>**17:02**</time>
<speaker>**H**</speaker>
<text>**" One thing here is another following is it seems it is true they can provide in 2 cups to 6 cups. But according to their design, you see that the stainless-steel carafe, if we want to have 6 cups (from) the stainless-steel, it will be provided in very big, heavy as supposed to the plastic one. In plastic, we have only a single thing."**</text>
</transcript>
- <transcript>
<time>**17:30**</time>
<speaker>**I**</speaker>
<text>**" Yes, we should exchange the information about the weight and the portability. And for the coffee pot A, The weight is light, and the portability says not portable. I do not quite understand what does it mean by not portable."**</text>
</transcript>
- <transcript>
<time>**18:07**</time>
<speaker>**P**</speaker>
<text>**" I think portability means the ability to shift from one place to another. Maybe because it is glass, it might break. "**</text>
</transcript>
- <transcript>
<time>**18:13**</time>
<speaker>**I**</speaker>
<text>**" OK, and how about..."**</text>
</transcript>
- <transcript>
<time>**18:15**</time>
<speaker>**P**</speaker>
<text>**" And for the steel coffee pot, coffee pot B, it says it is heavy, but portability is portable. So probably you can take it with you if you..."**</text>

</transcript>
- <transcript>
<time>18:20</time>
<speaker>H</speaker>
<text>So there is a drawback for stainless-steel because it is heavy.</text>
</transcript>
- <transcript>
<time>18:22</time>
<speaker>P</speaker>
<text>" It is heavy, exactly."</text>
</transcript>
- <transcript>
<time>18:25</time>
<speaker>I</speaker>
<text>Then how about for the plastic pot?</text>
</transcript>
- <transcript>
<time>18:28</time>
<speaker>H</speaker>
<text>" the Plastic, it is portable, it is light, and not easy to clean, not attractive, and less durable, footprint size is small, and fragile material inside, fragility, and $15 price cost, and thermal-insulated plastics."</text>
</transcript>
- <transcript>
<time>18:40</time>
<speaker>P</speaker>
<text>so the cost is $15?</text>
</transcript>
- <transcript>
<time>18:44</time>
<speaker>H</speaker>
<text>costing is $15.</text>
</transcript>
- <transcript>
<time>18:50</time>
<speaker>P</speaker>
<text>And what about warming plate cost? 0?</text>
</transcript>
- <transcript>
<time>18:56</time>
<speaker>H</speaker>
<text>" 0, yeah."</text>
</transcript>

- <transcript>
<time>**19:02**</time>
<speaker>**P**</speaker>
<text>**" OK, and it can keep the coffee warm because it is thermal-insulated."**</text>
</transcript>
- <transcript>
<time>**19:07**</time>
<speaker>**H**</speaker>
<text>**" Yes, thermal-insulated inside, but outside is fragile. So..."**</text>
</transcript>
- <transcript>
<time>**19:12**</time>
<speaker>**P**</speaker>
<text>**" So the thing is..., what is your durability for the glass coffee pot, Iris?"**</text>
</transcript>
- <transcript>
<time>**19:18**</time>
<speaker>**I**</speaker>
<text>**" Durability (of glass pot), it says durable, reliable."**</text>
</transcript>
- <transcript>
<time>**19:24**</time>
<speaker>**H**</speaker>
<text>**Because they usually they use temper glass.**</text>
</transcript>
- <transcript>
<time>**19:27**</time>
<speaker>**P**</speaker>
<text>**Ok.**</text>
</transcript>
- <transcript>
<time>**19:28**</time>
<speaker>**H**</speaker>
<text>**They (glass pot) are not fragile (?).**</text>
</transcript>
- <transcript>
<time>**19:30**</time>
<speaker>**P**</speaker>
<text>**So I think...**</text>
</transcript>
- <transcript>
<time>**19:32**</time>
<speaker>**I**</speaker>

<text>**So what is the cost for the steel (steel pot)?**</text>
</transcript>
- <transcript>
<time>**19:33**</time>
<speaker>**P**</speaker>
<text>**It is $20.**</text>
</transcript>
- <transcript>
<time>**19:34**</time>
<speaker>**I**</speaker>
<text>**$20.00**</text>
</transcript>
- <transcript>
<time>**19:35**</time>
<speaker>**H**</speaker>
<text>**So more costly.**</text>
</transcript>
- <transcript>
<time>**19:36**</time>
<speaker>**I**</speaker>
<text>**and warming plate is 0?**</text>
</transcript>
- <transcript>
<time>**19:38**</time>
<speaker>**P**</speaker>
<text>**" yes. (Steel pot) Warming plate is 0, and footprint size is small, and fragility is strong, it does not break, durability is durable, heat retention is OK with double layers of steel, and weight is very heavy, and portability is portable, and not easy to clean"**</text>
</transcript>
- <transcript>
<time>**20:06**</time>
<speaker>**[The second questionnaire]**</speaker>
<text />
</transcript>
- <transcript>
<time>**22:12**</time>
<speaker>**H**</speaker>
<text>**So is it (glass pot) attractive (?)**</text>
</transcript>
- <transcript>
<time>**22:15**</time>
<speaker>**I**</speaker>

<text>**I do not have the information for the plastic coffee pot. Is it easy to clean?**</text>
</transcript>
- <transcript>
<time>**22:25**</time>
<speaker>**H**</speaker>
<text>**" No, it is not easy to clean. It's not attractive. Can be designed as wanted, available for 2 cups and 6 cups."**</text>
</transcript>
- <transcript>
<time>**22:35**</time>
<speaker>**I**</speaker>
<text>**So how about the steel coffee pot? How about the style and aesthetic value? Is it looking attractive?**</text>
</transcript>
- <transcript>
<time>**22:45**</time>
<speaker>**P**</speaker>
<text>**" Yes, it looks attractive."**</text>
</transcript>
……………..