THE INFLUENCE OF TRAINING ON PREFERENCES

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ABSTRACT

Any organisation or company that want to bring about a change in the process, procedures or internal organisation encounters the issue of training the staff. Training is commonly used to increase dedication in specific issues for example environmental issues, energy saving or enhancing the overall competence of the staff.
When working with environmental- or energy issues, the attitude of the employees is often considered one of the most important factors for the outcome.
In this paper two different studies are compared. In both studies training has been included as a background factor in a conjoint analysis study.
The first study concerns preferences for new materials, in this case advanced high strength steel. The respondents were asked to rank eight alternative steel containers and the results, (preferences) were compared to any previous training the individual respondent had.
The same procedure was taken in study number two where employees at a paper & pulp industry was asked to rank eight alternative processes with different environmental impacts. Also here the respondents were asked to state any previous training and the preferences was compared to previous training.
It has not been possible to show any significant connection between preferences in a specific issue and training in the same area. However, it would be interesting to use the method to measure the effect of training on preferences before and after a specific training session.

KEYWORDS

Conjoint analysis; education; environment; preference; training.

1 INTRODUCTION

Training and education is often said to be an important way of addressing environmental issues in a company or an organisation [1]. Training of the employees supposedly raises the level of awareness, decreases the number of nonconformities and helps organisations to work with continual improvement on the environmental arena. If there are problems with compliance to procedures or legal requirements, training is often proposed as a solution. If the employees have the correct training, the problem is assumed to lessen. This paper aims at comparing educational level and training to preferences derived through conjoint analysis.

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2 CONJOINT ANALYSIS

The choices people make are based on many things. Previous experience, training, attitude, habits, ethics etc. A person will choose the product or alternative that brings the most utility to this person (utility theory). The decision is formed by simultaneously considering multiple factors, a unique quality of the human brain. On a daily basis a person makes hundreds or possibly thousands of choices in this way, and this is what the method of conjoint analysis takes advantage of.

A conjoint analysis is a stated preference method that can be used to determine participants' preferences for predetermined factors [2]. The researcher determines a number of factors to be included in the study, e.g. through focus group discussions or interviews with key persons. These factors should not be too many and they must be independent of each other. The factors are provided with levels (high/low, change/no chance). Experimental design is used to create alternatives. To keep the number of evaluations as low as possible for the respondents sake, a fractional factorial design is most often used. The drawback of the reduced design is that interaction effects are lost. However, in most studies, the main effects are enough to describe the most important properties of the material.

If the participants have been asked to rank the alternatives (rating and pair wise choice is also common) the material can be analysed in a number of ways, regression and ANOVA are common methods. In the studies that are presented in this paper however, multiple linear regression and partial least squares regression are used.

3 TRAINING AND PREFERENCES

When an organisation want to change the attitude of its employees, for example if the process is to be rearranged, training is often suggested as a practical and fairly easy measure. In this paper respondents previous training is compared to their preferences for adjacent topics. In one of the studies the respondents actual knowledge has also been measured and this is also compared to the preferences.

The main research question in this paper is if training of staff has any effect on their preferences for key issues in the same area. For example, if a course in environmental awareness is given to the employees, will it effect their preferences for environmental issues?

3.1 Case 1: New materials – advanced high strength steel

What is presented here is one part of a study designed to examine the preferences with different stakeholder groups to new materials, in this case, high-strength steel. Participants came from the whole of Sweden. The study was designed as a web-based questionnaire and participants from the steel industry were offered participation through an e-mail list. In this paper only a small part of the total number of participants in the actual study are presented. Only the first 75 participants are included, since the sampling is ongoing and these are the samples that are collected as of this day. The survey consists of three parts, one conjoint analysis, one part with questions about the participant (age, gender, education, etc.) and one part with knowledge-questions [3] related to steel and the environment.

Table 1 Factors and levels from conjoint analysis of case 1

Factor	Low level	High level
Impact properties	Normal	High
Weight	1600 kg	2300 kg
Chromium content	0.0%	1.0%
Production country Sweden	No	Yes
Scrap content	20%	60%
Price (VAT not included)	18500 SEK	23500 SEK

Five factors were identified and each factor was presented in two levels, see Table 1. Experimental design is used to create alternatives (fractional factorial design, resolution III, all interaction effects confounded). By asking the participants to rank the alternatives, the preferences can be identified through decomposition of the ranks.
The responses on the knowledge-questions in the last part was summarised (on point per correct answer), and averaged. The points from the questions in the last part could then be compared to the rankings in the conjoint analysis part and training can be compared to preferences.
In order to illustrate the properties of the different alternatives, a transportation container ("ISO container") was used as an example-product. The container was chosen because it has no moving parts, it is not connected to health- or security issues and it is a fairly well known product made of steel. If the container is produced out of high strength steel the weight is affected and thus the environmental impact.
Generally, weight and impact properties were considered as the most important factors, see Figure 1. The variation in preferences was large, as it always is, since peoples preferences tend to differ a lot.
The participants also answered questions about whether they had taken part in a training or education concerning steel, materials science or the environment. Participants answered a small quiz with questions on steel and the environment, the results of the knowledge questions were summarized and thereby a measure of their knowledge was obtained. This measure of knowledge was then compared to the preferences obtained from the conjoint analysis.

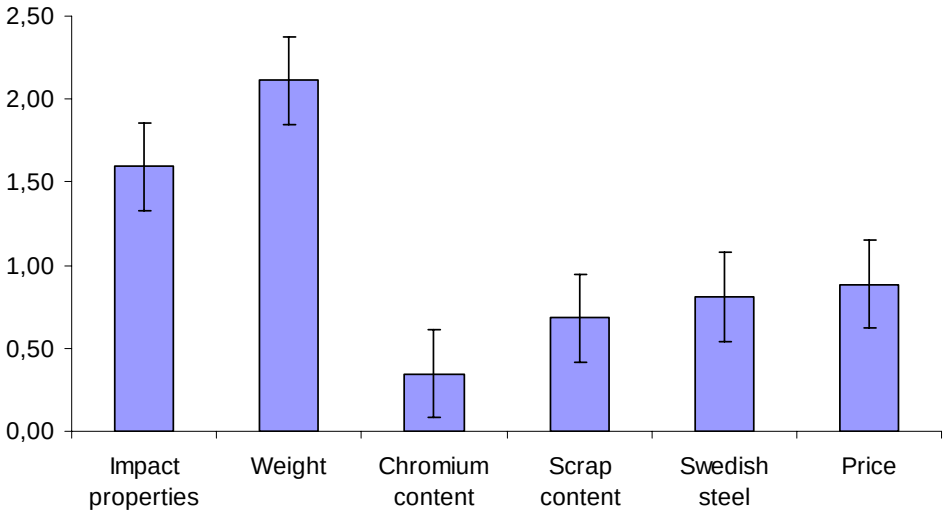

Figure 1. Average main effects with standard errors

5 steel questions were asked and 5 environmental questions. One of the steel questions had to be removed due to possible misinterpretation. The average respondent had 75% of the steel questions right and 77% of the environmental questions.
However, if the respondents that state that they have participated in an environmental training are assessed, the result increase to 79% for the environmental questions and 75% for the steel questions. People with a steel training reach 77% for the environmental questions and 74% for the steel questions.
If the level of training is compared to the preferences, university studies only seem to affect how one consider chromium content ($p=0.006$). Participation in steel-, material technology or environmental training has no visible effect on preferences.
When the knowledge level is compared to preferences, high points on the environmental knowledge-questions lead to an increased preferences for reducing chromium ($p=0.013$). High points on the steel knowledge-questions do not correlate to any of the factors in the conjoint study.
Gender affects preferences, women give a higher priority to scrap content than men ($p=0.009$), see Figure 2.
Even if training and education do not seem to play an important role in how preferences are created, there are some other significant differences in the material. Whether or not you have been employed at a steel work influences your preference for impact properties ($p=0.006$). One can speculate that people within the steel industry have a better knowledge on what impact properties is and the effect it has on the product.
One final significant correlation was found between preferences for weight and preferences for high scrap content.

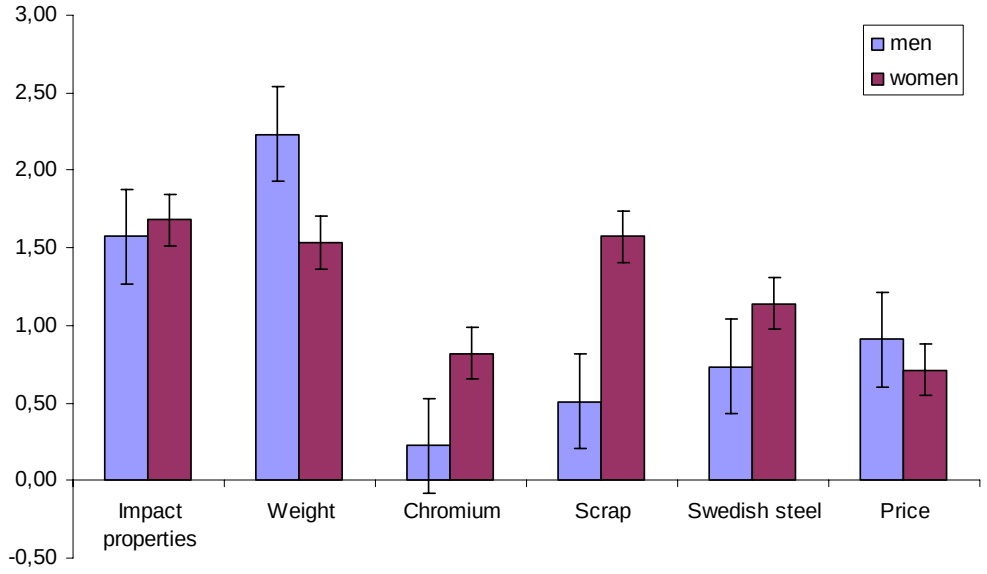

Figure 2, Average main effects from fractional factorial design with standard errors.

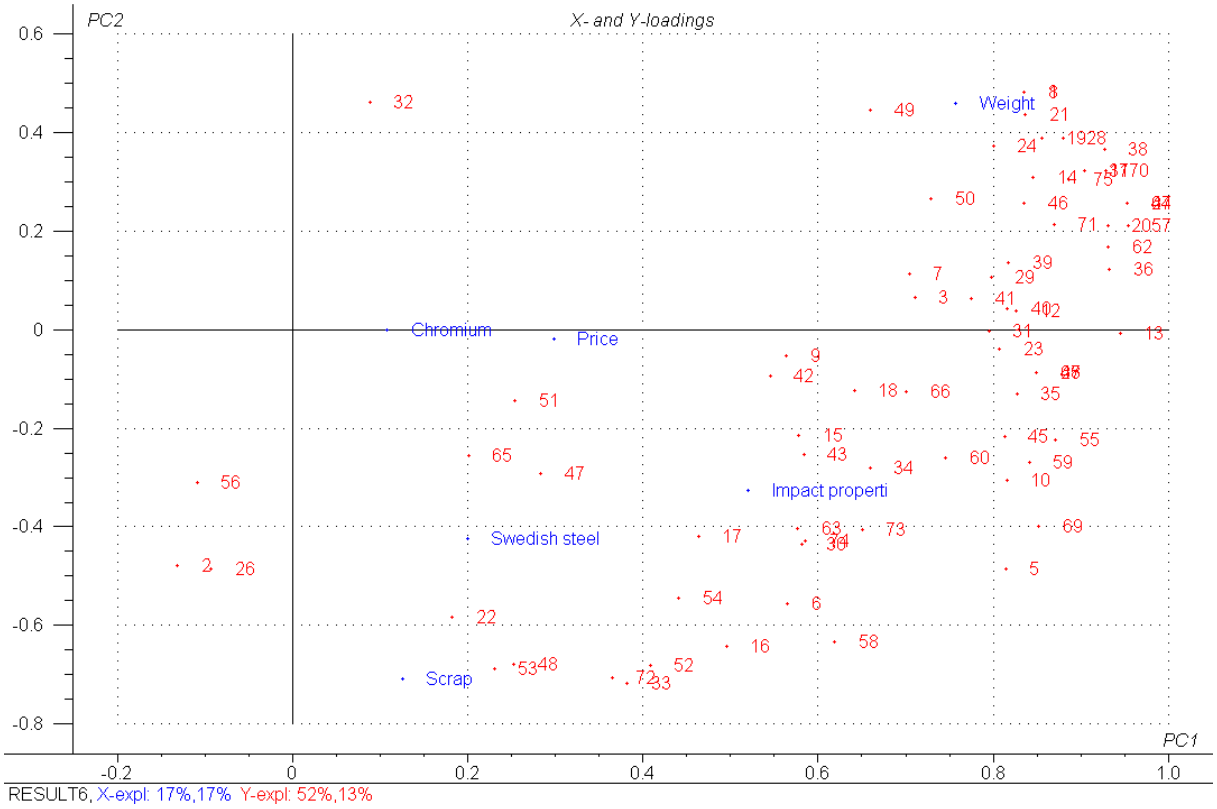

Figure 3. Partial least squares regression (PLSR) of case 1. The first two latent variables explain 65% of the total variance.

The results can be visualized through a partial least squares regression (PLSR), see Figure 3. A PLSR draws a "map" of the results where all respondents are drawn individually.

3.2 Case 2: Adding a bio refinery to a paper/pulp mill

Case 2 is a study that aims at integrate conjoint analysis with a process integration model (energy efficiency) in a paper mill. The pulp/paper mill is located in Kalix outside of Luleå in the north of Sweden (Billerud Karlsborg).
The factors were chosen in order to illustrate how attitudes towards change can be incorporated as a parameter in a process integration model. Along with the conjoint analysis, the participants in the study were asked questions on educational level, work situation and any training in energy efficiency, environment, work environment and forestry. In this paper, the questions on educational level and training will be compared to the stated preferences from the conjoint analysis.
The factors (see Table 2) were decided through discussions with representatives from the pulp/paper mill and fellow researchers from the process integration project. The study was designed as a web-based questionnaire that the employees from the mill accessed through the intranet of the mill. All employees hand the opportunity to fill out the questionnaire, it was open for two weeks in order to cover all shifts. In all 61 persons answered the questionnaire and from these six responses had to be removed due to inconsistent answers.
The experimental design was a fractional factorial design with resolution IV. Only main effects were estimated.
Educational level influence preferences for climate change ($p=0.006$). 10 respondents had taken part in three or four of the training subjects (forestry, energy, environment or work environment) and for these respondents preferences for forestry differed significantly from the others ($p=0.029$). The training subjects individually had no influence on the preferences at all.
One thing is interesting to notice however, all educations correlate to each other, i.e. if a person has attended one education, she or he is more likely to attend educations in other areas as well, see Figure 4.
The women in the study was much less worried over climate change than the men, people living close to the mill were more interested in the local environment than average, respondents working with maintenance do not want to increase the forest outtake, while people working with process- and product development feel strongly for an increase in forest outtake. All of these results are outside of the 99% confidence interval.

Also here, the overall results are illustrated with a PLSR-plot (see Figure 5).

Table 2 Factors and levels from conjoint analysis of case 2

Factor	Low level	High level
Local forestry	As today	Increased outtake
Process	Paper/pulp	Paper/pulp/bio refinery
Effect on climate	As today	Decreased
Local environmental effect	20% increase	As today

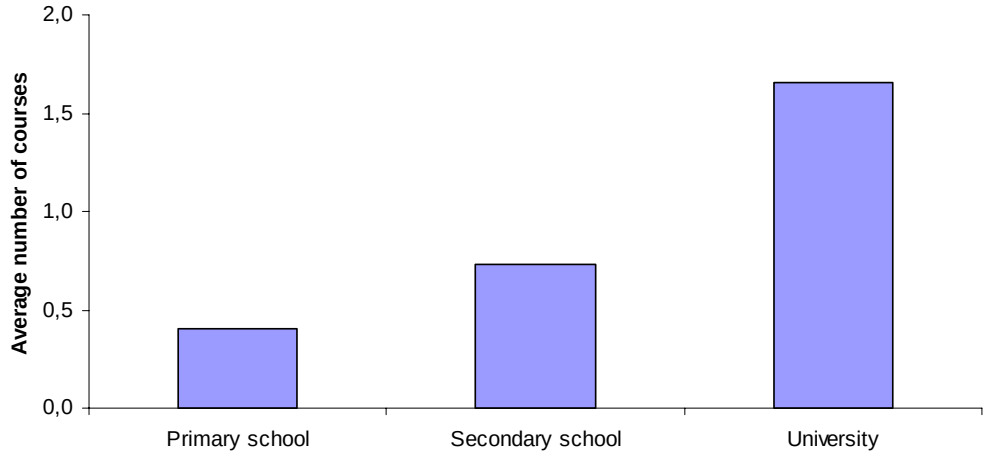

Figure 4, Average number of courses (environment, energy, work environment and forestry) for each educational level.

Figure 5. PLSR of case 2. The first two latent variables explains 65% of the total variance.

4 DISCUSSION AND CONCLUSIONS

In case 1, chromium content was chosen to represent toxic substances that is associated with environmental problems. In the results we can see that respondents that show a high level of knowledge in environmental issues also tend to focus on chromium content.

In case 2, it was possible to show that a high educational level correlates to preferences for reduced climate change. It is also interesting to notice that people that has already taken one course tend to take more courses. Perhaps it is not surprising to find that respondents that live close to the paper/pulp mill in case 2 also focus on the local environment.

The fact that it has been possible to show that different occupational groups have different preferences in case 2, is something that may be useful for an organisation. If a change is planned for the process or organisation, different groups of employees will perceive this change in different ways. Conjoint analysis can thus be used to identify these differences in preferences (attitudes) and thereby make tailored information campaigns within the company possible.

Future research could provide the industry with a tool that enables the organisation to identify groups of employees with specific preferences (attitudes). There is also a need for studies on what use internal training sessions really bring to the organisation in the long run, for example by measuring preferences before and after a training session. Perhaps other means of affecting the attitudes of the employees need to be developed, besides training.

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