



**Explaining adoption and market success
of “green products”**

A Conjoint Analysis Experiment
on German Students’ preferences on eco-labels

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Dissertation submitted to obtain the Master Degree in
Industrial Engineering and Management

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November 2012

Abstract

This study objective is to assess the relative importance that German students attach to chosen food eco-labels, namely Dolphin Safe, Organic, Fair Trade and Marine Stewardship Council (MSC). Eco-labels are seen as necessary instrument to discriminate what is a green product and what is not. In fact, despite a significant amount of past research attention on “green” products, this topic reveals still some lacks in scientific knowledge, special the students attitude towards “green” products.

Students’ buying behavior is studied through a web-based survey in a sample of 213 respondents recruited in Hamburg area. A realistic multi-attribute framework is adopted through a Conjoint Analysis experiment, in which respondents are forced to choices similar to real marketplace situation’ ones.

The findings suggest that students attach a high importance to eco-labels, more than to other quality related attributes. In coffee products, they evaluate more the Fair Trade than Organic label, in tuna fish products, the MSC label more than Dolphin Safe one, but all these labels get a considerable importance. The demographic segmentation unveils unexpected sex based differences and the relevance of the “experience” effect. Findings are consistent with existing literature and addresses future research through specific insights. The study offers implications for marketers of “green” goods and for governments and NGOs promoting eco-labels, which are useful especially in long-term perspective.

The fact that Germany is pioneer in green products policies and diffusion increases the international relevance of the study.

Keywords

Germany, Eco-label, Coffee, Tuna, Conjoint Analysis, Students

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1 INTRODUCTION

Green products and market concern

Concern about the environmental issue is growing among people as the effects of environmental depletion and resource exploitation are dramatically becoming visible and an object of media interest. A well-informed public opinion recognizes the priority of the environmental issue and people are domestic with some environmentally friendly behaviors. Companies started offering “green products” to this base of consumers worried about the environment. These products traditionally offer an additional benefit to the consumer, called “greenness”, and comport a premium price.

Market studies suggest that despite a broad awareness of the environmental problem there is little uniformity towards the attitude of buying green products within the population. Particularly, 20-30 % of the population is very likely to be green consumers and a large part of the remaining population consists of “latent” green consumers (1).

The targeting exigency explains why the effort of numerous researchers has been to profile the “green” consumer, but results are often controversial (2).

More than 20 years of history of “Green marketing” (the marketing of green products) offers several examples of market successes and failures of green product launches which were studied in order to better understand what consumers want from these products. Particularly green marketers suggest that consumers do not consider the “greenness” of a product as a benefit *per se* but rather as a way to enhance other features of the product. Most successful green products presented a different kind of appeal which was combined with the “greenness”: for example they were trendy, convenient or healthier (3).

In the last two decades, Green products have been protagonists of a continuous growth in sales and popularity (*Annex A*). Although the situation is very specific according to each industry, they reached a considerable market share in several industries and their sales are often growing at a rate of more than 10% per year (*see Annex B*).

Nevertheless, in the opinion of some experts, until now Green Marketing failed its expectations: it didn't dramatically tune the market (as they expected). Instead green products are often still regarded as niche products. Those claiming this had big hopes towards Green Products because of their promise to lower our impact on the environment without changing our consumption patterns (4). Therefore environmentally friendly products seem one of the easiest ways to “do something” for the environmental problem, because they don't imply change in the consumer's lifestyle, but imply just a premium price (which is usually affordable).

Both those enthusiastic claiming that “green is already mainstream” (5) and those thinking Green Marketing until now underachieved (4), agree on a “rose” future for green products. The fast rising market shares as well as the market success in developing countries (6) are encouraging signals for Green Marketers.

But the attention on Green Products keeps high also on Governments side. They are interested in preserving the environmental wellness for their citizens, and therefore they have all the interest in encouraging these practices of eco-friendly consumptions. Governments mainly act in two directions

in order to turn the market more “green”: they establish minimum environmental standards to commercialize a product and they can boost green consumption through eco-labels.

Eco-labels

Eco-labels, or environmental labels, are an instrument raised by governments and NGOs to supply to the informational gap existing between consumer and producer. In fact, there are some goods (the so called “credence goods”) for which no distinction is possible to the consumer, who has to trust what the producer declares.

Eco-labels are promoted by third parts and ensure the consumer that the product complies (or exceeds) with some environmental standards. The promoting institution certifies and monitors the compliance with defined standards; therefore it spends its credibility.

“Eco-labelling is a means to narrow the information gap: independent third parties assure the consumer that the producer has complied with published, transparent, environmentally friendly status” explain Van Amstel et al. (7). In the purchasing decision, the eco-label behaves as an “interface” for the consumer.

Perhaps the most relevant eco-label (for several reasons, among them: its completeness, a wide coverage of several industries and the supporting institution) is the “EU label”. This label is available for most of the industries (see 3.1). It’s supported by a powerful governmental organization and comes as complementary initiative to other policies adopted by the EU in order to “green” the market (8).

Students and Green Products

This work focuses on students and on their relationship with green products. They are at the same time a convenient sample, easy to reach, and traditionally objective of academic surveys (9). In the green products case they have some specific elements of interest: among them, their relevance as consumers of tomorrow and their high attitude towards the environment. They are completely aware of the environmental problem, probably because their generation has grown up in a media saturated context (10).

But students typically have a lower income with respect to the rest of the population, and their consumption patterns are very different from other people’s. Since they are the target of the study, it was necessary to take into account these specifications. Particularly their consumer pattern is restricted to staple products. those products bought frequently which form the basis of our daily pattern of behavior (11) (see *Annex A for a marketing classification of the products*). Therefore food products were chosen as the object of the study, which is a necessary part of everybody’s routine and eventual premium prices are affordable also for students’ pockets (and the products are largely available in Germany).

Unfortunately the feasibility of extending the EU label for food products is still under discussion (12), and the choice of eco-labels to be used within this experiment fell on some of the most popular labels within the food industry. They were Organic and Fair Trade label for coffee and Dolphin Safe and MSC for canned tuna. These labels differ from each other in some aspects, among the issues covered are

market share and responsible institutions. Products with these labels are widely available on the shelves of German supermarkets, and retail data places Germany in first place among all European Countries for most of them.

Objective

The purpose of the present study is to assess the relative importance that students attach to different attributes, and among them the chosen labels, in a typical consumer purchasing decision.

Methodology and thesis structure

To achieve this objective a state of the art review is done, with a special attention on Green Marketing and related issues in Chapter 2. Firstly, a contextualization of the problem within the controversial relation existing between the environmental issue and the market. The chapter is focused on the Green Marketing experience, the lessons and which can be derived. In the same chapter is presented previous research on students and eco-labels.

In Chapter 3 eco-labels are introduced. Beyond a panorama of the several industries (which is more deeply explored in Annex B), the focus of the chapter is on the chosen labels and on the usual limits which have been verified with eco-labels.

Adopted methodology is presented in Chapter 4. Labels have been rewarded as attributes of the product, as well as other characteristics, such as brand or price. The chosen technique to investigate consumer's preferences has been Choice based Conjoint Analysis: it is widely recommended for these kinds of problems and simulates a situation close to the real marketplace. The design of a Conjoint Experiment deals with several trade-offs, which is widely discussed in Chapter 4. The outcome of a Conjoint Experiment is the part-worth utilities, which are measures of consumers' preferences. Here they are used to derive the average importance of the attributes, which are telling us which attributes the consumer evaluates more and with what strength.

Results of the experiments (the average importances) are presented in Chapter 5, followed by a discussion including highlights and possible explications of the findings.

The final section includes conclusions, implications and limitations of the study, and suggestions for further research.

Annex A describes marketing classification of products, and contextualize the concept of "staple" products. Annex B shows the Green products and eco-labels situation across the industries.

Annex C and D are complementary to Chapter 4, because provide a practical example of conjoint analysis and an brief explication of the inverse-Wishart distribution and its application in Bayesian statistic.

Relevance and Contribution

The contribution of this study is twofold. Its comparative approach, involving two experiments (on two different products) for a total of four labels, it's innovative and allows us to observe how the same respondents react to different label-stimuli. In fact, most of the previous studies focus just on one

particular product. On the other hand, it unveils some peculiarities in how students relate to eco-labels. Although students are not typical consumers (9) and the results can't be immediately generalized, students (and young people in general) are objects of a particular interest when related to environmental behaviors.

The international relevance of the study is both in the dimension of the underlying environmental problems (which is generally world size) and both in the fact that while Germany is a leader in eco-labels and green products diffusion, the other countries are growing fast, and in some years they will probably have a green market situation similar to the German one.

The results are widely discussed and some segmentation of the respondents was performed. Different from other conjoint studies, where the segmentation is made later according to individual preferences, here a segmentation is provided according to demographic characteristics.

2 GREEN MARKETING

2.1 ENVIRONMENT AND PERSPECTIVES

The twentieth century saw the birth of the mass market and the boom of mass production to satisfy its needs. In a self-alimenting mechanism, the economic growth was the most beneficial strategy promising a growth in quality of life deriving from the investment of obtained wealth (13). The economy dramatically changed its face in the global market in this short period, and the Dominant Social Paradigm based on consumption was at the basis of this mechanism (4).

Meanwhile we're assisting increasingly urgent and global-sized environmental problems, such as the continuous increment of the world's temperature, the increasing of Co₂ in the atmosphere and the ozone depletion (14). The link between environmental depletion and overconsumption is unquestioned (15).

As the big levels reached by the mass market are a recent phenomenon, the environmental issue is, too. In fact, the environmental movement began in the US in the late 60s following some local polluting problems and focused on particular situations (such as polluting plants or the use of pesticides) and became the world leader for environmental reform. It raised public awareness and concern, and led to the creation of the Council for the Environmental Quality (CEQ) and the Environmental Protection Agency (EPA) in 1970 and the passage of numerous environmental laws (16). In that period Europe was experiencing an "economic boom" due to the recovery from WW2 and no actions were taken to comply with them. European environmental action began to grow in the 80s, while under the policies of deregulation of Reagan, the US lost its leadership role (16).

The activities of Green Parties (including election of its members to political offices) were a major factor in Europe's "green revolution". From the 90s the environmental issue has become important for all countries, even if there are lots of differences among single countries. (16)

Table 1 - The change of perspectives in the environmental movements (17)

Factor	1970s environmentalism	1990s green
Emphasis	On “environmental” problems	On the underlying problems with our social, economic, technical or legal systems
Geographic focus	On local problems (e.g. pollution)	On global issues (e.g. global warming)
Identity	Closely link to other anti-establishment causes	A separate movement embraced by many elements of “the establishment”
Source of support	An intellectual elite, and those at the fringes of the society	A broad base
Basis of campaigns	Used forecasts of exponential growth to predict future environmental problems (e.g. limits to growth)	Uses evidence of current environmental degradation (e.g. the hole in the ozone layer)
Attitude to business	Business is the problem. Generally adversarial	Business seen as part of the solution. More partnership formed.
Attitude to growth	Desire for zero growth	Desire for sustainable growth
View of environment/business interaction	Focused on negative effects of business activity on the environment	Focuses on the dynamic interrelationship between business, society and environment

Table 1 shows the differences between the environmental movement of the 70s and the 90s, highlighting the broader support to the movement and the research for a compromise with the economic growth and business. In fact while the environmental activists of 70s were in general hostile to businesses and plants (often seen as polluting), now they are seen in a different perspective if 77% of Europeans “believe that protection of the environment in general can lead to economic growth” (18). Media had a big influence in raising the environmental consciousness. News of ecological catastrophes such as large oil spills or the Chernobyl nuclear power meltdown on one side and information about world-size ecological problems like the ozone layer or acid rains really contributed to raising public awareness. (13)

Statistics show that nowadays the population of developed countries is almost (at least in what they say) completely aware of the environmental issue and “95% of EU citizens feel that protecting the environment is important to them personally”, claims the Eurobarometer 2011 (18). Environmentally friendly behavior is becoming part of everyday life, some of it is already taken for granted (18). Recycling is one of these behaviors: Figure 1 shows the composition of the destination of the

Municipal Solid Waste in Europe, the percentage which is recycled was increasing in the last decades and is expected to increase. This behavior, sometimes virtuous and sometimes forced by public administration, is very important if we think that every European produces on average almost 444 kg of waste per year. (19)

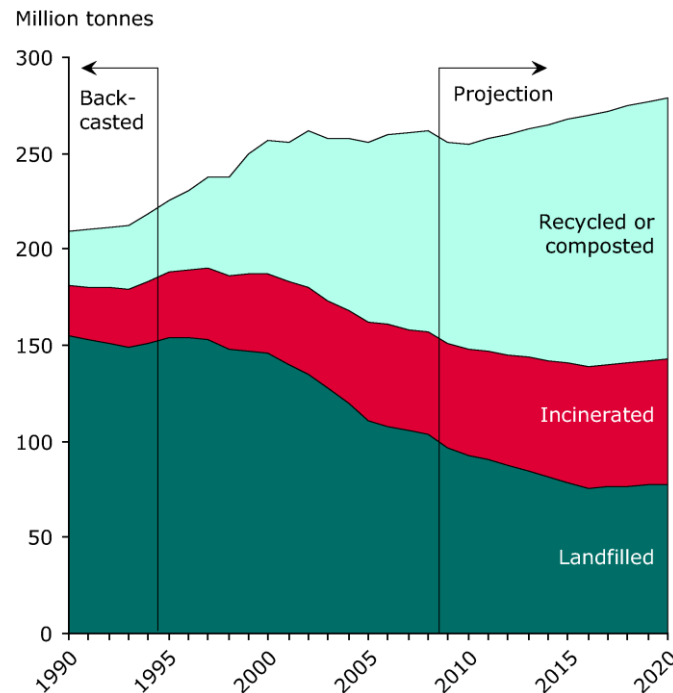


Figure 1 - Municipal Solid Waste in Europe at 27 (20)

The reader can argue that in this introduction we are talking just about Europe and the US, which do represent just a slice of the world in terms of population and consumption. In fact, until now the studies focused on green behavior were always associated with mature markets but recently surprising results have been found in developing countries, showing an unexpected level of environmental concern and attitudes (21) (6).

THE ENVIRONMENTAL ISSUE AND THE MARKET

The importance that the environmental awareness was getting among consumers made it necessary for every big firm to adapt their strategy to the new environmental issue (22).

Nowadays most of the important companies have Corporate Social Responsibility that includes their environmental priorities. More deeply, companies begin to understand the need to include an environmental dimension to their strategy, and while some of them are always claiming their efforts in implementing green procedures (for example, McDonald's publicizes its recycling and package reducing efforts), others are not marketing green efforts despite heavy investments (such as Coca Cola) (22).

The main reasons for a company going green, according to Chen (23) are:

- Compliance with environmental pressure
- Obtaining competitive advantage
- Improving corporate image

- Seeking new markets or opportunities
- Enhancing product value

As we can see the effort of a company in doing something green, in general, produces effects in a broader perspective, but can also have influence on the brand image. Researchers are studying how this behavior affects the intangible brand equity (23).

Governments have an important role in this. Through their policies and their initiatives they can contribute to setting up new environmental standards. Minimum environmental standards in practical terms consist in “green barriers”: if a product doesn’t accomplish the standards, it can’t be sold in the EU.

Other policies which can be taken by governments and public administration are monetary (subsidies to some products or taxes on others) or of different natures (for example several cities require cars entering historic city centers to be rated “low emission”).

Governments can also be an active part of the market by promoting eco-labels, but this topic will be discussed later more extensively.

EU and sustainable development

The European Union already showed great concern towards the environment, actively promoting sustainability in the market and is a leader in environmental policies. Particularly the European Union (EU) plays a prominent role in the world market because it is responsible for the world’s biggest mature market (24).

EU’s Environmental Policy is based on two recurring themes: sustainable production and consumption policy. The actions of the EU within this framework move in the direction of “improve the overall environmental performance of products throughout their life-cycle, to boost the demand for better products and production technologies and to help consumers in making informed choices” (8).

The main instruments the EU is using towards this goal are the adoption of eco-labels and the setting of minimum requirements to access the market: on one side they boost the consumer information and on the other they force the producer to meet some environmental standards. Particularly it sets forth the target of achieving a so-called sustainable development, e.g. an economic growth that does not imply the depletion of the environment. Basically, we can summarize the reasons behind the “sustainable development” concept in a simple relationship:

- economic growth is vital to our economies: non-growth or recession is an undesirable situation for an economy and lead, for example, to unemployment (as observed by Okun’s law (25)). Economic growth and fast technological progress characterized the last centuries and allowed a new welfare.
- at the same time inexperienced environmental issues and resource exploitation (at least on a planetary-size) came to the world-scene, suggesting that this rhythm cannot be kept for a long term (26).

Nevertheless there is no complete uniformity: the *sustainable development* concept was recently challenged by some authors, who discussed the radical incompatibility between continuous economic

growth and social and environmental sustainability. (27)

2.2 GREEN PRODUCTS AND GREEN CONSUMPTION

As Peattie points out, environmental concern as a phenomenon began to exist in the US in the 60s and it was strictly connected with the action of green activists. But in the following decades the focus switched on global-size issues, such as ozone depletion and global warming (17): the environmental concern was rapidly spreading all over the world. At the moment, data shows that almost the entire population in developed countries is aware of the relevance of the environmental problem and they feel they can do something about it. (18)

The rise of the environmental concern among consumers in the world directly triggered a trend of “green” consumption (13). Firms were attracted by these markets because of the possibility of capturing a premium price, so they offered “green” products to match demand from consumers.

The big problem with green consumption was that the firms attempting to capture this premium price (or to have a better reputation) were appearing greener than they really were. Claims were made about their supposed eco-friendliness however these firms were either only meeting minimum standards or purposefully confusing the consumers: this is called “green-washing” (28). This practice is possible since there is a big information gap between the consumer and the producer.

The instruments allowing firms to certify the greenness of their products are called “ecological label”, or “eco-label” and can be established both by governments or NGOs (7).

Marketing theory suggests that consumers are available to pay premium prices to seek a benefit in a product (29), in this case the “greenness” of the product is the attribute which is evaluated and increases the benefits. Unlike most of the marketing cases, the benefit obtained by the purchasing of a green product is rather intangible and of altruistic nature. If the consumer decides to pay a premium price for a faster car, the consumer obtains the immediate benefit of reaching high speeds and of a high status. If a consumer purchases a green car the direct benefit obtained is considerably less tangible, and it is more likely an altruistic behavior since the benefit (to have a less polluted environment) is for the whole community.

A green product is a product which has less environmental impact than others, yet as Ottman points out *“No product is 100% “green.” So, considering that all products use energy and create waste, green is a relative term. One product is greener for someone at some time in some place”* (30).

Several issues arise when considering green products in literature: for example greenness is often considered as a vertical attribute, social and environmental issues are often considered together, green products are considered as one even if their definition varies a lot according to the product category, as Ottman explains (30).

DEFINITION OF A GREEN PRODUCT

The word “green product”, commonly used to indicate a wide range of products, wasn’t born with a specific definition. We already underlined the comparative nature of this definition, which is not absolute since it needs a meter of comparison: there is no absolute green product, what we call “green products” are the greener products among others.

Here we present some of the definitions collected by D'Angelico and Potrandolfo (31).

A product is green *"when its environmental and societal performance, in production, use and disposal, is significantly improved and improving in comparison to conventional or competitive product offerings"*, defines Peattie (32), highlighting the necessity of taking into consideration the whole life cycle of a product, not just the use phase or the production.

"Although no consumer product has a zero impact on the environment, in business, the terms "green products" or "environmental product" are used commonly to describe those that strive to protect or enhance the natural environment by conserving energy and/or resources and reducing or eliminating use of toxic agents, pollution and waste" is the definition of Ottman et al. (3), distinguishing the main types of environmental focus.

The Commission of The European Community defines green products as the ones that *"use less resources, have lower impacts and risks to the environment and prevent waste generation already at the conception stage"* (33).

The necessary use of comparison in the "green product definition" implies its dynamic nature: what is a *green product* now may be a *brown product*¹ in some years if other products will surpass it.

The comparative nature of the green product definition implies also the necessity of a meter to establish the "greenness" of a certain product. Despite this, the impacts on the environment of a product life cycle are variable, ranging from global warming to fresh water pollution. The comparison between products in practice can be difficult and not so univocal since the various impacts on the environment cannot easily be "compacted" just in one value.

Another issue is that the ecological consumption is often seen as one side of sustainable consumption, which involves also the concept of ethical consumption. Here, coherent with most literature, we choose to refer to a green product just according to its environmental superiority, but we cannot forget that the ethical and ecological dimensions are tightly interconnected in practice.

GREEN PRODUCTS AND THE MARKET

It's important to understand how the population and its attitude are composed. Different levels of environmental concern and different levels of economic ability to support an additional cost for a "greener" product are just some of the components determining the attitude of a consumer towards green products.

Market segmentation is defined as "the division of a mass market into identifiable and distinct groups or segments, each of which have common characteristics and needs and display similar responses to marketing actions" (11) and it's vital when marketing a product to shape the marketing strategy on the target groups.

In this case, it was necessary to divide the population into categories depending on their attitude towards the purchasing of green products. Research has focused especially on how to identify the "green" consumer.

¹ In Green Marketing literature *"brown product"* is used as opposite to a *"green product"*, they are products which are not environmentally friendly.

More deeply, a segmentation used by the Roper Organization and nowadays common in literature, divides the consumers into 5 categories, ranging from true blue greens to basic browns.

Here we'll examine report surveys, the first one is the Roper survey (2002) and the second is the Roper Green Gauge (2007). As we can see in Table 2 and Figure 2 it highlights the enormous increase in True Blue Greens and the correspondent fall in Basic Browns. Similar results were found in OECDs segmentation (34).

Table 2 - American Consumer Segmentation in 2002 and 2007 according to Roper Green Gauge (1)

True blue greens	9 %	30 %	Strong environmentally conscious, take it upon themselves to try to effect positive change
Green back greens	6 %	10 %	Not politically active but willing to pay extra for environmentally friendly products
Sprouts	31 %	26 %	Believe in environmental causes in theory but not in practice, usually don't pay more for green products
Grouzers	19 %	15 %	Cynical toward environmental issues, think green products cost too much and are worst performing then competitors
Basic Browns / Apathetics	33 %	18 %	Do not care about environmental and social issues

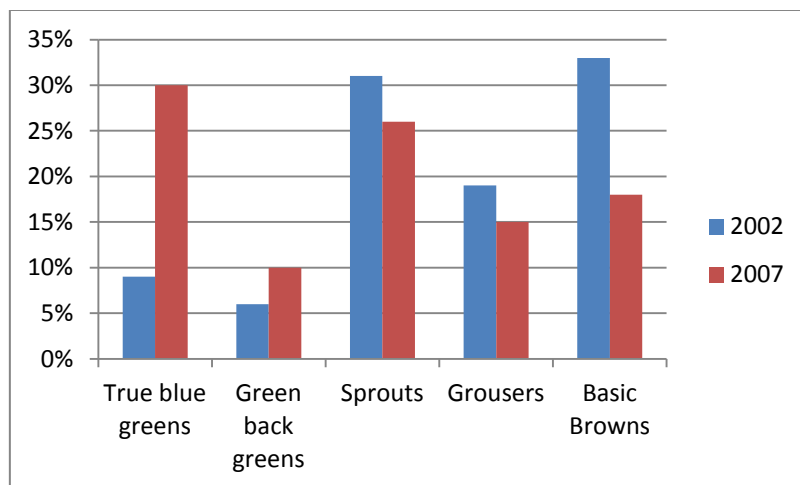


Figure 2 - Changing market segmentation in US

All the market research shows that a large part (which is increasing) of consumers is ready to spend money for the so-called "green" benefit.

Despite this encouraging trend, there is an enormous potential audience for green products (59% of Europeans are in this situation (18)) which still “have not crossed the threshold between intention and action”. They need to be appealed to with specific marketing initiatives (35).

As we can see, there is a huge gap between a widely spread environmental concern and the “green consumers” which attracted considerable effort in scientific literature (35).

A second, considerable gap, besides in the disproportion between declared green consumers (exceeding 30%, see *Table 2*) and market shares of eco-labeled products (usually around 3-5%) (36). Young et al., investigating the green consumers purchasing process, address the following key factors that will help green consumers to make a green purchase:

- the consumer's green value is strong;
- the consumer has purchase experience;
- the consumer has plenty of time for research and decision-making;
- s/he has good knowledge of the relevant environmental issues;
- green products are reasonably available and
- the consumer can afford and is prepared for the financial costs (36).

CHARACTERIZATION OF THE GREEN CONSUMER

Among the topics connected with green consumption, the “green consumer” was the one who attracted the most efforts (37) what can roughly explain the great interest behind this topic. The “green consumer” is the potential consumer of green products, and to characterize him/her would be a prerequisite for the launch of many green products. Market segmentation based on the demographic criteria is the most common market segmentation due to the availability and easy applicability of these data (38).

Many studies, especially in the first generation of green consumerism studies, try to profile green consumers based on the demographic criteria. Particularly they attempted to find a correlation between demographic variables and the environmental behavior or the environmental knowledge. Diamantopoulos et al. found that in the period 1966-94 39 studies were performed on education, 21 on sex, 35 about age and 21 dealing with social class (2).

Here, we will present the socio-demographic variables as reviewed by Diamantopoulos et al. (2):

- *Gender*: males show big environmental knowledge, while females show more environmentally friendly attitude and behavior. Eagly gives a theoretical justification explaining that women, as a result of social development, are more careful in considering the impact of their actions on others (39).
- *Number of children*: is a variable positively correlated with environmental behavior/attitude, researchers explain this with a bigger concern for the world inherited by future generations.
- *Education and social class*: both have positive correlations with environmental behavior. Particularly common is the justification that people having a higher income can bear the marginal cost associated with purchasing green products. The education was always linked with a higher environmental knowledge and behavior and it was confirmed by most of the

studies. When relating the environmental knowledge to the social class, there is not a uniform consensus.

- *Age*: has been explored by a large number of researchers. The general belief is that younger individuals are likely to be more sensitive to environmental issues (40), anyway on 33 researchers analyzed by Diamantopoulos et al. just 2 show a positive correlation between age and environmental behaviors (2).
- *Place of residence*: almost all researchers found that those living in urban areas are likely to show more favorable attitudes towards environmental issues (40).

Most of the studies try to identify groups with environmental knowledge, attitude and behavior, who are supposed to be the potential market for green products. The results of these studies are somehow ambiguous in profiling green consumers and don't give enough assurance for targeting.

As a result, the probable green consumer was described in several ways, sometimes contradictory (2). This has been addressed for several reasons. One of the possible is the geographical and temporal variety of the different samples which were object of analysis (2).

The relative weakness of demographics in profiling green consumers is of great managerial concern: if they are not suitable, a more complex segmentation and targeting approach is required.

Another strand of research shows that other characteristics are more effective in the description of the green consumer than the demographic criteria. They are called psychographic criteria, and environmental concern is one of them. (2)

Many disciplines, from psychology to political science, from environmental studies to marketing, got involved in the "hunt for the green consumer", and several instruments have been used in trying to profile him (41).

The research of the 90s and 2000s shows that there is positive correlation between some psychographic parameters and environmental behavior. We show in the following list the psychographic parameters reviewed by Straughan and Roberts (40):

- political orientation, these findings are connected with the general perception of being part of the liberal mainstream,
- altruism, or the so called social-altruism, which was examined by Stern et al. (42)
- the perceived consumer effectiveness, there is a general agreement on its positive correlation, and Roberts arrived to assess that this is the strongest predictor of Environmental Behavior (43),
- the environmental concern, a lot of studies have shown a positive correlation with environmental behavior,

Despite some agreement on their positive correlation, some problems arise in trying to consider these psychographic variables due to their nature. Some of these complications are:

- the assessments of the chosen measures
- inadequate theoretical specifications (the measures are taken from a number of different disciplines)

- the complexity of some constructs such as “environmental attitude” or “environmental behavior”

Beyond this, many authors underlined the contradictory nature of the links between environmental attitude and environmental behavior, and for this reason an analysis of the attitudinal components alone cannot determine an ecological behavior.

2.3 BARRIERS TO GREEN PRODUCTS

The ecological problem is imminent and world-size, and the notion/idea of consumerism that is prominent in western society and is expanding in the entire world is not sustainable for the planet. Green consumption seems to be the easier option for a consumer to contain the effect of his consumption while not changing his lifestyle (or changing it in a minimal way). (4) Despite this, green consumption had just a marginal success and still didn't become a mass phenomenon. Moreover, green marketing (the marketing of sustainable goods), which was presented as revolutionary, “*gives the impression of having significantly underachieved*” (44) The initial promises of green marketing were not fulfilled in the last 20 years. Anyway the responsibility of this fail cannot lie just in companies and marketers, since “*the market's current flaws make it incapable of delivering sustainability alone*” (44), especially when this is a target of the entire society. Anyway, the state of the art shows that there is continuous progress towards a greener consumption, even if it is slighter than it should be considering the immediateness of the environmental problem.

This section sums up the main reasons found in recent literature, hindering the diffusion of Green Products.

THE BEHAVIOR OF MAIN ACTORS

The content of this paragraph is mainly extracted by the noticeable work of Michael J. Polonsky “Transformative green marketing: Impedments and Opportunities”.

Consumers

The consumers usually think of themselves as the central actors in the market. In this anthropocentric perspective of the western consumer, the natural environment is considered as a resource to facilitate this satisfaction (45) not a “*stakeholder*” whom consumers and firms should take into account (46). This is why researchers point out that micro-changes to consumption will fail until this anthropocentric view underlying the DSP (Dominant Social Paradigm) will change (47).

Furthermore, there are other barriers in the consumer's perception:

- The perceived inability to make a difference in terms of environmental problems
- The fact that consumers discount future environmental problems more than other types of risk (48)
- Consumers often seek the ownership of a certain commodity, but what they really need is the service (for example, they don't think “I need transportation” but rather “I need a car”)

Firms

Marketing and management theorists proposed multi-dimensional measures of value, such as the TBL, Triple Bottom Line, which includes social and environmental. Despite these new theoretical propositions, in reality firms just focus on the financial bottom line. And “*a value concept that is based on financial returns and discounts the natural environment will see the environment as a resource to exploit rather than a partner in existence*” (4).

Polonsky also suggests that a good practice would be firms creating upgradable products instead of replaceable products.

Another point is that ownership of goods is always promoted, even when the consumer can focus on service, for example Toyota is working with the Japanese government whereby “people purchase transportation without owning a car” (28). But, the main obstacle to this comes from the fact that the ownership of some objects reflects one's self-identity (49).

Governments

Governments depend on popularity and do not focus on long term perspective and the possibility of radical changes, they are always focused on the short term. And sometimes the geographical dimensions of a country are too small to face a global problem.

What governments can do (and sometimes do) is to act with policies to subsidize green products or to tax brown products. In fact, what is evident is that the big advantage of the “brown products” doesn't carry with them the costs connected to the exploitation of the environment (4). Even with this fact pointed out, it is still not trivial to translate the concept into economic consequences.

CONSUMING DIFFERENTLY OR CONSUMING LESS?

The green consumerism philosophy is to switch progressively to greener products, sometimes forgetting that the greenest product is the one which is not produced. In fact, most critics of this approach underline that green consumerism is not enough if pursued alone. It can only be complementary to other consumption-reduction policies. In other words, they say there is too much emphasis on “consuming differently” instead of “consuming less”.

In fact the use of green products leads to waste reduction or energy saving when compared to the use of brown products, but does not significantly impact the lifestyle of the population, the so-called, Dominant Social Paradigm.

Particularly critics argue that the use of green products can be useful to perpetuate the process of overconsumption, by reducing consumer guilt because they feel they are taking some pro-environmental actions (4).

GREEN IS NOT ALWAYS PREFERABLE

In our considerations we always implicitly assumed “greenness” to be an attribute which can be positive to some consumers or indifferent to others.

Luchs et al. found out that the green feature in products is not always adding appeal to the product, even if most consumers care about environmental and social issues. Rather contradictorily, sustainability can be a negative feature for some product categories.

Particularly, sustainability in products seem to be an asset in categories in which gentleness is especially valued, such as personal care products, which can be a liability in categories in which strength is especially valued (50).

Since the present study focuses on food, a product where perceived strength is not important, it is not affected (these results can however have a large impact on other product categories). The relevance of this research consists in the fact that it challenges one of the traditional assumptions of green products' marketing studies: "green" is not always an asset, but it can be a deficit.

THE LESSON: ENVIRONMENTAL SUPERIORITY IS NOT ENOUGH

What is changing in the last year is the fact that Green Marketing is trying to appeal to a broader segment of consumers. This seems to also be the only effective choice for green products: why focus on a small group of "True greens" when there are lots of latent greens are possible consumers?

The challenge for marketers is bigger here; the main point is that these consumers don't evaluate the greenness itself. Generally, most consumers are not going to pay a premium just because of the "greenness" of a product.

An example of this can be the CFL (Compact Fluorescent Light Bulb) launched by Philips in 1994. It was energy-efficient and designed to become the main alternative to the traditional energy-intensive incandescent bulb. The low level of sales marked the failure of the product.

In 2000 Philips reintroduced the product emphasizing its 5-year lifespan under the name "Marathon" and advertised the savings of more than \$ 20 during its lifespan if compared to traditional incandescent bulbs, and the new product was awarded an energy star label by the EPA. In a recent poll, 51% of US consumers declared they bought CFLs in the last 12 months (5).

The same product, presented under a different light, was a market success. Ottman points out that this example provides a valuable lesson on how to avoid what she calls "the Green Marketing Myopia": "marketers must fulfill consumer needs and interests beyond what is good for the environment".

In fact, the experience shows that it is possible to reach a broader segment of consumers (beyond the traditional green consumer group) by appealing to them through other features. These consumers, which still are the majority, won't buy a product just because of its greenness, they want something else : they decided to buy CFLs because of their convenience, not just because of greenness (3).

Some other examples of market success of green products seem to confirm this trend:

- NaturaLine is a Swiss supermarket brand which provides organic fiber clothes at the price of conventional clothes: the absence of a premium price allows them to target every consumer (51)
- Patagonia provides organic fiber sport apparel, but in this case the environmental performance "completes the positioning strategy rather than dominating other criteria" (51)

- Prius, was the first hybrid car with considerable market success: it was found that the main reason for choosing this car was to purchase symbolic values (52). In fact one of the reasons of its success was addressed to its fashion appeal and the fact that it was associated with the image of celebrities owning the car. The trend was labeled “eco-chic”.

As we saw, depending on the product category, other benefits are always connected with greenness, which are commonly efficiency, health and safety, performance, symbolism, status, and convenience. (3) Environmental benefits should be credible and certified but cannot be the only ones if the purpose of green products is to appeal to a broader segment of consumers. And appealing to a broader segment of consumers allows economies of scale and a broader environmental impact. Environmental superiority is not enough.

WHAT IS MISSING IN RESEARCH

Gap motivation-output

As pointed out by Peattie researchers never investigated “the potential disconnection between the motivation for and the environmental impacts”, which is considerable in some cases. For example a vegetarian diet may reflect religious convictions or personal health concern, but has a considerable (positive) impact on the environment (53). Therefore a behavior which is not perceived as green can have a better impact on the environment than one that claims to.

Outcome

Some investigators try to analyze the outcome of green behaviors, and sometimes its real efficiency has been challenged: Speirs and Tucker (54) suggest that often a consumer driving to recycling “bring sites” can expend sufficient energy to outweigh the energy and material savings involved. Therefore what we call a “green behavior” (recycling, in the mentioned case study) is not automatically the best choice for the environment.

Environmental Concern

Environmental concern is an umbrella concept which covers all the possible green issues, Zimmer et al. counted 57 issues (55), spacing from concern about waste to concern for wildlife. To say that there is “an environmentally concerned market segment” is not enough, because the structure of environmental concern has high variability across the population (55).

Moreover, researchers were often disappointed from the weak relationship between environmental concern and green purchasing behavior. Recent psychological findings suggest that environmental concern should not be seen as a direct determinant but rather as an important indirect determinant. (56)

Eco-labels: Simplicity or detail?

Teisl and Roe found just one research evaluating the welfare implications of information policies (57). The fact that the population is variegated regarding environmental knowledge, time available and

cognitive capacity make it particularly difficult to understand what the optimal level of detail of an eco-label is. There is no research known to the author exploring this issue.

Developing countries

The research traditionally focuses on developed countries as consumers of green products, while recent multi-country studies show that research should enlarge its geographical range. In 2008, among the consumers expressing concern about climate change, the proportion that could remember buying an explicit green product was highest in China at 76% (over the global average) and in the same country a lot of positive behavior towards environment was described (21).

The reasons behind this eco-friendly attitude in china are different from western eco-friendly behavior: Darryl Andrew, Synovate's CEO for China, explains that the actions are the same but the reasons are different. For Chinese people, purchasing a green product has a lot to do with the concept that *“Chinese people act green for two reasons: one, they look to the government for guidance and the Chinese Government is making decisions like power restrictions and plastic bag bans; and two, they have a very real desire to stay safe”* (21).

2.4 STUDENTS AS GREEN CONSUMERS

STUDENTS AS CONSUMER GROUP

The possibility of using students to represent the whole consumer sample has been widely investigated in literature, mainly because they are a convenient sample. It was shown that students are socio-psychologically different from other consumer samples, and these differences are manifested in decision factors and information preferences (9).

Hence, students' response patterns don't represent the general consumer (9). Rather, research on students as population can disclose insights on their consumer behavior. The reasons why international marketers consider young people as a possible target market have been resumed by Lee (58):

- they have purchasing power,
- they have influencing power in their parents' and friends' purchasing decisions,
- they welcome new and innovative ideas,
- their anticipated lifespan is longer.

Restricting the focus on students, their purchasing power grows when they get a job. And it's known that the possibility to afford the financial costs is one of the key factors in green products purchasing (36).

Other reasons of interest can be found in the controversial expectations offered from demographic research. In fact we can basically agree that students differ from generic consumers because they have a low income and a level of high education. The first was generally negatively related to environmental behavior, the second element, positively.

STUDENTS AND GREEN CONSUMPTION

In fact, the students of today belong to the so-called “Y generation”, which is the generation which is more inside consumerism, and are the workers and the consumers of tomorrow (59). Understand their

consumption patterns, their attitude towards green products and how to appeal to them, can become a critical factor for the success of a green product.

The members of this generation are nowadays between 20 and 30 years old, and have grown up with the computer and the internet. They are the first generation in which being green is an integral part of the educational system, spacing from reusable water bottles in school canteens to masters' courses focused on sustainability (59).

Despite their (future) relevance as consumers and their singular characteristics, the number of studies focused on them is still limited.

Indeed, there are several reasons why research should pay attention to them. Particularly it was found that students are more likely to be heavy green consumers (60).

Moreover, while political declarations idealize the role of the 'consumer as citizen' (61), young people recognize this discourse, they speak of 'saving the planet earth', 'of doing your responsibility' and 'being one of many making a difference' (62).

STUDENTS AS CONSUMERS OF GREEN ELECTRICITY

In an interesting analysis of Gossling et al. (63) in which students show a large positive attitude towards green products purchasing, 99,7 % of them show a positive attitude towards green electricity. This translates in willingness to pay (WTP), which is shown in Figure 3.

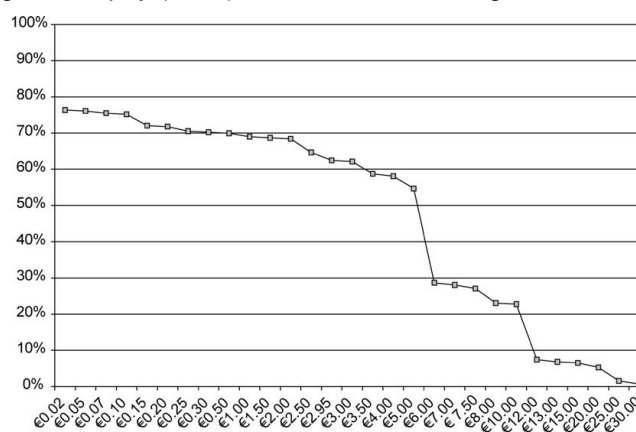


Figure 3 - Students WTP for Green Electricity in Gossling et al. study (56)

Despite this their knowledge about green electricity is limited, they often don't know how much energy they consume, and just half of them can say the correct name of their supplier.

The authors explain: *"There is a complex paradox surrounding the perception of costs of green power products. With virtually no exception, students claimed green power products to be (too) expensive. However, this notion of expensiveness is not grounded in factual knowledge of energy prices as most students have no idea how much money they pay for electricity, or how much energy they use"*. A possible explanation of their actual disinterest can be the fact that they live in flat sharing and often they don't know how much they consume and the contracts are managed by the owner. (63)

And they continue, *"the perception of expensiveness is arbitrary"*. And findings seem to show that this conclusion is reflected by the reality from their contracts in which conventional supply is preferred just

due to the routine. It is also said that even if it is declared a WTP of 2 €, since they are not aware of their consumption they don't know how much this will add to their energy bills.

The authors underline also the point of credibility: these students which are likely to switch to green products want the company to provide "true green" electricity and since they are also well informed and the necessity of a reliable label is even more important (63).

COMPASSION WITHOUT ACTION

Margee Hume in her paper "*Compassion without action: Examining the young consumers consumption and attitude to sustainable consumption*" and according to research findings (59) describes a generation where their strong consumer value has not translated into practice (10). Young consumers are completely aware of the environmental issue but they don't reflect this in their behavior, "*a clear pattern of contradiction exists between what they know and they practice in regards to sustainability efforts*", she explains (10).

The picture resulting is of a generation that has wide access to information and is often skeptical about the authorities (5). They are aware of the environmental problems, but this is not often translated into eco-friendly practices.

Eurobarometer offers interesting insights on the environmental opinion of students: for example students present the largest consensus (among the other groups) on the fact that the effective use of resources can boost the economic growth in the EU, 88% of them agree with that, unveiling their optimism for a sustainable development (18).

Authors highlight that education plays a prominent role in shaping Europeans' environmental attitudes, which is a considerably higher rate of environmental activity among people with a better education (18). The result matches the founding of demographic literature about the positive correlation between education and environmental knowledge and behavior, better education means higher probability of green products purchasing (40).

On the other side, the ambiguity of students as a consumer group, besides mainly in their characterization of having a lower income, usually they are just depending on their parents or they have work while they are studying. Vice versa a lower income indicates lower probability of being a green consumer (40).

While demographic data offers contrasting forecasts, the specific literature doesn't give uniform previsions on students behavior.

Our analysis, different from past literature, is instead aimed to understand students' consumer behavior and if they really consider green products as an option, or if what really matters to them are other features of the product and that they are not willing to compromise on other features. Despite this, we think that students are not likely to face consumption issues such as the choice of the energy contract (63) and that most of them don't have the possibility to pay high premium prices, this makes them unlikely consumers of certain expensive green products. To do this, as explained, we decided to focus on some known food labels, each of them with their own characteristics. Each of them has different promoting institutes, and we can expect, different credibility

behind them. Each of them targets different issues, some more specific (such as dolphin safe labels or fair trade) and some with a more general program (such as MSC). In fact among all the industries food is the least expensive and is likely to be part of the daily routine of each consumer. Not all the students live in the same situations, not all of them live alone and they don't have all the same income, but a demographic segmentation can be made out of that.

3 THE ECO-LABELS

3.1 ECO-LABELS: AN OVERVIEW

We can summarize that the main reasons which led to the eco-label's creation were:

- *the information gap between producer and consumer*, particularly that the information available to the consumers doesn't allow them to understand on their own if a product is green or not; some products which are called "credence goods" cannot be distinguished when green or not green;
- *the appeal of the "green" attribute*, which is a valuable attribute for the consumers (or at least for some of the consumers),
- *the costs connected to the green attribute* (a green product is expected to be more costly to produce and develop than a traditional one), which sometimes forces firms to make their products appear greener than they actually are, practicing so called "green-washing".

BRIEF HISTORY OF ECO-LABELS

The first eco-label was the *Blauer Engel* (the Germany's Blue Angel), which certifies the environmental friendliness of several product categories. Following its example other states created their own eco-label.

Nowadays some eco-labels, such as The Blue Angel, cover a lot of product categories. In this way consumer knowledge and trust can be applied to every purchase, while others are specific for a product category and usually address one specific issue (such as Dolphin Safe label for the tuna).

Nowadays these labels are released by various entities (Governments, ONGs...) and affect almost all product and service categories, from food to tourism (64).

Particularly, regional programs are emerging to avoid the proliferation of national labels. In this context in 1991 the regulation establishing an EU Eco-label Scheme was agreed by the EU Environment Ministers at the Environment Council (65) and defines the reduction of environmental impact as minimization of

1. Use of natural resources and energy resources
2. Emissions to the air, water and soil
3. Generation of waste and noise and underlines that the basic tool to evaluate the impact on

the environment is the Life Cycle Assessment (65).

An increasing number of consumers is proved to recognize eco-labels (3), and they are a key instrument, transmitting the environmental compliance to the consumer in a certificated way.

Labels often take the form of "seal of approval": this is a kind of binary eco-labeling, in the form of pass/fail. It's the simplest way. It benefits consumers' understanding and market studies (it splits the market in two, who has and who doesn't have the label (66)) but can resolve in an oversimplification. EPA classifies also the "report cards", an information disclosure label using a standardized form to quantify the impacts of a product on the environment, while single attribute certification certifies the compliance with a program (67). The report cards provide the consumer with more complete information while a seal-of-approval program is more widely understood (and used) by consumers.

The proliferation of eco labels in the past two decades made it necessary to evaluate them and understand the key factors in an eco label in order to evaluate if it's well built and successful. This is the branch which absorbed a considerable amount of research in the last decade.

Schumacher resumes the three points to evaluate an eco-label: Product differentiation (based on objective criteria), Reliable Labeling and Reducing Information Asymmetries (68). Particularly with the large availability of labels arises the problem of reliability. In fact, since the consumer cannot be sure of what he/she is really buying, the eco-label for the consumer who wants to purchase green products is a tool to reduce uncertainty (68). And the more reliable a label is, the less uncertainty there is towards the greenness of that product. In other words, if an eco-label is more reliable, the consumer is more likely to pay a premium price for that product.

LABEL'S CLASSIFICATIONS

The ISO classifies eco-labels in three types according to their nature:

- Type 1: labels compare products with others within the same category, awarding labels to those that are environmentally preferable through their whole life cycle. The criteria are set by an independent body and monitored through a certification or auditing process.
- Type 2: labels are environmental claims made about goods by their manufacturers, importers or distributors.
- Type 3: labels list a menu of a product's environmental impacts throughout its life cycle. They are similar to nutrition labels on food products that detail fat, sugar or vitamin contents. The information categories can be set by industrial sectors or by independent bodies.(69)

Unlike type 1 labels, type 3 labels do not judge products; they leave the task to consumers.

The EPA (US Environmental Protection Agency) makes a distinction between first party labels and third party labels. First party labels is a label provided by a business itself with the intention of highlighting a particular environmental feature of the product (67).

Since there are not independently verified and they don't use pre-determinate and accepted criteria for reference, we won't consider eco-labels the ones that ISO classifies as type 2 and the EPA as first party labels. They are more marketing claims and are not supported by verification, which is proven by the fact that labels of this type can accomplish very high environmental claims or meet minimum standards, or they can be a form of "green-washing".

What we are referring to with the word eco-label, are the labels verified on an independent third party. They are separated into voluntary or mandatory categories. An example of mandatory labels is the EC label for "energy using products", for example refrigerators and washing machines. In this case the consumer can compare the products through a simplified table.



Figure 4 - The EU eco-label

The European Eco-label (Figure 4) is an initiative by the European Commission and an integral part of the Sustainable Development program. It is a voluntary label, e.g. the producers can decide themselves whether or not to join the scheme, and takes the form of a seal-of-approval. Its peculiarity is that it can be applied to products belonging to different industries, having a vast range of application.

In the complex scenario of labels, European Eco-Label deserves to be mentioned for its peculiarities: it's part of a broader program, it's actively promoted by a strong institution, and it has ambitious objectives. While other labels address a single issue or a single part of the product life, EU eco-label is always taking in account the cradle-to-grave cycle when defining the standards. It's a complementary action to the always more restrictive minimum requirements to access the market established by the EU, and clearly proposes to stimulate the clean products' development and marketing.

What we said until now and the support from a powerful governmental organization such as the European Union make this label an important element in the current green products panorama.

Here we present an overview of the situation in the main industries.

Cleaning products – relatively low market shares (less than 1% in Denmark), but in this industry other labels co-exist and seem to have more popularity (such as the Nordic Swan). There are 26 labeled producers in the European Union.

Electronic/Appliances – it is available just for some appliances, TVs and PCs. The eco-label here is focused mainly on consumption, durability through upgrades, recyclability and an after-use disposal provided by the manufacturer (8).

Household Appliances – Is available for light bulbs and heat pumps (8). Thus, in this sectors the energy efficiency is particularly important because the domestic use represents the 29% of the total energy consumption in European Union and is expected to grow (70).

Paper Products – EU label in copy paper assesses the sustainability of the forests where virgin fiber comes from and the emissions in the life cycle, while stricter parameters there are for tissue paper (which involves the use of chemicals as softeners) (8).

Textiles – Certifies a reduced used of resources in the production and the absence/limitation of hazardous substances (8).

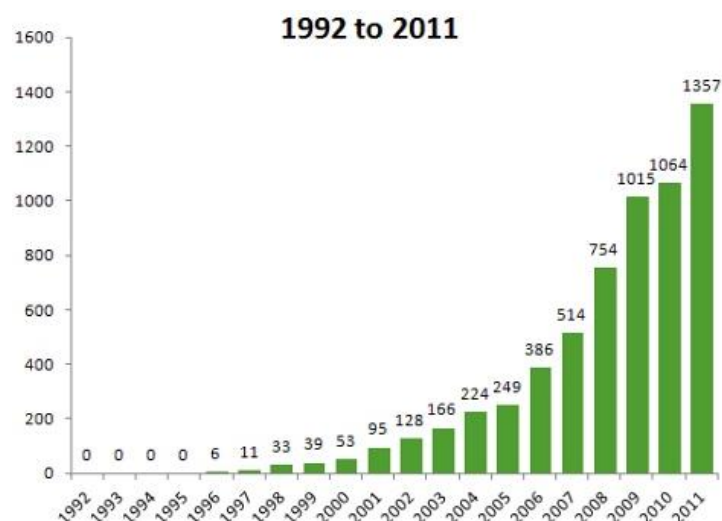


Figure 5 - Total number of licenses issued for the EU eco-label in the last 20 years (14)

ECO-LABELS AND GREEN PRODUCTS ACROSS THE INDUSTRIES

The present work, for necessity focuses only on a particular case, the food industry,(and some particular products and labels are chosen). But labels have been applied to a full set of products (as *illustrated in Annex B*) and their situation is rather peculiar. In Table 3 specific market status is presented in a brief overview which can be useful to the reader who is not domestic with environmental impacts. Eco-label promoters reached different results across the industries.

It can be shown that green products need time to become mainstream. For example, while eco-detergents already have a solid tradition and a big market share, organic clothing is still a marginal phenomenon.

Another point is that the importance of consumers is growing because of market liberalization, for example the choice of renewable sources of power is not just on governments but depends on consumers choosing green electricity.

Table 3 - A brief overview on industries' situation (extract from Annex B)

Industry	Market situation
<i>Cleaning products</i>	These products were among the first to be regulated in 70s because of the consequent pollution. Surveys point out that nowadays eco-friendly detergents are the top-choice of approximately half of consumers in the biggest European countries, showing a big consensus to green products in this industry.
<i>Electronics/Appliances</i>	European Energy labels are mandatory for appliances to be sold in the EU (classifies every appliance into a class, mostly spacing from A to G). It was shown that consumers use it and understand its message. (68) Enhanced marked sales of energy-efficient appliances in the years

	immediately following its implementation (66) and the premium price consumers were available to pay (70) confirm the success of this scheme.
<i>Automotive</i>	Reasons of concern about this industry are that transport is the second sector for Co2 emissions and the greatest cause of air pollution in towns. The EU's answer was the European Emission Standard, classifying every vehicle into a class, from Euro0 to Euro5, and pushing the industry to produce cleaner vehicles in this way. Really less polluting alternatives are electric cars (but they were mostly a market failure) and hybrid cars (which, especially with the Prius, have known great market success).
<i>Electricity</i>	The progressive deregulation of the Communitarian Market allows citizens to choose their own electric supplier and they are informed of the energetic sources of their contract: electricity became a market similarly to the other products. Green energy accounted for around 10 % in the European market in 2008.
<i>Clothing</i>	In a typical apparel life cycle most of the environmental pollution comes from the use phase, which is depending mostly on the appliances and on the use. Instead, the main reason of concern within this industry is the cotton cultivation: it covers 2,5 % of world cultivated lands and uses 16 % of the world's insecticides. Despite this organic cotton is still a niche market.
<i>Tourism/Restaurants</i>	The difficulty in considering the whole Life Cycle of a product of this industry is the reason why eco-labels mainly focus on a single issue, such as the blue flag. But increasing attention was seen by consumers, who are available to pay premium prices for meals and holidays which are healthier and do not damage the environment.
<i>Buildings</i>	In Europe a certification is mandatory remove comma here when a building is sold or rented, and an Energy Performance Certificate is available to the buyer and contains key items of the property. The certificates present (in a scale from A to G) the house energy performance level, (and with an analogue scale its emissions of CO ₂). In the next years, relatively low premium prices (and increasing savings from bills) are expected to boost the market of "green buildings".

3.2 FOOD INDUSTRY AND CHOSEN LABELS

THE FOOD INDUSTRY AND THE LABELS

After a general overview of the market situation across different industries, we describe here the food industry scenario. A more detailed analysis will be performed here, because even if the work aims to investigate a general relationship between students and labels (without focusing on a particular industry) food was chosen as a “particular case”.

Given the variety within the industry, few problems are general and often most of the problems refer to a specific product or group of products. We can argue that main ecological problems connected with the food industry are:

- the sustainability of marine resources (most of them are overexploited)
- the massive use of chemical pesticides and fertilizers (with deriving soil pollution)
- the Co2 emissions in the life cycle. (74)

In this context it's interesting to point out that there are also few labels connected with Co2 emissions, but they are of marginal relevance. That's surprising because grocery goods are involved in around one third of UE emissions, but the possibility of a carbon-label for these goods is still being studied. (74)

To this list of problems it is necessary to include the social implications of the cultivation of some particular goods in the third world, especially when farmers have less economical power. The eco-label answer to these issues is spread in 147 food labels (catalogued by EcolabelIndex.com). They mainly aim to guarantee the social sustainability of the farms (as Fair-Trade brand), the organic production of the good, and the sustainability of marine resources. (75) A first observation reveals a big variety of available food labels, but almost none of them are considering the whole food life cycle, and usually they just refer to one particular issue. Food and drinks are (with medicine) the only categories of everyday consumer goods excluded by the EU eco-label. Recently a feasibility study has been commissioned for them (12) but it's noticeable that differently from other industries, most known labels here are not governmental (see Table 3).

THE CHOSEN LABELS

In the choice of labels to be submitted to students I decided it was opportune to represent the wide horizon of food labels and the issues they cover. Since this research focuses on consumer behavior rather than on the quality of labels it was decided to choose labels characterized by large diffusion and popularity among consumers.

For these reasons, the research will take place around four labels, namely Fair Trade and Organic for coffee and MSC and Dolphin Safe for tuna. In this way an exhaustive representation seems to be pursued.

Fair Trade label



Figure 6 - Fair Trade label

The Fair Trade label (Figure 6) is a label provided by the Fairtrade Labeling Organizations, which groups 25 organizations (76). Since it accounts mainly for social problems, it's a rather ethical label and, therefore, cannot be considered a truly eco-label. It aims "to better distribute the benefits of trade, and promote empowerment among impoverished smallholder farmers, artisans and workers". Generally, the fair trade accounts for 1-5 % of the global trade in the specific agricultural commodities, and the market is growing at an annual rate of 10-25 % in many countries. The certification network included in 2006 586 producer organizations and 1.4 millions farmers (77). The consumer who purchases a coffee with Fairtrade Certification Mark knows that the coffee originated from circumstances in which farmers are paid a fair wage (1.26 \$/pound), can participate in credit programs and have a decent working condition (78). Coffee cultivation has a considerable socio-economical relevance in some regions of the world: it's the most important single commodity in tropical area export, accounting for nearly half of total exports of tropical products (79). The EU is the biggest world importer of coffee, and Germany is the biggest consumer in Europe. In Germany Fair Trade coffee market share is between one and two percent (but it is subject to a very fast growth) (79) .

Since it became perhaps the most popular ethical label, it was largely challenged in recent literature about effectiveness and transparency. In their study Getz and Shreck denounce that "*while the Fair Trade model approximates 'fairness' and 'equal exchange' in which consumers and producers are in partnership via trade, this partnership can be illusory at best*" (80). The main outcome of their work is that operationalizing agricultural production practices via third party certification is a complex process which can create a disconnect between the expectations raised by the label and its implementation on the ground. Most criticism has to do with the low level of farmer participation in fair trade networks and it's reinforcing the differences between northern consumers and southern producers (81).



Figure 7 – Traditional German Organic label and EU Organic label

As plants began to be shipped around the world instead of being cultivated in their land of origin, in the 19th century, they became victims of diseases and foreign pests. The implementation of monocultures also helped the pest diffusion. Chemical research seemed to offer an ideal solution to battling such pests. On the other hand there was concern about the nutrition of the crops and nutritionists argued that artificial supply of nitrogen, potassium and phosphorus make the soil health unimportant. Now it is clear that the massive use of such inputs results in a destructive cascade effect, negatively affecting the surrounding ecosystem's health (82).

Organic farming saw its exploit in the 80s and nowadays refers both to small-scale and large-scale production. Organic farming is a world trend, driven by a growing demand on a world scale of organic food (83). How the continents rank brings some surprises, with Oceania on the top when accounting the hectares dedicated to organic farming (Figure 8).



Figure 8 - Land under organic management by region(83)

The Organic products market is growing in Europe at an annual rate of 10-15 % (82).

Even if every single state has an Organic Label available, the communitarian legislation is already uniform-and the EU organic farming regulation has created a set of procedures to use the EU Organic Label. It substantially certifies that at least 95% of the product is organically produced (84).

In Figure 7 the traditional German organic label and the one from the EU are presented.

Market share in Germany was estimated at 3% in 2005 but the growth rate makes us suspect that it's bigger in the last years. A particularly high growth rate for organic products was found at discounters, such as Aldi or Lidl. (85) In fact, in Germany most of the organic food is sold in traditional multiple retail chains (41%) and a slighter but consistent slice in specialized organic food retailers (31%) (85) This data seems to support the feeling that organic food is not anymore a niche market but it is getting mainstream.

Coffee itself is one of the main agricultural commodities in regards to volume of trade and research on organic farming shows that among permanent crops², organic coffee represents the second main cultivated surface in the world, just after olives (86). Recent surveys show that 5,3 % of the world's harvested coffee areas are organically managed and this percentage is rapidly growing. (83)

Dolphin Safe Label



Figure 9 – The Earth Island Institute's Dolphin Safe label

Canned tuna is one of the most important seafoods in the world, in terms of quantity consumed. In the Eastern Tropical Pacific, where almost one fourth of the world's catch comes from, dolphins often associate with large yellow fin tuna. In some cases, dolphins were used as a way of finding and getting tuna. The indiscriminate use of large nets by fishers implied that dolphins were also killed, in a number that the US National Research Council estimated at 100 000 per year between 1960 and 1972, by only the US fleet. Since the fisheries began in the 1960s, six million dolphins were estimated to have been killed (87). Currently dolphin mortality is around 5 000 per year (88).

Dolphin safe labels were instituted in the early nineties to re-establish consumer trust by corporations, therefore, according to the ISO classification, they are type 2 labels. Because of their proliferation, Congress specified that no dolphin safe logo could be applied to the product if even one dolphin was caught. (88) Dolphin safe is rewarded as the first example of seafood eco-label and is often perceived as the most effective seafood label (89).

We chose here the Earth Island Institute's label (Figure 9) which is rewarded as the most important in terms of international market share (90) and is a third party label.

While it is confirmed that the label is considered by the canned tuna industry as primarily a marketing tool rather than an agent for helping to protect dolphin populations (90), it's unquestioned that its introduction coincided with a huge reduction in the phenomena of dolphin by-catches and helped to reassure public opinion.

² Permanent crops (FAO classification): land cultivated with crops that occupy the land for long periods and need not to be replanted after each harvest (80).

Decades after the introduction of this label it cannot be claimed to be fully successful since the threatened dolphin populations still have to recover (87). Evidence suggests that reduction of by-catches is not enough and other tools may be needed to ensure their recovery (87).

MSC label



Figure 10 - Marine Stewardship Council logo

The fishing industry is divided into large-scale industrial fishers, which make use of sonar technology and industrial nets, with advanced freezing and processing on board, and small-scale fishers, who operate in limited ranges and do not have access to the same technology. Small-scale fishers account for over 90% of the world capture and are particularly concentrated in developing countries. The ONU Food and Agricultural organization estimated in 2005 that 77% of the global fish stocks were fully exploited, over exploited, depleted or recovering from depletion. This situation can be mainly addressed to the increasing global demand for fish products and the expansion of the commercial fishing efforts. The decline threatens food security, employment, community survival and the greater environment.

In this context, in 1997 the Marine Stewardship Council was established by a partnership between WWF and Unilever, becoming completely independent two years later. It recognizes with its label (Figure 10) the products accomplishing this according to its standards. A factor that is improving credibility is that it complies with the general FAO guidelines for seafood products' eco-labeling. (91) A few years ago it still covered less than 1% of the world fish trade (92) while in the last year the labeling program reached around 6 % of all the wild seafood caught and the number of certified fisheries increased by 50% compared to the previous year (93). These numbers let us expect a continuous growth in the following years. Public opinion seems to be highly sensitive to the threat on marine fisheries: 87% of European consumers declare they prefer to buy eco-labeled seafood and 79% agree that the impact of seafood is an important consideration when they buy fish products (94).

Given this trend, *"there is little doubt that environmental stewardship is becoming the newly dominant mode of fisheries governance"* (95). Researchers suggest that it's time to address other issues within its schemes, which are still not addressed, such as the energy efficiency or other environmental aspects (91).

Despite encouraging diffusion, there is a widespread perplexity about the effectiveness of the MSC Program in achieving ecological improvements (96) (97), mainly because of the scarce results obtained until now (87).

Germany is the biggest market for this label, and its presence on the shelves was boosted by a number of retailers, including Edeka, Kaufland and ALDI (98).

3.3 LIMITS OF ECO-LABELS

RELIABILITY OF ECO-LABELS

How do we expect that even a green consumer will buy a green product if he cannot be sure if it's a green product? Especially after plenty of green washing scandals, the eco-labels are key instruments in certifying the authenticity of a green product to the potential buyer.

So an eco-label is in the consumer point of view a "reduction of uncertainty" about the presence of a real benefit, and the more a consumer is sure that a green product is really "green", the more he/she would spend money on this. (68) The graph in Figure 11 clearly explains this concept.

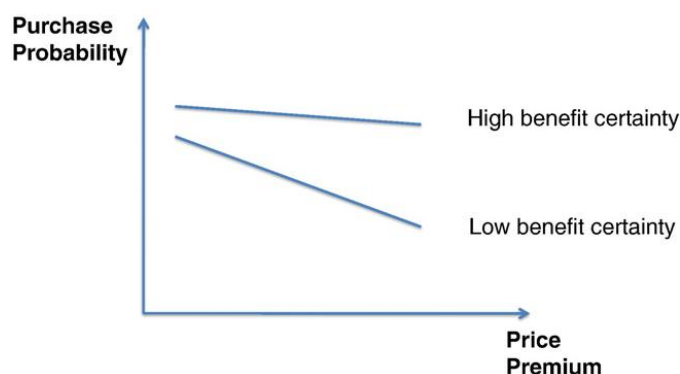


Figure 11 - The eco-label credibility effect (35)

This makes the reliability of an eco-label a key factor. This is why the conclusion of Van Amstel et al. can't be ignored, stating that the "*main shortcomings of the eco-labels were found in their ambiguity about environmental themes, their failure to assure the buyer about the product's ecological impact and the insufficient information about producers' compliance*" (7). Enhancing eco-labels and making them reliable should be one of the priorities of the governments and of the ONGs involved in their promotion.

The "quality" of an eco-label is something that is largely simplified in the literature on this subject, which approaches them as "all the same".

The quality of an eco-label refers to the number of steps from cradle-to-grave in the process of making the product (68). It involves creating better controls in terms of the supervisors and the work conditions of these firms and possible fines for those who disrespect the set rules (7).

ISSUES WITH ECO-LABELING

Authors are pointing out some problems with eco-labels. For example a company can fulfill the criteria but not detain an eco-label. Then consumers will have higher uncertainty or they might consider the

product a dirty product (68) and the same author underlines that it can be misleading to the consumer if the entire Life Cycle is not taken into consideration.

Recently the efficiency of food-labels was criticized by Van Amstel et al (7). In their analysis they point out that they “do not provide enough information to diminish the information gap”, questioning the way they adept their primary function.

Of the sample of eco-labels analyzed by the authors, there is a lack of a proper monitoring process to assess the correlation between eco-labels and an improvement in the environment. Furthermore, there is insufficient communication in producers’ compliance with requirements for eco-labels.

Nilsson et al. addressed the main reasons of limiting credibility in food labels (99), but their results can be easily generalized to other industry labels:

- There is no independent third party that formulates objectives, sets criteria, and follows-up compliance.
- The underlying values and objectives are not clear.
- Limited supply chain coverage.

The big issue that policy makers have to face when defining an eco-label is the optimum trade-off between simplicity and detail, which is “likely to *be different for different individuals and for different products*”. In fact within the population the “*cognitive abilities, consumer desires, and values of time*” vary a lot (100). This is a question which has not been readily explored in research, while in practice most popular labels, including the object of our analysis, are more simplistic (they are the *seal of approval*).

4 METHODOLOGY

The question arisen from the previous chapters is whether or not students consider eco-labels when buying something. Understanding the relation between students and eco-labels is the purpose of the work. The best method to answer this question was believed to be Conjoint Analysis, which is the most used marketing research method for analyzing consumers' trade-offs (101). Conjoint Analysis is any decompositional method that derives the structure of consumers' preferences by overall judgments on a set of alternatives (102). Such an approach implies that eco-labels are *attributes* of a product. Among the existing Conjoint Methods, Choice Based Conjoint Analysis was found to be the most suitable for this work (which will be discussed later). The inclusion in the questionnaire of some demographic questions allowed us to learn more about respondents and to segment them.

Since the judgment of the respondents is on a set of alternatives, a statistical method is necessary to calculate the part-worth utilities. Results obtained and possible biases occurred during the interview are discussed later.

4.1 CONJOINT ANALYSIS

A GENERAL OVERVIEW

Conjoint Analysis has its earliest roots in psychology, particularly its foundation is seen in the essay by the psychologist Luce and the statistician Tuckey (102). Since its introduction in marketing literature by Green and Rao (103) and by Johnson (104) it received a lot of attention both by theoreticians and by those who carried out the field studies.

Conjoint analysis is a decompositional approach, e.g. it derives the structure of individual preferences through overall judgments. This definition is opposed to the compositional (or self-explicated) approach, where the respondents are asked the importance of a certain attribute (102) and the total utility obtained by adding the separate utilities together (105). This is based on Lancaster's theory of demand, which argues that consumers derive utility not from goods directly, but from the attribute of the goods that satisfy consumers' needs and wants (106).

In conjoint experiments a product is defined by a set of *attributes*. Each attribute can assume a defined set of *levels*. For example, for the product *car* the attribute *color* can assume the levels *white*, *blue* or *black* and the attribute *brand* can assume the levels *Mercedes*, *Audi* or *Opel*. A product *profile* comes from the combination of different levels of these attributes. In this example, possible product profiles are a white Mercedes or a Black Opel.

The number of possible combinations dramatically increases with the number of attributes and of their levels. Conjoint methods do not ask the respondents to evaluate all possible product profiles, rather just a small sample of profiles are evaluated by the respondent.

There are three main approaches within conjoint methods (105):

- Full profile conjoint analysis. All attributes are included in every profile and the respondent evaluates or ranks the product profiles.

- Adaptive or Hybrid conjoint methods. Their basic idea is to integrate some self-explicated information in the conjoint experiment. This allows an increase in the amount of information obtained with the same length of the interview with respect to the other methods.
- Choice based experiments. The respondents will choose one product profile (the one he thinks is the most attractive) among a set of possible products. So here the respondents don't provide a rate or a rank, rather they provides choices among different alternatives.

The choice on which method to use should be made according to several parameters of the survey (such as sample size, number of attributes, possibility of using internet for the interview...) (107), but all of these methods have something in common. A particularly good design will result in lot of medium-attractive profiles and few very or zero attractive profiles. This allows us to understand more about the consumer's decision-making process.

And regardless of which method is used, it is necessary to use a statistical method to observe the utilities (since the experimental data are choices, rates or grades). (105)

PART WORTH UTILITIES AND IMPORTANCES

In fact, the underlying theory of conjoint analysis holds that a buyer places a certain part-worth (or utility value) on each attribute level, and that the overall utility of any product is obtained by summing up the part-worth values of its specific attribute levels. Therefore the utility of every product profile can be derived, including the ones which were not explicitly asked to be evaluated. (108) Part-worth utilities are derived from the experimental data through a statistical technique. They represent the "strength" of the preference placed to a certain attribute level when compared to the other levels.

Conjoint part-worths are scaled to an arbitrary additive constant within each attribute and are interval data³. Part-worth utilities are scaled to sum to 0 within each attribute.

Recalling the example in the previous paragraph, the found part-worths for the attribute *Brand* can be *Audi 0.70, Mercedes 0.20 and Opel -0.90*.

Even if they are already a finding of the experiment, they are computed later in the market simulator software according to the object of the research. From part-worth utilities one can derive the share of preferences, the purchase likelihood and the importances.

The last one is our case. The relative importance of each attribute considers how much difference the attribute could make in the total utility of a product. That difference is the range in the attribute's utility value (108). Note that differently from part-worth utilities, importances are ratio data (an attribute with importance 20% is twice as important as an attribute with importance of 10%).

In the car choice example, the importance of the attribute *Brand* would be $0.70 - (-0.90) = 1.60$ (*maximum utility – minimum utility*). If the study was limited to two attributes, color and brand, and the range of the utilities within the attribute color was 1.40, the importance would have been *Brand 53.3%* and *Color 46.7%*. In Annex C a more comprehensive example is provided.

³ An interval data permit the simple operations of addition and subtraction: a level with part-worth utility of 0.20 is not twice as preferred as a level with a 0.10 part-worth.

CHOICE BASED CONJOINT

The chosen method has been the Choice Based Conjoint, or the so-called Discrete Choice Experiment.

Differently from the traditional Full Profile Conjoint, the respondent is not asked to evaluate a product profile (or to rank them), his/her task is to choose one of several products. The respondents' task is similar to what happens to the consumer in the marketplace, and this is one of the reasons why it has found widespread use in packaged goods research and became the most widely used conjoint method among all market researchers (109). Specifically, asking respondents to make choices among sets of products is more realistic than rating them individually.(109)

The main "cost" the designer of the experiment has to pay for the increased realness is a loss of accuracy (when compared to other conjoint methods). In fact the choice among several options contains a poor amount of information, because the strength of the preference is not expressed (e.g. we don't know how much the respondent prefers one option rather than the others) and because there is no information on how he/her likes the other alternatives(107) (the possibility of including second or further choices should be avoided because of the small amount of attention paid by respondents (109)).

The advent of commercially available software for designing and analyzing Choice Based Experiments, and adoption of this method by market researchers has grown dramatically. (105) While most of the authors consider it as a particular case of conjoint analysis, Louviere et al. point out its radical difference with Conjoint Analysis. (110) Its theoretical base lies in the Random Utility Theory proposed by Thurstone in 1927 and later extended by McFadden to a multiple comparison.

Random Utility Theory proposes that there is a latent construct called utility existing in a person's head that cannot be observed by researchers (this is why it is termed latent), and assumes that it can be summarized by two components, a systematic (explainable) component and a random (unexplainable) component. This random component comprises all the unidentified factors that impact choices.

$$U_{in} = V_{in} + \varepsilon_{in}$$

U_{in} is the latent, unobservable utility that individual n associates with choice alternative I , and V_{in} is its systematic component while ε_{in} its random component.

The theoretical background of Discrete Choice Experiments makes it more consistent with economic theory and makes it more suitable for economic studies (110).

Beyond the more consistent theoretical background, with this method the respondent has to face a situation that is similar to the market place experience (e.g. the choice among different possible products).

The main alternative method would have been the Adaptive Conjoint Analysis, which combines self-explicated approach, and was found to be more interesting for the respondent (and is able to "grab" more information from each respondent) (107), but there is little theoretical background due to its recent development. Moreover it is recommended for researchers who are already experienced with Conjoint Analysis and seems not to perform as well as Choice Based Conjoint in the packaged goods experiments. (107)

4.2 DESIGN OF THE CHOICE BASED EXPERIMENTS

NUMBER OF ATTRIBUTES AND THEIR LEVELS

The design of a CBC experiment consists in several choices to undertake, the first of which is the number of attributes. In conjoint analysis, every attribute increases exponentially the complexity of the research. For example let's consider a case where every attribute is considered with 3 levels: a 4 attributes design would involve 81 (3^4) possible combinations, while a 5 attributes design would involve 273 (3^5) possible profiles.

Thus, in order to obtain the same predictive accuracy in each of the two cases, I would need a considerably larger amount of respondents in the 5 attributes case. This effect is to see if it's more noticeable in CBC which is a relative inefficient technique of data collection (the amount of information obtained from each respondent is low) (107). Fortunately, since CBC was widely used in the last few decades, there is a considerable amount of research on that and some good-practice have emerged. The number of attributes has been perhaps the most discussed design question, and generally it is not recommended to exceed the 6 attributes in a choice based experiment. (102)

Price and labels-attributes (binary attributes which indicate the presence/absence of a eco-label), needed to be accompanied by some quality related attributes. The choice of these quality attributes relied mostly on previous conjoint experiments: it was decided to keep the ones which have emerged as most evaluated by consumers. In coffee it was comfortable because of the availability of previous research (111) (112). According to these previous surveys it was decided to include Brand, Blend and Provenience. Chosen attributes and defined labels are presented in Table 4.

In tuna experiment because of the absence of a significant amount of research, in a careful choice it was decided to include brand (which, together with price is traditionally the most important attribute in packaged goods (109)) and Conservation Technique (which provides a first sub-division in canned tuna products). Table 5 includes attributes and defined levels in this second experiment.

Table 4 - Attributes and levels of the first CBC experiment

Product : Coffee (Roasted, 500g)	
Attribute	Levels
Price	3,79 4,69 5,59 6,49
Fair Trade Label	Yes No
Organic Label	Yes No
Brand	Store Manufacturer
Blend	100% Arabica Arabica&Robusta
Provenience	South America Africa non specified

Table 5 - Attributes and levels of the second CBC Experiment

Product : Tunafish (Canned, 120g)	
Attribute	Levels

Price	0,99 1,29 1,69 1,99
Dolphin Safe Label	Yes No
MSC Label	Yes No
Brand	Store Manufacturer
Conservation	Water and Salt Sunflower oil Olive Oil

Defining attributes and their levels is the most critical aspect in designing a conjoint study (111), because despite the availability of recommendations and previous experiments, it's widely discretionary and relies on the experience of the interviewer.

In the following points I underline some notes on the experiment:

- While Conjoint Analysis is often used to study market acceptance of a product, in this experiment the intention was to represent the available choices in the supermarket. The range of prices attempt to reflect those observed in main German supermarkets and discounts after in-site observations (Toom's, Lidl, Aldi)
- There is a large body of literature about the so called Number-Of-Levels effect, an undesirable bias according to which the importance of a certain attribute grows when its number of levels increases, both for psychological and analytical reasons (111). Moreover, it's known that the ideal Conjoint design is symmetrical (e.g. with the same number of levels for each attribute) but while most of the attributes are binary, price needs to have several levels in order to differentiate profiles. It's recommended not to exceed 5 levels (111), the author believed that 4 price-levels were a good trade off and allowed an effective real marketplace representation.
- Some limitations are intrinsic in Conjoint Analysis and prevent us from an exhaustive representation of the profiles. Attributes have to be objective (for example an attribute *taste* wouldn't be possible) (111) and the importance of some sensorial aspects (for example, the color of the package) would be underestimated if presented through written *stimuli*. Even if some previous studies include sensorial attributes (112) (113), they should be represented in multimedia if they cannot be adequately described in words (111).
- Without restrictions, the software will allow all product profiles including unrealistic ones (for example a 3,79 € Manufacturer Brand coffee). And this is undesirable because the presence of too attractive alternatives vanishes the trade-offs required to the respondents (the purpose of the CBC is to force respondents to trade-offs to understand his utility structure) (111). The software provides some solutions to this problem, such as the inclusion of prohibitions or conditional pricing. Unfortunately both of the solutions imply high costs: conditional pricing doesn't allow us to study the main effects (109), while prohibitions increase the design weakness (CBC is even more sensitive to prohibitions than other conjoint techniques) (111) (114).

According to these considerations, the author thought it was better to risk the inclusion of some obvious choices (which means wasting information) rather than compromise the design strength.

OTHER DESIGN ISSUES

After the definition of the attributes and of their levels some other key aspects concerning the design of the Choice Based Experiments have to be defined.

First of all, according to general recommendations, only first choices were chosen. (Pinnell, 2005) While apparently second choices provide more information about consumer preferences, it was found they are biased. (115)

It was decided to include 4 possible choices for each choice set including a None-choice. The inclusion of the "None" choice is a good practice for these reasons, according to Johnson and Orme (114):

- It makes the choice task more realistic
- It makes the experience more pleasant for the respondents (who are not forced to choose unacceptable alternatives)
- It improves the quality of the data (by letting respondents screen themselves out of questions containing only alternative they would never consider)

One can be concerned that respondents choose the "None" alternative in order to avoid complicated tasks, but it was definitively proven that they don't (115).

The choice of 4 concepts per task fits with general recommendations, which suggests to keep the number of concepts lower than 5. (111)

INTERVIEW METHOD

Thanks to the availability of the necessary technology, it was decided to choose a computer interview. There are two main benefits connected with the computer interview. First of all, it is a good way to bypass the systematic bias in answers detected by Luchs et al. (50): they found that in the presence of an interviewer, people declare to behave much more ethically friendly than they actually do.

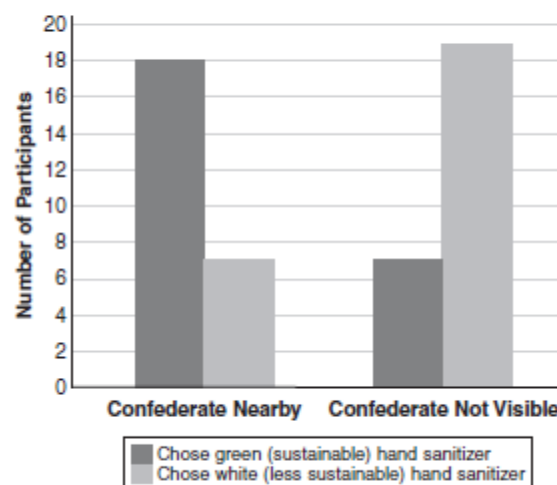


Figure 12 - Changing behavior of respondents according to the presence or not of the confederate. Darker column represents people choosing sustainable hand sanitizer, lighter a "traditional" hand sanitizer (50)

Therefore, skipping this point seems a good way to overpass “social condemnation” and people are expected to answer more spontaneously. To have a measure of this effect (even if it's not still generalized to affect all kinds of products), we report the findings by Luchs et al. in Figure 12.

The second benefit is that computer interviews allow us to manage without complications a huge variety of questionnaires, and in this way to adopt almost-individualized choice sets (which means that each respondent receives a different questionnaire) (116).

Other designs that are also feasible with paper and pencil interviews are the fixed and the randomized individualized choice sets. Fixed individualized choice sets (each respondent receives the same questionnaire) present some bias due to undesirable effects, such as the Sequence and Order Effect (117) probably due to fatigue and learning effect through the interview (116).

A randomized design (the order of questions is different for each respondent) overcomes these effects (116) but since the required technology was available, it was preferable to adopt individualized choice sets in order to guarantee a good overlap within the complete set of respondents. (108)

DESIGN METHOD

As stated previously, not all of the possible product profiles are evaluated by the respondent. Instead a (relatively) small number of them appear in each questionnaire. In an individualized experiment they are different for each respondent and the software provides the questionnaires.

All the methods obey to some principles:

- Minimal Overlap (each attribute level is shown as few times as possible in a single task)
- Level Balance (each of the attribute levels is shown approximately an equal number of times)
- Orthogonality (attribute levels are chosen independently from other attribute levels, so that each attribute level's utility can be measured independently of all other aspects).

There are some possible algorithms for the software to create the questionnaires. Namely, complete enumeration, shortcut method, balanced overlap and random method.

Two of them (Shortcut and Random) were designed in order to save time in the creation, but this seems unnecessary to us, since the other methods take no more than 30 seconds to generate all the required questionnaires. They're properly used in presence of more complex designs and/or slower PCs.

The two main options are Complete Enumeration and Balanced Overlap. Balanced overlap adds a modest degree of level overlap and its preferable when interested in interactions. Complete Enumeration is the default method, considers all possible concepts and chooses each one so as to produce the most nearly orthogonal design for each respondent, in terms of main effects. (108) Complete Enumeration method was chosen for this work, since it seemed to provide a more efficient design and since we are interested in main effects rather than interactions.

LENGTH OF THE QUESTIONNAIRES

The number of choice tasks to be provided to each respondent is a key aspect. A longer interview will give us a more detailed information about the consumer preferences, but there are several problems connected with the length of the interview.

There are some systematic changes in respondents' answers as the interview progresses:

- The choices are completed faster
- They are more likely to choose "None"
- Brand becomes less important, and price more (115)

In an individualized design these systematic effects are supposed to average out (116), but they are still what influence the number of tasks each respondents should be given. Further analysis by Johnson and Orme found that a respondent could answer up to 20 choice tasks without degradation in data quality. (115)

According to these findings, it seemed reasonable to set the number of questions in 10 for coffee and 10 for tuna fish. During the first empirical tests on the questionnaire, it was found that it seemed boring and repetitive; therefore we decided to reduce them to 8 for each of the two experiments.

One can argue that it would be preferable to have a longer interview for coffee (which has 6 attributes) rather than for tuna fish (5 attributes). Experimental tests showed that the gain in "*D-efficiency*"⁴ in the design of the coffee experiment did not compensate the loss in the tuna experiment. This result supports the general finding that the main element of complexity is the largest attribute (in this experiment, the price) rather than the number of attributes (109).

SAMPLE SIZE

The last issue concerning the design of the conjoint experiment is the targeted number of respondents.

Since we had no experience in previous conjoint studies, we relied on general guidelines from literature.

It's particularly noticeable that in Conjoint studies the sample size is considerably bigger than in traditional self-explicated methods because of the poor amount of information derived from each respondent (118).

Considering the nature of the work and the obvious limitations, it was decided to target a minimum set of 150 complete questionnaires. This fits with Johnson's rule-of-thumb (118)

$$\frac{(150 \text{ respondents}) \cdot (3 \text{ choices}) \cdot (8 \text{ tasks})}{(4 \text{ maximum levels in an attribute})} = 900 \geq 500 (\text{threshold})$$

This target seemed to be coherent with the nature of the work and the available resources.

In Choice Based Conjoint, while using advanced techniques in analyzing results (such as Hierarchical Bayes, as we'll do) there aren't simple statistical tests available to verify the accuracy of the data. Despite this, there is a simple mathematical calculation that can give us an idea of the precision of the obtained results.

Following the guidelines from Johnsons & Orme, here we follow an approach that can give us the idea of the precision of our results (114) (118).

⁴ D-efficiency is calculated within the software when testing a design, and summarizes how precisely this design can estimate all the parameters of interest with respect to another design. It's described in an article by Kuhfeld, Tobias, and Garratt (1994), "Efficient Experimental Design with Marketing Research Applications".

Our experiment consists of 150 respondents, 8 choice tasks and 3 concepts. 3600 profiles are shown. Our largest interaction measures 12 (4x3), but since we are most interested in measuring main effects, we can divide per 4 to obtain the average number of occurrences of the main effect. $3600/4 = 900$.

Average probability of a concept being chosen: $1/3 = 0,33$

Average std error: $\sqrt{0,33 \cdot 0,66/900} = 0,0157$

95% confidence: $1,96 \cdot 0,0157 = 0,0308$

This means that for a confidence interval of 95% we'll have to consider an error of +/- 3,08 %.

It's reasonable to suppose that with most advanced methods (such as Hierarchical Bayes) the error will be lower. (118)

4.3 THE COMPLETE INTERVIEW

While the core of the questionnaire that will be submitted to each respondent in the conjoint experiment, some other questions were asked in order to get some demographic parameters about him.

They are presented below in Table 6. The possibility of asking their income was debated (as it has been done in some previous studies (63)), but despite the desirability of this information we suspected the information provided would have been approximate and related with other variables (we expected students living with their parents don't know exactly how much they spend), and this would have turn into a biased classification. Therefore, conditioned by this doubt, it was decided not to make the questionnaire longer than it already was.

The idea behind the demographic question is both to know more about the population and to allow a segmentation.

Please note that while here it is presented in English, the questionnaire was provided in German, to have a more direct approach to the target population.

Table 6 - Demographic questions

Question	Possible answers
What is your sex?	Male Female
What is your age?	-number-
Are you a student?	Yes No
Do you live with your parents?	Yes No
How often do you drink coffee specialties a day?	Never 1 2 3 4 or more
How often do you eat tuna in a month?	Never 1 2 3 4 or more

THE COMPLETE QUESTIONNAIRE

In total, the questionnaire was composed of 22 slides, among which the respondent could move through two arrows situated in the bottom of the page.

They were divided like this:

- 1 start-slide, asking for email (facultative) and presenting the survey

- 2 slides about demographic data (Figure 13), the first including the first four questions in Table 6 and the second asking about the habits towards coffee and tuna consumption (questions 5 and 6 in Table 6)
- 1 intro-slide about coffee consumption
- 8 slides for coffee Choice Based Experiment, one for each choice set (Figure 14)
- 1 intro-slide about tuna experiment
- 8 slides for tuna Choice Based Experiment, one for each choice set (Figure 15)
- 1 end slide

Bitte gib uns ein paar Informationen über Dich und Deine Gewohnheiten.

Geschlecht

- ☒ Männlich
☐ Weiblich

Wie alt bist Du?

22

Bist Du Student / Studentin?

- ☒ Ja, ich studiere.
☐ Nein, ich studiere nicht.

Wohnst Du bei Deinen Eltern?

- ☐ Ja, ich wohne bei meinen Eltern.
☒ Nein, ich wohne nicht bei meinen Eltern.

Wie oft gehst Du im Supermarkt einkaufen?

- ☒ Öfter als drei Mal pro Woche
☐ Zwei bis drei Mal pro Woche
☐ Ein Mal pro Woche
☐ Weniger als ein Mal pro Woche

Figure 13 - The first Demographic questions slide

Welche Packung **500g Röstkaffee** würdest Du aus den folgenden Möglichkeiten wählen?
Eine Hausmarke ist eine Marke, die zum Händler gehört, wie z.B. "Ja!" oder "REWE". Beispiele für Markenprodukte sind "Jacobs", "Tchibo" oder "Lavazza"

<p>5,59 EUR Markenprodukt Mischung aus Arabica und Robusta Herkunft: nicht angegeben</p> 	<p>4,69 EUR Markenprodukt Mischung aus Arabica und Robusta Herkunft: Afrika</p> 	<p>3,79 EUR Hausmarke 100% Arabica Herkunft: Südamerika</p> 	<p>KEINS: Ich würde keins dieser Produkte auswählen</p>
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Klicke auf den Pfeil, um fortzufahren.



0% 100%

Figure 14 - A slide from Coffee CBC Experiment

Hier sind drei Thunfisch-Produkte. Welches würdest Du am ehesten kaufen?
 Die Unterscheidung zwischen Hausmarke und Markenprodukt ist analog zu Kaffeeprodukten.
 Hausmarken gehören dem Händler. Markenprodukte sind eigenständige Marken, z.B. "Saupiquet"

<p>1,29 EUR Olivenöl Markenprodukt</p> 	<p>1,69 EUR Sonnenblumenöl Hausmarke</p> 	<p>0,99 EUR Wasser und Salz Markenprodukt</p> 	<p>KEINS: Ich würde keins dieser Produkte kaufen.</p>
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Klicke auf den Pfeil, um fortzufahren.



0% 100%

Figure 15 - A slide from Tuna CBC Experiment

PRACTICAL EXECUTION OF THE INTERVIEW

The web interview was uploaded through the software SSI Web to the server of TUHH (Technische Universität Hamburg-Harburg). A shorter one was provided to redirect the respondents.

Respondents were recruited among the students of Hamburg universities, TUHH and University of Hamburg, through an intensive flyer distribution in campus' refectories and outside. Distribution of flyers was also made within the Paul-Sudeck Haus dormitory. Moreover, a brief presentation of the survey was made in a marketing class in TUHH.

The only constraint required by the nature of the survey was to target students, and this was ensured by a filter demographic question.

To help persuade respondents to answer the questions (thereby increasing the response rate), a 25 € gift voucher from mymuesli.com was purchased as a prize for one of the respondents.

Filters to the Answers

In order to filter an obviously biased answer, some minimum filters were provided. It was decided to exclude statistics questionnaires completed in less than 2 minutes (this means less than 6 seconds per slide!) and obviously, all the incomplete questionnaires.

All the other questionnaires were kept valid for statistical purposes.

4.4 THE SOFTWARE: HIERARCHICAL BAYES

ESTIMATING PART-WORTHS

Until this point we explained the execution of the interview, and as output we'll have some *choice data*, e.g. the discrete choices the respondents made. These data are the "raw material", while the desired result are the part-worths utilities. Therefore, some software is necessary in order to estimate part worths.

Sawtooth provides three options:

- Logit analysis
- Latent Class
- Hierarchical Bayes

The first is the most traditional, it's perhaps the most simple, but on the other hand it suffers some bias. Latent Class analysis was introduced in the mid-90s and its main point is its ability to segment respondents. (119) Hierarchical Bayes is the most powerful technique powered by Sawtooth Software and due to technological progress in computers in the last few years, it has been possible to add this software to ordinary PCs.

Comparative studies assess that in tests "hierarchical Bayes has proven more stable and more accurate in predicting both the item chosen and the choice shares" (119). Moreover it has shown a good predictive accuracy even with few questions asked to the respondents (120) (which is our case).

A good aspect of this software is that it estimates individual part-worths. In fact when summarizing attribute importances for groups it is best to compute importances for respondents individually and then average them, rather than computing importances from average utilities. For example, suppose we were studying two brands, Brand A and Brand B. If half of the respondents preferred each brand, the average utilities for A and B would be tied, and the importance of Brand would appear to be zero!

The algorithm behind CBC/HB is rather complex, but in this paragraph we'll have an overview of the basics, attempting to understand the software rather than explain it in detail. The following subparagraphs are mainly extracted from the User Manual of CBC/HB v5.0 which provides an exhaustive overview yet it is still comprehensive to inexperienced users.

BAYESIAN ANALYSIS

"Often in conventional (non-Bayesian) statistical analyses, we assume that our data are described by a particular model with specified parameters, and then we investigate whether the data are consistent with those assumptions. In doing this we usually investigate the probability distribution of the data,

given the assumptions embodied in our model and its parameters.

In Bayesian statistical analyses, we turn this process around. We again assume that our data are described by a particular model and do a computation to see if the data are consistent with those assumptions. But in Bayesian analysis, we investigate the probability distribution of the parameters, given the data.” (119)

Bayesian analysis makes use of conditional probability. The probability of an event A given the event B is defined by the formula $p(A|B) = p(A, B)/p(B)$.

Bayes' theorem expresses the probability of a particular hypothesis, H_i , given the data.

One of its formulations is $p(H_i|y) = p(y|H_i) \cdot p(H_i)/p(y)$.

Dividing everything for $p(y)$, which is a constant, we obtain that

$$p(H_i|y) \propto p(y|H_i) \cdot p(H_i)$$

This expression illustrates the “central principle of Bayesian analysis” (119)

The probability $p(H_i)$ of the hypothesis is the “prior probability”, and that describes our belief about the hypothesis before we see the data.

The conditional probability $p(y|H_i)$ is known as the “likelihood” of the data, and is the probability of seeing that particular collection of values, given that hypothesis about the data.

The probability $p(H_i|y)$ of the hypothesis, given the data, is known as its “posterior probability”. It's the probability of the hypothesis given both prior information and data.

Bayesian analysis starts with a prior estimation of the probability of hypothesis, and update it with information from the data.

The CBC/HB software is an application of this principle. We should notice also that it deals with continuous rather than discrete distributions, and so sums are substituted by integrals.

THE HIERARCHICAL MODEL

Hierarchical Bayes model is called Hierarchical because it has two levels:

- At the higher level, we assume that individuals' part worths are described by a multivariate normal distribution. Such a distribution is characterized by a vector of means and a matrix of covariances.

Namely, $\beta_i \sim \text{Normal}(\alpha, D)$, where:

β_i = a vector of part worths for the i_{th} individual

α = a vector of means of the distribution of individuals' part worths

D = a matrix of variances and covariances of the distribution of part worths across individuals

- At the lower level we assume that, given an individual's part worths, his/her probabilities of choosing particular alternatives are governed by a multinomial logit model.

The probability of the i_{th} individual choosing the k_{th} alternative in a particular task is

$$p_k = \exp(x_i' \beta_i) / \sum (x_i' \beta_i), \text{ where}$$

p_k = the probability of an individual choosing the k_{th} concept in a particular choice task

x_i = a vector of values describing the j_{th} alternative in that choice task

The parameters to be estimated are the vectors β_i of part worths for each individual, the vector α of means of the distribution of worths, and the matrix D of the variances and covariances.

The estimation of the parameters α , β e D is made through an iterative process. Their default values are set to zero. The process seems to be quite robust and doesn't appear to depend on starting values.

In each iteration, the set of parameters is re-estimated, which happens in three steps:

- the first one is α , which is assumed to follow a normal distribution with mean equal to the average of betas and covariance matrix equals to D divided for the number of respondents;
- an inverse Wishart distribution is used in order to obtain a new estimation of D (*refer to Annex D for a detailed introduction to this distribution which is largely used in Bayesian statistic*);
- the Metropolis Hastings Algorithm⁵ is used to draw the betas, using precedent estimates of α and D .

Typically this process is repeated for a large amount of iterations, typically several thousand. In our case we kept the default setting of 20 thousand. The first part of iterations is used to find convergence, when the software is confident in convergence, the values of the parameters starts to be saved in the hard disk.

Final values are the average of the saved ones.

⁵ The Metropolis-Hastings algorithm is a Markov Chain method to simulate multivariate distributions (170). The reader interested in a detailed presentation of this algorithm should refer to chapter 3.4 of the User Manual of CBC/HB v.7.0 (108) or to Chib and Greenberg (170).

5 RESULTS AND DISCUSSION

The conjoint analysis method resulted in individual part-worth utilities for each level of each attribute from which the relative importance of each attribute could be derived. In this chapter findings are presented, beyond general results, most noticeable demographic segments have been observed.

5.1 DEMOGRAPHIC DATA ON THE SAMPLE

After application of the filter (see *Table 7*) the complete respondents were 169, of which 148 were students. The filter we refer to, as explained in Chapter 4, excluded respondents who took less than 2 minutes to complete the questionnaire.

Table 7 - Number of respondents before and after application of filter

	Non-Filtered Data	Filtered Data
Complete Respondents	174	169
Incomplete Respondents	39	8

Representativeness of the sample

In *Table 8* the demographic data on the sample is presented. The proportion between males and females seems not far from reality.

The percentage of those living without parents (in this section, for space reasons, we refer to them as “*students alone*”) is high in this survey (86%); perhaps this is a consequence of including one of the biggest Hamburg dormitories among the places where flyers were distributed. Nevertheless it’s also important to underline that in Germany (and especially in Hamburg) it’s very common to German university students to live without their parents.

The impression is that given the big number of respondents needed and the nature of the work, the procedure adopted was good and data seems to be consistent. We can consider the sample not so far from the representation of the students-population.

In order to keep the sample more representative of the whole population (Hamburg students) it’s important to pay attention to the way respondents are recruited. While intensive flyer distribution in some crowded areas of the campus or in the dormitories is a good way to recruit a lot of respondents, it doesn’t ensure representativeness. The author also notes that the use of Adaptive Conjoint analysis could have helped in defining a more representative sample, because since it needs fewer respondents to obtain the same accuracy (107), one can focus on the *quality* of the respondents.

Nevertheless, as the main aim of the study was to investigate the effect of labels on students’ choices, the sample representativeness is not as important as it could be in a study that aims to investigate market share.

To overcome this limitation, further research can reproduce this study with a sample that is more representative of Hamburg’s student population. A way the author recommends (which allows also to estimate the *respondent rate*) is to use universities’ mailing lists.

Table 8 - Demographic data on the respondents

	All	Students	Students Alone
Sex			
<i>Male</i>	40%	39 %	39%
<i>Female</i>	60%	61 %	61%
Living with parents			
<i>Yes</i>	15%	14 %	-
<i>No</i>	85%	86 %	100 %
Age			
<i>Average</i>	24,04 years	23,39 years	23,54 years
<i>Mode</i>	24 years	24 years	24 years

The age of students answering to the question was quite spread in the range between 19 and 30 years, with peaks in 22 and 24 years old (Figure 16).

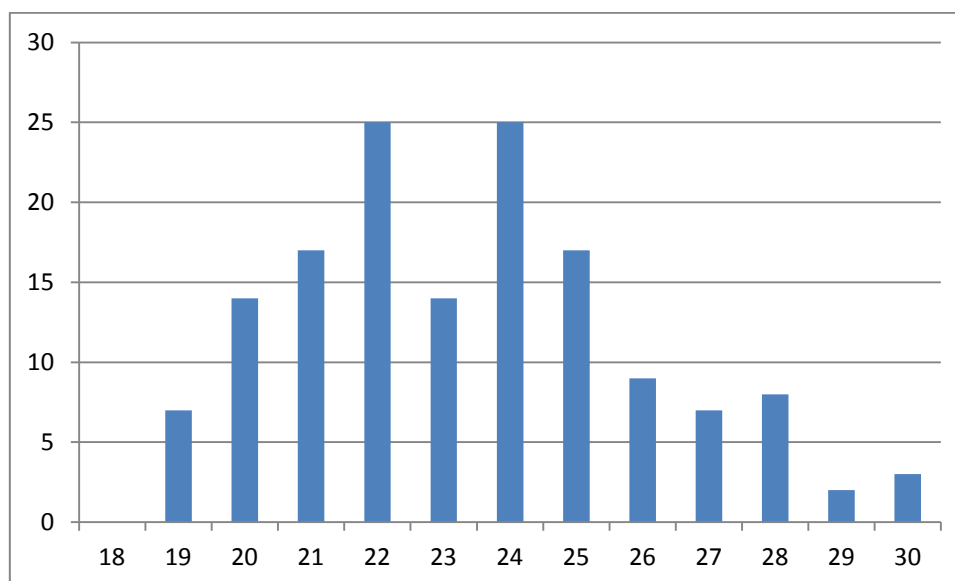


Figure 16 - Age of respondents

In Table 9 habits of the sample are presented, related with some demographic characteristics. As expected, frequency of supermarket shopping grows among those living alone.

It's noticeable that 38% of students who responded do not drink coffee at all, and 44% do not eat tuna. Further data analysis will take in account these data.

Table 9 - Habits of the respondents related to chosen demographic parameters

How often do you go to supermarket?	All	Students	Students Alone
More than three times per week	24%	22%	25%
Two or three times per week	51%	53%	52%
Once a week	20%	21%	21%
Less than once per week	4%	3%	2%
How often do you drink coffee in a day?			
Never/Almost never	36%	38%	39%
Once a day	34%	34%	34%
Twice a day	17%	16%	17%
Three times a day	9%	9%	6%
More often	4%	3%	3%
How often do you eat tuna in a month?			
Never/Almost never	45%	44%	46%
Once a month	24%	26%	23%
Twice a month	11%	13%	13%
Three times a month	6%	5%	4%
More often	14%	13%	14%

SEGMENTATION

According to the demographic questions, the following segmentation was created (dimension of the segment is also presented in the results-tables because estimation loses accuracy when decreasing the sample size):

- All respondents
- Students (those answering they're studying)
- Students alone (they are studying and they live alone)
- Sex
 - Male (they are studying and they are male)
 - Female (they are studying and they are female)
- Supermarket habits
 - Occasional (they are studying and they go to the supermarket once or less per week)
 - Frequent (they are students and they go to the supermarket twice or more per week)
- Coffee habits
 - Never or almost (they are studying and they never drink coffee)
 - Coffee drinker (they are studying and they drink coffee at least once per day)

- Tuna habits
 - Never or almost (they are studying and they never eat canned tuna)
 - Tuna eater (they are studying and they eat tuna as often as once per month)

The work is focused on students which is why non-students are taken into account just in one segment. They are too few to be analyzed on their own, but in a joint analysis at least we can have an idea of how their presence influences the results.

Please notice that segmentation was done trying to avoid segments including too few respondents: too small segments wouldn't be adequately estimated.

Tuna habits have been used just when referring to the tuna experiment; analogously coffee-related habits have been used just in the coffee experiment segmentation.

FURTHER INFORMATION ON THE SEGMENTS

In this paragraph a more detailed analysis of how segments are related to each other. In Table 10 habits of the different demographic sample are highlighted, in Table 11 segments are divided according to their demographic composition.

Some age-related behavior was predictable: coffee drinkers are older than those who never drink coffee, and respondents going more often to the supermarket seem to be slightly older than occasional shoppers.

More interesting observations can be evinced by results in Table 10:

- Males go less to the supermarket than females
- A big percentage of those not drinking coffee are also not eating tuna fish
- Females are more frequent coffee drinkers than males (opposite to expectations)
- On the opposite males are more often tuna eaters than females

Table 10 - Interrelation of defined segments, the percentages are referred to the total number of the segment in the left column (for example, 86% of interviewed male students lives alone).

	Male	Female	Living Alone	Supermarket Often	Supermarket Occasional	Never Coffee	Coffee Often	Never Tuna	Tuna Eater
<i>Male</i>			86%	78%	22%	45%	55%	40%	60%
<i>Female</i>			87%	74%	26%	33%	67%	47%	53%
<i>Living Alone</i>	39%	61%		77%	23%	39%	61%	46%	54%
<i>Supermarket Often</i>	40%	60%	88%			37%	63%	45%	55%
<i>Supermarket Occasional</i>	36%	64%	81%			42%	58%	42%	58%
<i>Never Coffee</i>	46%	54%	89%	73%	27%			55%	45%
<i>Coffee Often</i>	35%	65%	85%	77%	23%			37%	63%
<i>Never Tuna</i>	35%	65%	91%	77%	23%	48%	52%		
<i>Tuna Eater</i>	42%	58%	83%	75%	25%	30%	70%		
All Students	39%	61%	86%	76%	24%	38%	62%	44%	56%

Table 11 - Demographic composition of segments

	Age (years)			
	19-21	22-23	24-25	26+
<i>Male</i>	26%	28%	29%	17%
<i>Female</i>	26%	26%	28%	21%
<i>Living Alone</i>	24%	26%	29%	21%
<i>Supermarket Often</i>	22%	25%	30%	22%
<i>Supermarket Occasional</i>	36%	31%	22%	11%
<i>Never Coffee</i>	32%	29%	29%	11%
<i>Coffee Often</i>	22%	25%	28%	25%
<i>Never Tuna</i>	22%	28%	35%	15%
<i>Tuna Eater</i>	29%	25%	23%	23%
All Students	26%	26%	28%	20%

5.2 COFFEE EXPERIMENT RESULTS

PART WORTH UTILITIES

In Table 12 and Table 13 part worth utilities estimated from the respondents are presented. The column “students” is reported in both of them, since it’s considered as a benchmark to observe differences.

Table 12 - Part worth utilities for roasted coffee (segmentation according to demographic parameters)

Segment (Segment Size)	Student (148)	All (169)	St Alone (128)	Male (58)	Female (90)
Price					
3,79 €	93.43	87.90	89.65	113.64	85.39
4,69 €	56.12	62.22	52.86	45.46	58.70
5,59 €	-20.57	-24.61	-23.24	-34.58	-17.26
6,49 €	-128.99	-125.51	-119.26	-124.52	-126.83
Brand					
Store Brand	-17.83	-18.19	-18.76	-12.22	-19.33
Manufacturer Brand	17.83	18.19	18.76	12.22	19.33
Blend					
100% Arabica	10.02	11.46	13.08	23.31	2.92
Mix of Arabica and Robusta	-10.02	-11.46	-13.08	-23.31	-2.92
Provenience					
South America	21.89	22.98	23.89	7.53	32.03
Africa	10.37	11.62	12.01	12.20	10.18
non specified	-32.26	-34.60	-35.90	-19.73	-42.21
Fair Trade					
Yes	45.46	47.84	47.99	43.67	43.65
No	-45.46	-47.84	-47.99	-43.67	-43.65
Bio					
Yes	29.19	29.52	28.86	36.57	23.68
No	-29.19	-29.52	-28.86	-36.57	-23.68
None	-42.24	-47.54	-37.97	-39.79	-32.86

Table 13 - Part worth utilities for roasted coffee (segmentation according to personal habits)

Segment (Segment Size)	<i>Student</i> (148)	<i>Sup</i> <i>Occasional</i> (36)	<i>Supermarket</i> <i>Often</i> (112)	<i>Never</i> <i>Coffee</i> (58)	<i>Coffee</i> <i>Drinker</i> (90)
Price					
3,79 €	93.43	120.47	84.11	101.94	93.22
4,69 €	56.12	55.26	50.55	56.66	51.31
5,59 €	-20.57	-46.48	-19.58	-36.07	-21.68
6,49 €	-128.99	-129.25	-115.08	-122.53	-122.85
Brand					
<i>Store Brand</i>	-17.83	-5.74	-19.56	-9.35	-19.19
<i>Manufacturer Brand</i>	17.83	5.74	19.56	9.35	19.19
Blend					
<i>100% Arabica</i>	10.02	16.80	8.89	13.30	9.95
<i>Mix of Arabica and Robusta</i>	-10.02	-16.80	-8.89	-13.30	-9.95
Provenience					
<i>South America</i>	21.89	-1.30	30.94	29.52	18.78
<i>Africa</i>	10.37	16.90	9.17	27.67	1.87
<i>non specified</i>	-32.26	-15.60	-40.11	-57.19	-20.65
Fair Trade					
<i>Yes</i>	45.46	27.36	51.45	42.24	48.71
<i>No</i>	-45.46	-27.36	-51.45	-42.24	-48.71
Bio					
<i>Yes</i>	29.19	15.73	32.84	33.65	27.66
<i>No</i>	-29.19	-15.73	-32.84	-33.65	-27.66
None	-42.24	14.88	-55.55	42.14	-55.59

AVERAGE IMPORTANCE

The average importance of attributes was calculated by the software and is presented in Table 14 according to the previously defined segmentation.

Table 14 - Importance of roasted coffee attributes within the defined segments of respondents

	Price	Brand	Blend	Provenience	FT Label	Bio Label
Student	41.11	8.04	7.24	16.55	15.94	11.12
<i>All Respondents</i>	40.79	8.00	6.93	16.24	16.96	11.08
<i>Students alone</i>	39.59	8.73	7.66	16.08	16.64	11.29
<i>Male</i>	41.67	7.46	9.60	12.98	15.04	13.26
<i>Female</i>	40.07	8.50	6.89	18.71	16.04	9.80
<i>Supermarket Occasional</i>	42.61	8.74	7.69	16.46	13.27	11.23
<i>Supermarket Often</i>	38.28	7.93	7.39	17.43	17.50	11.47
<i>Never Coffee</i>	38.94	7.31	7.14	20.79	14.12	11.71
<i>Coffee Drinkers</i>	41.08	8.22	8.18	14.25	17.30	10.96

INSIGHTS

The most important attribute was found to be the price. The general ranking of the attributes sees, in decreasing order, the provenience, the FT label, the Bio label, the Brand and the Blend and is observed in almost all of the segments.

Some noticeable exceptions: males, students alone, people going often to the supermarket and coffee drinkers evaluate more the presence/absence of the FT label than the provenience.

Observations

Beyond some expected trends, some data seems to be surprising. Sex segmentation is the one which most polarizes opposite trends. It's noticeable that among all segments evaluated, males are the ones who are most price-sensitive, and consider more the blend and the presence of the Bio logo (13.26 vs 11.12).

The opposite happens among female respondents: they consider less the Bio label (9.80). A symmetrical trend can be noticed towards the fair trade logo: females evaluate more its presence than males. This is debated later in paragraph 5.4.

Unexpectedly, students alone are less price sensitive than the average, and evaluate more quality related attributes. Perhaps the expenditure capacity of those living alone is higher than those living with their parents, and this data reflects a higher income.

Coffee drinkers evaluate the blend more than average of students, but this was expected, and they attach a lot of importance to the presence/absence of the Fair Trade logo, while a decreased

importance was observed towards the provenience. They are more price sensitive than the average. This can be explained with the fact that traditionally higher purchase frequency is related to higher price sensitivity (121).

Indeed, those who go more often to the supermarket are less price sensitive than those who go less, and they consider more the presence of eco-labels on a coffee-product. On the opposite, previous research points out that shopping frequency is related with price sensitivity (122). A possible explanation for this is that students aren't typical consumers.

5.3 TUNA EXPERIMENT RESULTS

PART WORTH UTILITIES

In Table 15 and Table 16 part worth utilities estimated from the respondents are presented. Again, the column "students" is reported in both of them, since it's considered as a benchmark to observe differences.

Table 15 - Part worth utilities for canned tuna (segmentation according to demographic parameters)

Segment (Segment Size)	Student (148)	All (169)	St Alone (128)	Male (58)	Female (90)
Price					
0,99 €	70.72	61.74	69.45	82.78	64.95
1,29 €	20.41	25.79	18.99	17.79	23.51
1,69 €	-33.42	-34.14	-28.52	-23.27	-38.16
1,99 €	-57.71	-53.40	-59.91	-77.30	-50.31
Conservation					
Water-Salt	5.36	4.51	5.78	5.48	10.04
Sunflower Oil	-26.78	-28.08	-24.36	-31.11	-20.31
Olive Oil	21.42	23.57	18.58	25.63	10.28
Brand					
Store Brand	-6.37	-4.45	-6.44	-5.97	-5.48
Manufacturer Brand	6.37	4.45	6.44	5.97	5.48
Dolphin-Safe Label					
Yes	36.88	40.61	38.07	26.62	44.55
No	-36.88	-40.61	-38.07	-26.62	-44.55
MSC Label					
Yes	46.24	45.90	46.62	42.67	46.97
No	-46.24	-45.90	-46.62	-42.67	-46.97
None	4.72	23.92	33.05	5.86	27.98

Table 16 - Part worth utilities for canned tuna (segmentation according to personal habits)

Segment (Segment Size)	<i>Student</i> (148)	<i>Sup</i> <i>Occasional</i> (36)	<i>Supermarket</i> <i>Often</i> (112)	<i>Never Tuna</i> (65)	<i>Tuna Eater</i> (83)
Price					
0,99 €	70.72	46.91	79.23	67.37	69.79
1,29 €	20.41	14.54	22.05	20.04	24.97
1,69 €	-33.42	-16.63	-31.72	-26.89	-33.42
1,99 €	-57.71	-44.83	-69.56	-60.51	-61.34
Conservation					
<i>Water-Salt</i>	5.36	-1.40	3.86	0.84	7.38
<i>Sunflower Oil</i>	-26.78	-45.77	-13.61	-5.78	-26.54
<i>Olive Oil</i>	21.42	47.17	9.75	4.94	19.16
Brand					
<i>Store Brand</i>	-6.37	-12.62	-5.70	0.65	-6.92
<i>Manufacturer Brand</i>	6.37	12.62	5.70	-0.65	6.92
Dolphin-Safe Label					
<i>Yes</i>	36.88	29.45	41.29	55.75	32.58
<i>No</i>	-36.88	-29.45	-41.29	-55.75	-32.58
MSC Label					
<i>Yes</i>	46.24	43.05	43.30	34.98	47.44
<i>No</i>	-46.24	-43.05	-43.30	-34.98	-47.44
<i>None</i>	4.72	9.93	31.64	117.92	-24.90

AVERAGE IMPORTANCE

The average importance of attributes was calculated by the software and is presented in Table 17 according to the previously defined segmentation.

Table 17 - Average importance of canned tuna attributes within the defined segments of respondents (percentages)

	Price	Conservation	Brand	Dolphin Safe Label	MSC Label
Student	29.34	31.27	4.82	15.46	19.10
<i>All Respondents</i>	27.30	32.37	4.36	16.82	19.15
<i>Students alone</i>	28.94	31.02	4.94	15.80	19.30
<i>Male</i>	34.50	30.75	4.93	11.57	18.26
<i>Female</i>	26.28	30.72	5.36	18.48	19.16
<i>Supermarket Occasional</i>	24.46	35.16	8.71	13.72	17.96
<i>Supermarket Often</i>	32.74	27.63	5.00	16.82	17.81
<i>Never Tuna</i>	27.85	27.13	6.64	22.30	16.09
<i>Tuna Eater</i>	29.66	31.93	5.05	14.34	19.02

INSIGHTS

In this experiment, the most important attribute was the conservation technique. The general ranking of the attributes, ordered by decreasing importance is:

- Conservation technique
- Price
- MSC Label
- Dolphin Safe Label
- Brand

The attention paid to brand in tuna products is very low, almost nothing when compared with other attributes.

Observations

In the tuna experiment, male students were found to be much more price sensitive than females, and females paid more attention to the presence of eco-labels on the product and to the brand. It's noticeable that male students give higher importance to the price rather than to the conservation technique (thus opposing the main trend), and they consider dolphin-safe labels of little importance. The dolphin-safe implications and the gender differences are widely discussed in the following paragraph.

Those going often to the supermarket are more concerned with the price, and those who go occasionally are more concerned with quality related attributes (conservation technique, brand). This

differs from the coffee findings but it is consistent with previous research (122). Respondents who go often to the supermarket also give more consideration to the presence of a dolphin safe label.

More relevant differences have been detected between those who eat and those who don't eat tuna: the firsts evaluate more price, conservation and Dolphin Safe labels than the others. The experience effect is debated later.

5.4 DISCUSSION

The focus of the work was eco-labels and without a doubt one of the main findings was that they are relevant to students when involved in a purchasing situation. All of the chosen labels were shown to be relevant in the choice of the product, but the part-worth utilities attached to them cause us to have some reflections. In the discussion of the results, special attention is paid to some of these unexpected trends that emerged by segmentation.

Price, the first choice criteria

Coherent with literature, price plays the biggest role in the choice. It was the most important attribute in the coffee experiment, and although conservation technique was the most considered in the tuna experiment, price was very close to it. It's important to specify the particular nature of price: not a feature of the product *per se* but rather "*that which the consumer pays in return for features*". (123)

This finding is consistent with demographic statistics, which show that students are very price sensitive consumers. The fact that when including non-students in the respondents', the decrease in the importance of sample price is a partial confirmation of this.

The detected importance probably is biased because of the Number of Levels effect (since "Price" in the experiments was the only attribute with 4 levels, the others had 2 or 3), but known literature and the big gap with the other attributes' importance suggest that there wouldn't have been relevant changes.

When enlarging the focus to all respondents the price decreases importance, and the eco-labels generally (with the only exception of Bio-label, keeping constant) grow in importance. This seems to predict that money is a relevant constraint for students and we can expect students to buy more green products when they will be able to afford it, reinforcing our idea. This is also consistent with previous research (income as a predictor of green buying behavior, see (40) and page 12). Although the non-student respondents were very few (they are all university-related workers who were not targeted by the survey), this is an "incidental" finding which can at least give an idea for a future comparison work. A note: it's curious, and of doubtful meaning, that while in the tuna experiment those who often go to the supermarket are more price sensitive and choose cheaper tuna more than the others, the opposite happens in the coffee experiment.

Table 18 - Average importance in the two experiments, males and females (extract from Table 14 and Table 17)

	Coffee experiment						Tuna experiment				
	Price	Brand	Blend	Prov.	FT Label	Bio Label	Price	Conserv.	Brand	Dolphin Safe	MSC Label
Male	41.67	7.46	9.60	12.98	15.04	13.26	34.50	30.75	4.93	11.57	18.26
Female	40.07	8.50	6.89	18.71	16.04	9.80	26.28	30.72	5.36	18.48	19.16

The considerable differences in preference expressed by these two respondent groups turn the sexual-based segmentation into the most polarizing among those performed. In Table 18 an overview of the importance allocated by these two population segments is presented.

Among a total 11 attributes to be evaluated, while a few of them don't differ substantially within the two categories, some of them reflect an opposite trend.

Males are more price sensitive than females, but they still attach importance to eco-labels (even if in a different way, as discussed later). A previous study about altruistic behaviors showed that males are more likely to undertake altruistic behavior when the cost is low, than females, even when the cost is higher (124). These results can be interpreted as a confirmation of this finding (that buying green products is a form of altruistic behavior).

Returning to our results, in the coffee choice males paid more attention to blend and Bio labels than females do, while females paid more attention to brand, provenience and Fair Trade labels than males.

In the tuna experiment, trade-off between price and dolphin-safe labels is very peculiar; males are much less likely to spend more for a Dolphin-safe labeled product than females are.

In the tuna experiment, males allocate a considerably higher importance to MSC labels than they do with Dolphin-Safe ones. On the other hand, females allocate almost the same importance to the two labels. In the coffee experiment, males consider Bio labels almost as much as the FT label, while females consider the Fair Trade Label much more than they do the Bio label. This can hide different priorities, with males discounting more environmental issues and females discounting more the social issue. The result obtained is even more relevant because these two categories have different roles in the society, and in previous results women are the "gate-keepers", the ones which are usually responsible for household purchasing (15).

A previous work verified a gender difference in green behavior for adolescents in environmental-related attitude and behavior (125), with our finding showing that this difference is maintained when ageing.

Although it needs to be validated through a more representative sample (as we'll see later, at the end of the chapter), the finding suggests the adoption of a different marketing strategy where it is possible

when marketing green food for these two categories. It also enhances a broader future research on that, in a direction that is still largely unexplored: *how do the two sexes react to eco-labels?*

The experience effect

Table 19 - Average importance in the two experiments, consumers (coffee drinkers and tuna eaters, according to the experiment) and non consumers (extract from Table 14 and Table 17)

	Coffee experiment						Tuna experiment				
	Price	Brand	Blend	Prov.	FT Label	Bio Label	Price	Conserv.	Brand	Dolphin Safe	MSC Label
<i>Non-Consumers</i>	38.94	7.31	7.14	20.79	14.12	11.71	27.85	27.13	6.64	22.30	16.09
<i>Consumers</i>	41.08	8.22	8.18	14.25	17.30	10.96	29.66	31.93	5.05	14.34	19.02

During the design of the questionnaire the idea emerged of reserving the questionnaire for those who are true consumers of the object of the experiment. But 3 labels on 4 do not regard just the chosen product; rather there is a broad set of products that can be labeled as Organic, MSC or Fair Trade. For example it's possible that someone who doesn't drink coffee is a potential consumer of Fair Trade label products because he/she likes chocolate bars. Therefore, since the purpose of the work is to understand the relationship between students and labels and the chosen products are just a way to do this, it was decided to also include in the experiment non-habitual consumers.

In the duality between consumers and non-consumers, we can suspect that direct experience plays a big role: those who are not used to buying a certain good will pay attention to different attributes. And this is verified in the survey, especially with regards to some attributes.

Non-consumers seem to be less price sensitive, probably because what they see as an occasional purchase would have less impact on their pockets than it would for regular buyers, or maybe because of the informative function of price⁶ which we expect to be more relevant to inexperienced buyers.

The reaction to brand is opposite in tuna (tuna eaters evaluate it less than non-eaters) than in coffee. What is interesting is the reaction to the label-stimuli, because (with an exception made for the dolphin safe label) they are present in other food categories for which they are probably consumers (for example chocolate bars for FT label, fresh fruit for Bio label or seafood products for MSC), so they are supposed to have already had contact with most of them.

The reason besides a different behavior towards Dolphin-Safe label can be explained with inexperience and these emotional implications that are addressed in the following paragraph *The Dolphin Safe label case: green washing or eco-label?*. Also a stronger importance of Bio labels in coffee can come from the fact that they associate organic coffee to other categories of organic

⁶ Price has two roles in the marketplace situation: allocative (e.g. its function as a monetary constraint) and informational (e.g. price as a signal of quality) (169)

products they consume. In these food categories, as we'll see, organic products have a stronger appeal than in coffee products.

It's rather surprising that the less attention paid to the price doesn't translate for non-consumers in an increased attention to other transversal labels (MSC and Fair Trade). There is no reason to suspect that the structure of the ecological/social concerns is different between these two groups; instead the differences have to be addressed to the previous consumption behavior, which accumulates experience and information. We can carefully suppose that eco-labels are something that attract more confident consumers, while the first effort of new/inexperienced consumers are quality related attributes.

Fair Trade vs Organic

In the coffee experiment, the presence of Fair Trade labels is evaluated more than those of Bio label. The main difference between these two labels is that they are involved in substantially different areas, in fact as explained previously, the FT label is more of a social label than an eco-label.

Recalling the issues with eco-labeling we previously explored, there are some suppositions that arise from this finding.

It can be seen as a reflection of people's concern, evaluating the social problem as more relevant (or more urgent) than the ecological one. On the other hand, recall that buying a green product is a form of altruistic behavior (35), and it is possible that students evaluate the directness of their actions: a Fair Trade product appears to translate more directly in a benefit for someone (third world farmers get an honest wage for their products) than an Organic Product (effects of polluting on the land are medium-long term).

Another considerable aspect differing in the two labels is the responsible institution: while behind Fair Trade there is a well-known (126) international institution, behind Bio-label there are local governments. Although no inquiries were made about this, the author suspects that the credibility of the institution that certifies the label plays a relevant role here (*the importance of credibility effect in eco-labels was reviewed in chapter 3.3*).

Organic Label and Coffee

We already said that the benefit of Organic products is traditionally considered to be bi-dimensional: on one side the ecological aspect, on the other the health/taste implications. In fact, in general, organic products are believed to be healthier and tastier than traditional ones. Even if the absolute importance of these selfish benefits was recently challenged, its presence is confirmed within literature (127). But an Organic label is available for several food product categories; therefore these considerations refer to a broad horizon. Particularly among the most traded organic goods there are fresh vegetables and fruits (128). Evidently while these considerations fit perfectly with fresh goods, we can suppose that the health dimension accounts considerably less in coffee (which is used in powder together with boiling water). The Bio-label in coffee turns out to be a more "pure" eco-label than in other food products, but at the same time loses some of its appeal.

This can be transposed to a personal dimension: while an ecological benefit is rather altruistic and intangible (the benefit involves someone else in some other place) the health benefit involves the consumer itself.

And considering that coffee is cultivated in third world (or developing) countries, it's also possible that people discount differently the environmental damage linked with the use of pesticides and fertilizers according to where it is cultivated.

It is already demonstrated that people discount less environmental threats when they are further away in a temporal dimension (4), and it's possible that something analogue happens with space.

Dolphin Safe vs. MSC

The two most used eco-labels in tuna products are both considered by students in the purchase action. But what emerges from our findings is a clear ranking: MSC label count more than dolphin safe labels (19.10 vs 15.46).

As explored previously, there are no doubts that MSC is a more complete label (see paragraph 3.2). Therefore the fact that this trend is relevant to and widely chosen among frequent tuna consumers is understandable, because of a supposed better knowledge of the eco-label.

But the relative importance emerged on the segments of non-eaters is rather surprising (Dolphin Safe accounts more than MSC) among those who don't eat tuna. The Dolphin Safe Label is of considerable importance to them (22.30 vs 16.09). Another segment that was found to allocate considerable importance for this label were the females, and possible reasons for this are debated in the following paragraph.

The Dolphin Safe label case: green washing or eco-label?

Why do some segments of consumers consider the Dolphin Safe label more than a well-established and well-known label?

In the case of non-eaters this can be explained by a scarce knowledge of the label. Those who ~~is~~ are not habitual buyers/eaters of tuna have fewer reasons to be familiar with tuna-related labels. But it's necessary to appoint that while Dolphin-Safe is just a tuna-related label, MSC has a broad coverage of all seafood products (especially on the German market (98)), therefore it is more possible to be known among those who don't eat tuna but eat other kinds of seafood.

Taking a look at the other consumer segments, a higher than the average importance was allocated to the Dolphin Safe label by females. Sure, this data can lead to several different interpretations of the causes. But a possible explanation for this is the image of the label itself and the covered issue, rather than ~~in~~ an issue of the credibility parameters. As previously seen, eco-labels involve several areas, and while under the light of the usual parameters used to assess eco-labels it is difficult to understand such a behavior, this perspective can be seen as different when considering emotive factors. In fact the choice of buying green food is both rational and emotional (129). It is therefore possible that women are more sensitive to values inspired by Dolphin-Safe labels.

A good observer would notice that there were probably emotional reasons behind this, such as public concern over dolphin massacres, and the consequent fall of sales of canned tuna (88). Would it have

been the same if the threatened species were unknown, such as small fish without a personality. Obviously no, because a lot of marine species are threatened and risk extinction (126), but public concern doesn't take them into account.

The extraordinary attention paid to this case is understandable just under an emotive perspective, but the label is therefore remarked as a case of green washing used by the industry to increase sales, rather than an effective step to protect marine biodiversity (130).

Limitations

A main limitation of the study is the choice to analyze just some products. In fact as analyzed in this chapter, probably eco-labels have a different appeal on consumers according to the products they are applied. The adopted approach, while provides a realistic representation of the real marketplace, asks for prudence in a generalization of the results. Similar experiments based on different food products can help to get insights from this trend.

Food products are rather peculiar respect to other products, and it's not obvious that findings can be automatically extended to other product categories.

The size and the representativeness of the sample are elements of concern to every researcher. The chosen size and origin can represent Hamburg's student population, but whether they are representative of all German students population it's still an open question. Furthermore, because of the mechanism of intensive flyer distribution and online survey, it's not available here a respondent rate data.

Although the general students' preference data has the desired accuracy, the accuracy of the data of the analyzed segments is much smaller (depending on the size of the segments themselves).

In general this study has an exploratory nature and discloses insights on the students-green products relationship, but some prudence is necessary when trying to generalize its findings.

6 CONCLUSIONS

The answer provided by the work to the question whether students consider eco-labels in the purchasing decision is yes; students really evaluate eco-labels when buying a product. Their main constraint is the price, but there is evidence that they pay more attention to the presence of the chosen labels than to other product characteristics. The importance allocated to labels in certain cases exceeds the expectations of the author.

University students, because of high education, belong to those segments of the population who are more likely to be “green consumers”; therefore this finding is consistent with previous literature.

This finding, combined with an enhanced green consumption when students get higher paying jobs (because of a bigger income), is a reassuring signal for green marketers.

In the tuna experiment, the MSC label was found to be more important, in respondents’ eyes, than the label by Dolphin Safe. And this is good news, because it’s a more complete label that supports the effort of making world fisheries sustainable, as they are largely overexploited (126). On the contrary, the Dolphin-Safe label addresses a particular issue and was promoted by the industries to face a fall in sales: it was questioned whether its main purpose was to protect the environment or to protect the industry of canned tuna (90).

In the coffee experiment it was found that consumers attach more importance to the Fair Trade label than the Organic label. Some possible explanations for this:

- Students consider the social problem to be more prominent than the environmental one
- Students trust a more well known NGO (the Fair Trade foundation) more than local governments
- Students discount the environmental risk less because it is far from them (coffee is cultivated in tropical areas)

Regardless, it’s important to note that the Organic label in coffee has a weaker appeal than in other typical Organic labeled goods (such as fresh fruit), because of the nature itself of the product (it is not consumed fresh).

A particular element of interest in the study is that while in the real marketplace Organic and Fair trade labels are very often presented together, here their effects are calculated separately.

Although students are a convenient sample and the findings cannot be easily generalized, there are several elements of interest in their relation to green products, among them, their future relevance as consumers. It’s reasonable to expect that their detected green purchasing behavior will be transversal and generalized to other products as well, when they will be able to afford premium prices.

In all of the surveys, sample representativeness is always of concern to the researcher. This sample does not claim to be representative of the entire German student population, and therefore accepts the limitations regarding the extent to which our findings can be generalized to broader populations. Nevertheless, as the main aim of the study was to investigate the relative effect of labels on students’ preferences, the sample representativeness is not as important as it could be in a study that aims to investigate market share.

To overcome these limitations, future research may find it useful to reproduce this study with a sample representative of the entire German student population.

An interesting finding is that there were some peculiarities, which emerged from the segmentation. A particular, strong difference emerged between males and females. It was known that males and females had a different approach to environmental-related issues (125) but it was not obvious that this was translated so strongly into labels preferences. While researchers still question whether socio-demographics are relevant in explaining and describing environmental consumption behavior, the evidence from this study is that there is a gender-based difference on label preferences.

The most noticeable differences were observed in Bio-labels (much more important for males) and in Dolphin-Safe labels (much more important for females). A possible explanation for the major importance attached by females to Dolphin-Safe labels is the emotional value this label carries, which seems to appeal more to this segment. In fact, despite this it is often omitted in green buying behavior studies, the choice of buying a green product is both rational and emotional (129).

The previous finding that males are likely to undertake altruistic behaviors when the cost of giving is low (124) fits with the results of this work: they are more price sensitive but they also attach a considerable importance to eco-labels. The finding is relevant also because these two categories do not contribute in the same way to the purchasing, particularly women are main responsible for household consumption (15).

Something that has been highlighted even more in this work is the role which experience plays in consumption: those who are regular consumers have different priorities from those who are occasional consumers, and the same happens with labels.

While conjoint analysis is often used to represent hypothetical products, this survey wanted to be as closer as possible to the marketplace situation in order to appear more realistic to respondents, forcing them to make effective trade-offs among the attributes. The multi-attribute approach is fully compatible with the problem, and Conjoint Analysis is a powerful technique to investigate consumer preferences. Our study focuses on the main effects of estimation. Therefore interactions between attributes haven't been detected, also because accurate results imply a high number of respondents. But we suspect that they are relevant, particularly since the presence of two eco-labels is more valuable than the sum of the two (131). Further research can explore whether the combination of two labels is more valuable than the two separately. It would also be interesting to measure the effective "Willingness to Pay" for eco-labels, but in order to do this would be preferable in an economic experiment.

Eco-labels are a vast topic that embraces several disciplines: every time a research deals with them it is constrained in a certain area of scientific knowledge. Due to this limitation, intrinsic in the nature of the objective of the research, and some technical limitations, the findings of this work open some questions.

Some **further research** should explore whether the difference in preferences depends upon the issuer of the label (and so its credibility) or the content of the label itself. It's also not clear the effective knowledge of the labels among the consumers, and while research always focuses on the final effect; it would be interesting to understand how their knowledge affects final purchasing behavior.

Demographic-based preferences are unexplored in eco-labels and should be verified for a broader sample of the population.

As mentioned, intuitively the Organic label has a stronger appeal in fresh consumed products. Nevertheless this is not supported by research and a consumer behavior analysis in this direction would offer insights on the motivations leading consumers to buy organic food.

While the results offered by this work cannot be immediately generalized to other European countries, some insights are useful and are likely to be reflected in other situations. The fact that green food has high market shares in Germany increases the interest of the study, because the other developed countries, according to actual growth rates, will be in the same situation within some years.

As a general recommendation will be useful that industrial engineers and management of the products taken in consideration more active of environmental performance of the products (to students) with a good price balance.

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ANNEX A - A MARKETING CLASSIFICATION OF PRODUCTS

In the most widely accepted approach to classifying consumer products (which differentiates themselves from business products), they are divided in marketing terms in four categories, according to the behavior consumer demonstrates when buying them. We make large use of the classification by Dibb *et al.* they are (29):

- Convenience products, relatively inexpensive, frequently purchased and rapidly consumed items on which buyers exert only minimal purchasing efforts. In this case distribution is very important.

According to Baines *et al.* they can be sub-classified into(11):

- o Staple products, available almost everywhere, bought frequently and form the basis of our daily pattern of behavior. They include groceries and bread.
- o Impulse products, which the consumers had not planned to buy but are persuaded in the very last minute to pick up and put in their trolley, such as chewing gums or magazines.
- o Emergency products, bought when a special need arises, buyers are more intent on buying a solution than the right quality or image related product, like umbrellas in summer.
- Shopping products, purchased infrequently and expected to last a long time, they are chosen more carefully from buyers.
- Specialty products, they possess unique characteristic and which a significant group of buyers is willing to expend considerable effort to obtain.
- Unsought products, which people usually don't buy and don't have knowledge or awareness of brands in marketplace. An example is life insurance.

When buying an unsought product, not even the more ecological conscious consumer matters if is green or not. Specialty products can be green, but they are not focused on this and usually the consumer is going to purchase exactly what he expected, such as a Cartier watch or a Picasso painting. So when we talk about green products, we refer to products belong to the first two categories. Highlight this difference was important since the category they belong has substantial implications on the way these products are marketed.

ANNEX B – GREEN PRODUCTS ACROSS THE INDUSTRIES

Another important and more basic classification is to classify products according to the industry. This classification is important here due to the complex panorama of the green products: any industry has significantly differences from the others. The division adopted here is the one used by EPA in its on-line green product catalogue (interiors, office products and landscape products are voluntarily omitted since they are much more inherent the small business than the consumer⁽⁶⁷⁾).

Particularly, the situation of each industry will be described here through the following topics:

- Market situation (market share, availability of green products, consumer perception)
- Ecolabel situation (ecolabel developed, popularity, institution promoter)
- Research state-of-the art
- Additional reasons for the consumers to buy Green

The peculiarity of each category are the reason why lot of studies focus on a single product category. Other studies attempt to more generic results, and consider the “environmental product” as one, but as we will see this implies a big simplification.

Beyond this, some models/studies developed until now often consider “environmental friendliness” of a product as a vertical attribute, but as evident this leads to two big simplifications:

- the horizontal dimension of the environmental impact is not present, so is necessary to “compact” all the environmental impacts in one scale, with a considerable dependency on criteria and priority chosen,
- in the reality, consumer is not completely awarded of an hypothetical measure of the environmental impact, because he’s mainly informed by the eco-labels, and sometimes they are not a scale of values but (often) are a seal of approval.

FOOD

Food and drinks are (with medicines) the only categories of everyday consumer goods excluded by the EU ecolabel. Recently for them a feasibility study has been commissioned (12).

The main issues covered by the 147 food ecolabels catalogued in EcolabelIndex.com are the social sustainability of the farms (as Fair-Trade brand), the organic production of the good, sustainability of marine resources.⁽⁷⁵⁾ There are lots of available food labels, but almost none of them are considering the whole food life cycle, and usually they just refer to an aspect of the product.

There are also some a few of labels connected with Co2 emissions, but they are of marginal relevance. Given that grocery goods are involved in around one third of UE emissions, would be interesting to promote them and researchers are currently evaluating the possibility of a carbon-label for these goods accounting all their life cycle. ⁽⁷⁴⁾

Labels assessing the sustainability of marine resources are still not very popular if we consider that the most popular one, MSC, covers less of 1% of the world fish trade ⁽⁹²⁾.

A success label was the Dolphin-Safe one(88), which certifies that no Dolphins are killed when fishing tuna.

The main noticeable trend of last ten years in this industry rising market share of “organic food”, which is defined as a food produced without using synthetic pesticides and chemical fertilizers, OGM free and without food additive. (132)

The concern on healthy and reliable food knew its boom in Europe with the spread of diseases such as BSE and Salmonella in early 2000s and later with debate on OGMs.

Of course organic food is a green product, its attractiveness derives also from the promise of a healthier performance compared with traditional food. And this path has been taken also by food retailers, there is a progressive reduction of the obstacles. In US the growth of organic food and beverages in 2010 was estimated in 7,7 %, being around 4 % of the total food and beverage sales(133).

In Europe the EU Regulation 2092/91 establishes how agricultural foods and products designated as organic has to be grown, while in US standards were established by Organic Food Production Act of 1990.

The credibility of Eco-labels is believed to be a key factor which is still to be explored in this sector. (99)

CLEANING PRODUCTS

UE eco-label: criteria exist for more than 23 products and services. The UE eco-label (the same of appliances) cleans covers also cleaning products, and focus on guaranteed eco-friendly packaging and fragrance with reduce toxicity, while keeping the same cleaning performance.

EPA covers these products with the DfE (Design for the Environment) label, which focuses main on the chemical composition, and consequently environmental problems and human toxicity.

In fact, these products have an historical role in the environmental regulation, being among the first ones to be objective of a restriction in their chemical composition because of their environmental impacts. Particularly in 60s the massive use of laundry detergents and their high content of surfactants was responsible of the pollution of fresh water. The resonance of some cases (such as the Great Lakes), as well as the entity of the environmental damage, forced the US government in doing something which was considerably different from its liberal tradition and promote a public policy.(134) In Europe the first restriction on surfactants in detergents by the European Community is in the 70s. (135)

Nowadays eco-friendly detergents are the top-choice of approximately half of consumers in Germany(55%), French (64%), UK (50%) and USA (40%) In the same survey, 75% of respondents were concerned with the ingredients in their detergents.(136)

ELECTRONICS/APPLIANCES

This industry is of strategic importance in the energy consumption panorama, since energy demands in the households accounts for the 25% of the final energy needs in Europe. (137)

In US the most common eco-label for appliances is Energy Star, which is provided by EPA and US Department of Energy. It's a "Seal of approval" label and it's available for every kind of appliances, for domestic use or for small business use. It's evaluating the energy consumption, but its specifications vary according to the product. For example, a freezer gains this when its consumption is 10% lower than the standard values, but for the TVs is required 40%. The support from the government, its horizontal structure (that can be applied to all products in this sector), made it broadly recognized by consumers (more than 80% of the consumers recognize it (67).

European Union has developed an eco-label for some appliances (Tvs and Pcs) but it's not as popular as Energy Star, but is more complete, since it involves more areas, such as durability and possibility of material recover. (138)

Much more popular and recognized is the EU Energy Label: appliances which are energy-consuming are identified based on their consumption in seven classes, from A to G, where A is the most efficient. They were implemented with the directive 92/75/EC. Other classes can also be implemented according by the directive 2010/30/EU in addition the most efficient class, A+, A++ and A+++, A+ and A++ are already available for Refrigerators and Freezers.

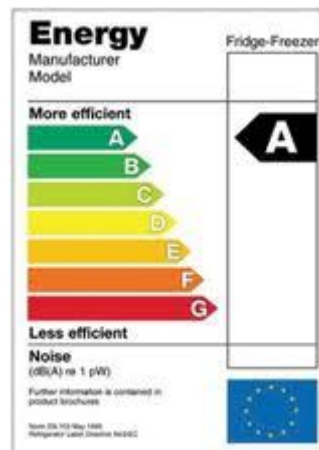


Figure 17- Example of European Energy Label for Fridges/Freezers

The EU Energy Label was innovative in its genre and can be seen as a success, considering that after three years from its introduction (in 1995) was reported that the consumers use it and understand its message. (71) The fast success of this mandatory scheme is confirmed by the enhanced marked sales of energy-efficient appliances in the years immediately following its implementation(72) and in the premium price consumers were available to pay(73).

Reassuring, we can say that the concern of consumer about energy consumption was successfully meet with the Energy Label. Beyond this, a label which takes in consideration all the life cycle of the product is still waiting to get more popular. Can this be seen as a tip that people are much more likely to choose green products when they imply savings in their bills?

A complementary measure to the ecolabel implementation is the establishment of Minimum Efficiency Requirements both in EU and in US. (137)

AUTOMOTIVE

In Europe transport is the second main sector for emissions of CO₂ (which is the main cause of global warming) and the only one which is growing in percentage in the last twenty years.(139) An analogue situation is verified in the US and in all the OECD members (in some cases, such as Mexico or New Zealand is the first one). (140)

Beyond the effect of global warming, the other important environmental impact connected with this industry is the air pollution, which is addressed as one of the first environmental issues in some of the EU countries(141) and due to its local dimension is a daily problem for lot of citizens. Particularly the exposition to polluted air was recently linked by researches to several respiratory disease. Some standards were introduced by governments to classify the acceptability of the quality of the air in relation to the contents of substances. (142)(143)

Several answers to these pressing issues were provided by the governments, through the implementation of

EPA invests of the label SmartWay the passenger vehicles, which are “up the average” in the EPA’s green vehicle guide on the parameters of Air Pollution and Greenhouse Gas.(67)

Directive 1999/94/EC impose to producers to show information to provide information to the potential buyer about fuel consumption and CO₂ emissions. In addition to the implementation of this directive, classifies the cars into seven classes (from A to G) similar to appliances, based on the same factors. (137)

Despite this, the consumer behavior is not broadly oriented towards environmentally friendly vehicles. In 2006 50% the UK motorists declared they would check emissions level before purchasing their next vehicle. But the same survey also points out that the priorities for motorists are others and this has rarely a considerable impact on their purchasing decision. (144)

The pollution issue was addressed in the European union through the classification of the vehicles into classes of emissions, spacing from Euro 0 (the most polluting) to the Euro 5 (the less emission vehicles).(137) This is a case of “evolving” labeling: a new category (which will be greener than all the previous ones) periodically appears according to the evolution of technology. Category Euro 6 will appear in 2014.(137)

The pressure on motorists to choose a “greener” category here comes mostly from the fact that progressively more polluting car are subjected to increasing restrictions in circulation, especially in the city centers, which are the most critical areas for air quality.

ELECTRIC CARS

Electric car are that cars which only uses energy derived by a rechargeable battery pack, and due to the absence of internal combustion they have a zero contribution the urban pollution, while their impact on the greenhouse effect would depend on how the electricity is generated. The main appeal on motorists is that with these vehicles they can circulate almost everywhere and are never objects of traffic bans. First electric cars were launched in the same years (late 90s) from GM and Ford, respectively EV-1 (in lease program) and Think Mobility (as rentals through Hertz), with a large publicity effort, and almost every producer launched an electric vehicle. They result in a market fail

with total 4017 units sold in the period 1996-2000. (145) Nowadays other models are on the market, the top-selling is Nissan Leaf (20000 units sold)(146), but still there are several barriers to a widespread diffusion, among them, the lack of recharge structures and the price gap with traditional vehicles. The price gap is mainly due to the cost of battery pack, which is expected to decrease with mass production. Governments are involved with public policies supporting electric car sales with incentives and financing research on this topic. These vehicles are seen as the future of vehicle industry.

HYBRID CARS

An Hybrid car is a car which combines the ICE (internal combustion energy) with an electric propulsion system. It has reduced emissions compared to an equivalent traditional vehicle since it makes a reduced use of the ICE, in some cases ICE is turned off when not required (start stop system).(145) The most popular hybrid car is Toyota Prius, released firstly in 1997 (followed two years later by Honda Insight), and sales reached 3 million units in 2011.(147) The market success of Prius is a case study which attracted studies of investigators, beyond ecological reason, Ottmann addresses its success to economic reasons, fewer fill-ups and its trendy appeal.(3) In some states in US hybrid vehicles have accorded some privileges, such as parking and lane-reserved occupancy. The market success in this case surprised also the manufacturer which *"hardly kept pace with the growing demand"*(3).

POWER

Household electricity is one important target for reduction of the consumption of fossil fuels (148), and it accounts for 29% of the total electricity consumption in UE (70). And it's expected to grow, while the percentage of industrial electricity to low.

The progressive liberalization (o deregulation, how it is called) which is occurring in the Communitarian energy market (which had started in different time in each country (149)) and which was spurred by the Energy Policy Act in 1992 in US (150) makes available for the consumers to choose their own supplier of electricity, in this way the consumer is supposed to choose among different plans which are characterized by a tariff and a power source composition. So electricity is a product as well as the others in almost all countries of EU and people are also enabled to choose plans in which a certain percentage of the electricity supplied comes is green electricity.

Green electricity is that electricity generated from renewable energy sources, such as wind, hydro/wave, solar, biomass, or geothermal power, having no or small impact on the environment.

EPA established the Green Power Partnership suitable for organization using at least a certain percentage (depending on their electricity requirement size) of green electricity.

In 2008 green electricity accounted for 10,3% of EU final energy consumption.

Purchasing of green electricity is associated with a premium cost, usually higher than brown electricity. In contrast to purchase of other environmental products, the benefits are intangible and less direct. (151)(152), while benefits to the community can be the achieving of societal goals. Particularly, the

possible benefits derived from this purchasing may be to reduce one's personal carbon footprint or respect other personal values. (35) Another possible motivation is the capturing a private benefit of a collective good. Anyway, we can assess that among all green products, green power purchasing is characterized by the most “pure altruistic” behavior.

Anyway, the price is not the only barrier to the purchasing, since in cases where green power price premium was minimum, zero or even negative (such as Nederland), costumer demand remains modest. (149)

This “green product” is the first one in our analysis in which the benefits are not translated immediately in a save on bills (as with appliances) or in other kind of benefits (such as cars), indeed the benefits are rather intangible. A large amount of studies focused on the green electricity, also because consumers seem to be determinant elements in “pushing” the demand of green electricity.

CLOTHING

The Life Cycle Assessment performed on a the clothes (see Figure 18 for a pair of jeans LCA) show that the highest contribution to the energy consumption and to the climate change come from the domestic use, particularly from the washing and drying (when performed with dryer). In this phase the economical impact is strictly related to the topics of the detergents and of the domestic appliances, and the use phase is not depending on the producer.

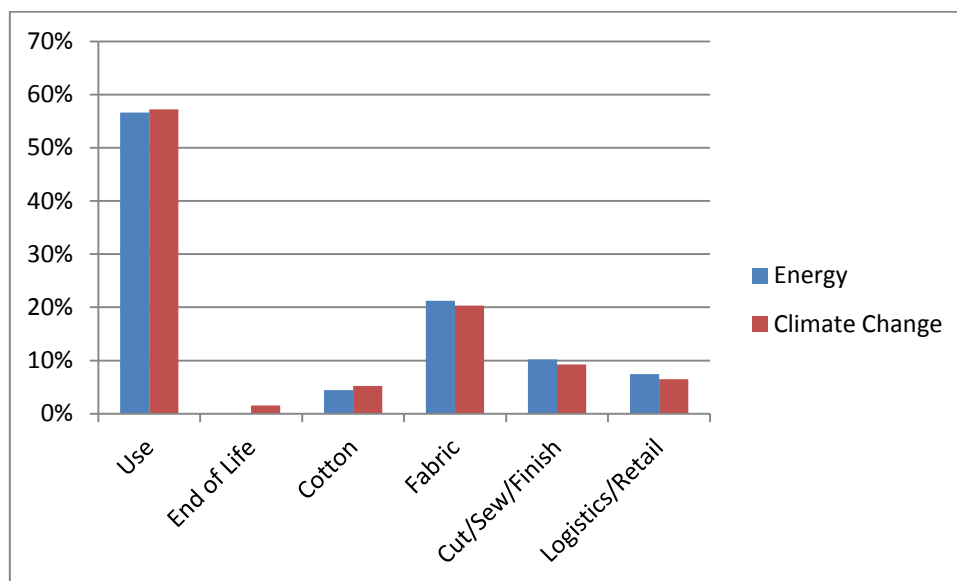


Figure 18 - Life Cycle Assessment of a pair of jeans (153)

Instead, the most notable case of “green product” within the textile industry are the organic cotton products. While the energy consumption and contribution to climate change of organic cotton apparel substantially is not different from non-organic cotton apparels, their main difference is their LCA besides in the use of pesticides. The massive use of pesticides associated with this cultivation explains the concern raised about this: cotton covers 2,5 % of the world cultivated lands and uses 16 % of the world's insecticides (154). These insecticides are often made of substances which are toxic to the humans, and they remain in the cotton and in the land. (128)

But the organic clothes are still a niche market in developed countries, the main reasons are identified in the high premium price and the difficulty in finding them by the consumers.

In US there is just one big company which is marketing organic products, Patagonia (which is specialized in sportswear). The rest of the market is made by small mail order firms. (155) The same authors calculate a premium price of 33,8 % for them. (155)

The research on the marketing of these clothes is not very consistent as for other industries. But an interesting case study is the success of a Swiss supermarket which introduced an organic clothes line, NATURA Line, trying to be cost effective as much as possible. The author suggests that this case shows that is necessary not just to aware the consumers of their environmental properties, but rather explain them the value added. Not “green marketing” but “marketing for green products”. (51)

TOURISM/RESTAURANTS

Tourism is one of the most important industry in the world economy, but despite this a LCA approach is rather difficult to adopt here, which is proved by the low literature about this industry (156).

“The complicated nature of the tourist system and a lack of specific LCA databases for tourism and related sectors” were the first obstacles in trying to explain the low number of studies. (156)

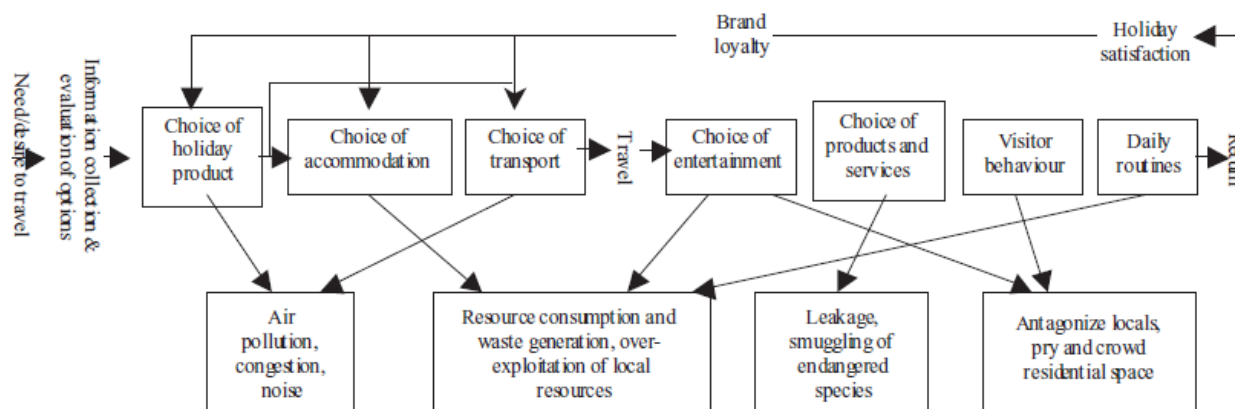


Figure 19 - Tourist holiday choices and associated environmental impacts (157)

The potential of sustainability of this industry is still unexplored, and another reason was addressed is that the tourists themselves are not encouraging this practice and just a few of them behave responsibly when purchasing touristic products. (157)

The most well known eco-labels in these areas are not just regarding the environmental impact but also are connected with some qualities of the consumer experience. In these sector eco-labels were born mostly on voluntary form.

One of the most famous touristic ecolabels is the popular “blue flag”, which was born in France, and adopted by Europe and from 2001 with world breath. It assesses beaches based on water quality, environmental management and safety and services and also marinas and is the most success label in touristic field. (158)

In touristic label, the main issue is to be easily recognized by consumers, since most of them are very recent (159)

The rising concern about environment and healthier food is changing the restaurant industry. Locally grown and organic produce are regarded as “green food” in the restaurant industry and are becoming a trend in the menus. (160) The “green restaurant” phenomena is then strictly connected to the rising popularity of the “organic food”. The existent literature is small and almost all American, but the large number of restaurants which are “greening” their menus show it as a very popular trend. Particularly it was identified that there is a consistent group of “health-conscious consumers” which express high WTP (willingness to pay) for healthier food in restaurants, and are actually a big market opportunity. (161)

But a “green restaurant” is not just about sustainable food, as defined by Green Restaurant Association, but involves all the inputs/outputs of a restaurant: water and energy efficiency, waste reduction, sustainable furniture and chemicals and pollution reduction. (162)

BUILDINGS

The electricity and heat production is, almost everywhere in the world, the first responsible of Co2 emissions (140) and the domestic use accounts for almost 30% of total electricity used (139), most of it for heating of obtaining hot water. The fresh water used by the population largely exceeds the one used by irrigation (34). These data give an idea of the relevance of household consumption. Improving the efficiency of the buildings where the people live, work, study can dramatically reduce their consumptions.

The “green buildings” are defined as that buildings “*that use key resources like energy, water, materials, and land more efficiently than buildings that are just built to code*” and further “*typically contribute to improved employee and student health, comfort, and productivity*”. (163)

Which kind of certification distinguish “green buildings” from traditional ones?

In America, a guideline and rating system is provided by the LEED, Leader in Energy and Environmental Design System, which was promoted by a non-profit organization. LEED is used both for every kind of building.

In Europe, a certification is mandatory. With the directives 2002/91/EC and 2006/32/CE members states are obliged to ensure that, when a building is sold or rent, an Energy Performance Certificate is available to the buyer and concerns key items of the property. The certificate presents (in a scale from A to G) the impact a house has on the environment, and with analogue scale its emissions of Co2. This kind of label conceptually is very close to the one adopter for appliances (the EU energy label we already introduced).

Traditionally “green buildings” were ad versed because of the perceived high costs. These costs were mostly associated to an “*increased architectural and engineering design time and the time necessary to integrate sustainable practice into projects*”. But the situation is rapidly changing: the rising number of green buildings made dropping the cost of green design. In Kats’ sample on 38 buildings with a LEED certification, the premium cost was average less than 2 %. (163) Recent researches are pointing out that they are preferable even for merely profit reason. (164)

ANNEX C – A PRACTICAL EXAMPLE OF CONJOINT EXPERIMENT

In this annex is proposed a practical example which the author believes useful to better understand the concept behind conjoint analysis. It keeps very simple when compared to the one proposed in this work. Please note that while both here and in the work we refer to a product choice (and is perhaps the most widely use of conjoint techniques), conjoint analysis can be used to evaluate consumer preferences in various situation.

Suppose we are interested in a consumer opinion on cars, the design of the experiment is defined in 3 attributes, Brand, Color and Oil Consumption which can assume respectively 3, 4 and 4 levels (as described in Table 20). A product profile is a combination of the levels, here $3 \times 4 \times 4 = 48$ products profile are possible. Notice that the number of possible product profiles is the main element of complication in a conjoint study, and it increases exponentially as the number of attributes increases. This is why the choice of the attributes is critical. On 48 possible product profiles, not all of them will be shown to the respondent, on the opposite a conjoint experiment consists in an evaluation on just a small part of the possible profiles, from which the consumer structure of preferences is derived.

Choice based conjoint substantially differs from traditional techniques because the consumer is supposed to choose among several product profiles (in traditional conjoint analysis the respondent has to rate product profiles, for example with a grade from 1 to 10). In Figure 20 is represented a possible choice set as appears to the respondent. In this example a none possibility is included.

Which of the following cars do you prefer?			
Choice 1	Choice 2	Choice 3	
Audi	Mercedes	Opel	None
Silver	Blue	Black	
9 l / 100 km	13 l / 100 km	7 l / 100 km	

Figure 20 - Choice task (three choice options and "None" option)

The results from the interview consist in choice data which are used to estimate part-worth utilities (*in this work estimation is done through Hierarchical Bayes, see 4.4 for a detailed presentation*). In Table 20 observed part-worths from a respondents are reported.

Table 20 - Attributes, levels and estimated part-worths			
Attribute	Brand	Color	Oil Consumption
Level (<i>estimated part-worth utility</i>)	Audi (0.70)	White (-0.10)	7 l / 100 km (1.30)
	Mercedes (0.20)	Silver (0.80)	9 l / 100 km (0.30)
	Opel (-0.90)	Blue (-1.00)	11 l / 100 km (-0.40)
		Black (0.30)	13 l / 100 km (-1.20)

Note that the sum of part-worths within the same attribute is zero. Just because a certain level receives a negative part-worth doesn't mean that that level was unattractive. In fact 13 liters/100 km may have been very acceptable to all respondent but the other options were better.

Sometimes we want to characterize the relative importance of each attribute. We do this by considering how much difference each attribute could make in the total utility of a product. That difference is the range in the attribute's utility values. We percentage those ranges, obtaining a set of attribute importance values that add to 100, as follows:

		Range	Importance
Brand (Audi-Opel)	0.70-(-0.90)	= 1.60	27 %
Color (Silver-Blue)	0.80-(-1.00)	= 1.80	31 %
Consumption (7-13)	1.30-(-1.20)	= 2.50	42 %
		<hr/>	<hr/>
		5.90	100 %

For this respondent, the importance of Brand is 27%, the importance of Color is 31%, and the importance of Consumption is 42%.

When summarizing attribute importances for groups, it is best to compute importances for respondents

individually and then average them, rather than computing importances from average utilities (as it was done in our work). Suppose we were studying two brands, Coke and Pepsi. If half of the respondents preferred each brand, the average utilities for Coke and Pepsi would be tied, and the importance of Brand would appear to be zero!

Although the interest in this work was restricted to importances, this is just one of the possible application of part-worth utilities. In fact through part-worths it's possible to understand which product is preferred by consumers, to predict shares of preferences and to determine purchase likelihoods.

ANNEX D – WISHART DISTRIBUTION AND INVERSE-WISHART SAMPLING

Named in honor of John Wishart (165), the Wishart distribution is a generalization to multiple dimensions of the chi-squared distribution, or, in the case of non-integer degrees of freedom, of the gamma distribution. The inverse Wishart distribution is a probability distribution which is used as the conjugate prior for the covariance matrix of a multivariate normal distribution.

The following paragraphs are extracted from the work of Stanley Sawyer (166) and consists in the introduction to the Inverse-Wishart Sampling (which is used in CBC/HB software). For the purposes of this work this is more than enough, but the reader interested in the topic can refer to the complete Sawyer's work.

WISHART DISTRIBUTION

The Wishart distribution $W(\Sigma, d, n)$ is a probability distribution of random nonnegative-definite $d \times d$ matrices that is used to model random covariance matrices. The parameter n is the number of degrees of freedom, and Σ is a nonnegative-definite symmetric $d \times d$ matrix that is called the scale matrix. By definition

$$W \approx W(\Sigma, d, n) \approx \sum_{i=1}^n X_i X_i' \quad X_i \approx N(0, \Sigma) \quad (1.1)$$

So that $W \approx W(\Sigma, d, n)$ is the distribution of a sum of n rank-one matrices defined by independent normal $X_i \in R^d$ with $E(X) = 0$ and $Cov(X) = \Sigma$.

In particular $E(W) = nE(X_i X_i') = nCov(X_i) = n\Sigma$

In general, any $X \approx N(\mu, \Sigma)$ can be represented

$X = \mu + AZ$, $Z \approx N(0, I_d)$, so that

$$\Sigma = Cov(X) = ACov(Z)A' = AA' \quad (1.2)$$

The easiest way to find A in terms of Σ is the LU-decomposition, which finds a unique diagonal matrix A with $AA_{ii} \geq 0$ such that $AA' = \Sigma$. Then by (1.1) and (1.2) with $\mu = 0$

$$W \approx W(\Sigma, d, n) \approx \sum_{i=1}^n (AZ_i)(AZ_i)' \approx A(\sum_{i=1}^n Z_i Z_i')A', \quad Z_i \approx N(0, I_d) \approx AW(d, n)A'$$

$$\text{Where } W(d, n) = W(I_d, d, n) \quad (1.3)$$

In particular $W(\Sigma, d, n)$ can be easily represented in terms of $W(d, n) = W(I_d, d, n)$.

Assume in the following that $n > d$ and Σ is invertible. Then the density of the random $d \times d$ matrix W in (1.1) can be written

$$f(w, n, \Sigma) = \frac{|w|^{\frac{(n-d-1)}{2}} \exp(-\frac{1}{2} \text{tr}(w\Sigma^{-1}))}{2^{\frac{dn}{2}} \pi^{\frac{d(d-1)}{4}} |\Sigma|^{\frac{n}{2}} \prod_{i=1}^d \Gamma(\frac{n+1-i}{2})}$$

Where $|w| = \det(w)$, $|\Sigma| = \det(\Sigma)$ and $f(w, n, \Sigma) = 0$ unless w is symmetric and positive definite. (161)

THE INVERSE WISHART CONJUGATE PRIOR

An important use of the Wishart distribution is as a conjugate prior for multivariate normal sampling. This leads to a d -dimensional analog of the inverse-gamma-normal conjugate prior for normal sampling in one dimension.

The likelihood function of n independent observations $X_i \approx N(\mu, \Sigma)$ for a $d \times d$ positive definite matrix Σ is

$$L(\mu, \Sigma, X) = \prod_{i=1}^n \frac{1}{\sqrt{(2\pi)^d |\Sigma|}} \exp\left(-\frac{1}{2} (X_i - \mu)' \Sigma^{-1} (X_i - \mu)\right) = \frac{1}{(2\pi)^{\frac{nd}{2}} |\Sigma|^{\frac{n}{2}}} \exp\left(-\frac{1}{2} \sum_{i=1}^n (X_i - \mu)' \Sigma^{-1} (X_i - \mu)\right)$$

This sum can be written (2.2)

$$\sum_{i=1}^n \sum_{a=1}^d \sum_{b=1}^d (X_{ia} - \mu_a) (\Sigma^{-1})_{ab} (X_{ib} - \mu_b) = \sum_{a=1}^d \sum_{b=1}^d (\Sigma^{-1})_{ab} \sum_{i=1}^n (X_{ia} - \mu_a) (X_{ib} - \mu_b) = \sum_{a=1}^d \sum_{b=1}^d (\Sigma^{-1})_{ab} Q(\mu)_{ab} = \text{tr}(\Sigma^{-1} Q(\mu))$$

Where

$$Q(\mu) = \sum_{i=1}^n (X_i - \mu)' (X_i - \mu) = \sum_{i=1}^n (X_i - \bar{X}) (X_i - \bar{X})' + n(\bar{X} - \mu) (\bar{X} - \mu)' = Q_0 + n v v', \quad v = \bar{X} - \mu$$

Substituting this last expression into (2.1) and (2.2) leads to the expressions (2.3)

$$L(\mu, \Sigma, X) = \frac{\exp\left(-\frac{1}{2} \text{tr}(Q_0 \Sigma^{-1})\right) \exp\left(-\frac{1}{2} n v' \Sigma^{-1} v\right)}{(2\pi)^{\frac{nd}{2}} |\Sigma|^{\frac{n}{2}}} = C_{nd} |\Sigma^{-1}|^{\frac{n-1}{2}} \exp\left(-\frac{1}{2} \text{tr}(Q_0 \Sigma^{-1})\right) \times \frac{1}{\sqrt{2\pi |\Sigma|}} \exp\left(-\frac{1}{2} n (\mu - \bar{X})' \Sigma^{-1} (\mu - \bar{X})\right)$$

Where $Q_0 = \sum_{i=1}^n (X_i - \bar{X}) (X_i - \bar{X})'$

Note that the integral $\int L(\mu, \Sigma, X) d\mu$ in (2.3) is the same as the Wishart density (1.4) with Σ^{-1} replaced by w , Q_0 in (2.4) replaced by Σ^{-1} in (1.4) so that $Q_0 \Sigma^{-1}$ is replaced by $w \Sigma^{-1}$, and n replaced by $n - d$, within multiplicative constants that depend only on n , d and X .

The similarity in forms between (1.4) and the first factor in (2.3) suggests that we might be able to sample from the density $L(\mu, \Sigma, X)$ in (2.4) by generating random variables by

$$W \approx W(d, n, Q_0^{-1}) \quad (2.4)$$

$$\Sigma = W^{-1}$$

$$\mu = \bar{X} + \left(\frac{A}{\sqrt{n}}\right) Z, \quad \Sigma = A A', \quad Z \approx N(0, I_d)$$

One subtlety is that the density of Σ in (2.4) will not be $f(n, Q_0^{-1}, \Sigma^{-1})$ for $f(n, S, W)$ in (1.4), or at least will not be this density with respect to Lebesgue measure $d\Sigma$ in R^{d^2} . In general for any function $\phi(y) \geq 0$,

$$E(\phi(\Sigma)) = E(\phi(W^{-1})) = \int \phi(y^{-1}) f(n, Q_0^{-1}, y) dy = \int \phi(y) f(n, Q_0^{-1}, y^{-1}) dy^{-1}$$

$$= \int \phi(y) f(n, Q_0^{-1}, y^{-1}) J_y(y^{-1}) dy$$

Where $J_y(y^{-1})$ is the absolute value of the Jacobian matrix of $y \rightarrow y^{-1}$.

In any event, substituting $J_y(y^{-1}) = |y|^{-d-1}$ (according to Anderson (167)) above leads to

$$E(\phi(\Sigma)) = \int \phi(y) |y|^{-d-1} f(n, Q_0^{-1}, y^{-1}) dy$$

Thus by (1.4) the joint density of (μ, Σ) generated by (2.6) is

$$g(\mu, \Sigma) = C |\Sigma|^{-(n+d+1)/2} \exp\left(-\frac{1}{2} \text{tr}(\Sigma^{-1} Q_0)\right) \times \frac{1}{\sqrt{2\pi} |\Sigma|} \exp\left(-\frac{1}{2} n(\mu - \bar{X})' \Sigma^{-1} (\mu - \bar{X})\right)$$

The first factor in this last equation is called the inverse-Wishart distribution. (167)