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Environmental knowledge and motivated beliefs in flight consumption

-An economic approach to cognitive dissonance and motivated reasoning

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Abstract:

Growing concerns for increasing consumption, and its impact on global warming, have led interest groups to press individuals and politicians to take action. The environmental movement focus on moral values and attitudes to change consumption behavior. However, previous literature suggests that "green" attitudes do not transform well into individuals' consumption behavior, questioning such approach. By conducting a choice experiment, this study explores a choice situation where respondents choose between flight and train for a hypothetical vacation scenario. Further, we include environmental knowledge and indicators of motivated beliefs to explain mechanisms behind motivated reasoning and "green" consumption choices. Through a conditional logit model, we show that higher environmental knowledge is significantly associated with higher probability of choosing train. Furthermore, we show that three out of four motivated beliefs indicators, *wishful thinking, "not wanting to know" and denial,* are significantly associated with higher probability of choosing flight. It indicates that environmental knowledge can be effective in changing consumption behavior, as it increases the psychological cost of engaging in self-deception.

Key Words:
Economics, Labeled choice experiment, Environmental knowledge, Cognitive dissonance, Motivated beliefs, Stated preferences, Conditional logit, Environment, Transport

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1. Introduction

Global warming has become an increasing concern among the public. With alarming reports from IPCC (The Intergovernmental Panel on Climate Change) on the increasing global carbon emissions, interest groups have pressed politicians to take action against global warming (IPCC, 2018). Substantial reductions in global CO_2-emissions need to be made in order to reach the goal of the Paris agreement to limit global warming to 1.5°C at the end of the century. Ethical aspects of environmental change have become drivers for shifting consumption attitudes and identifying environmental impacts from consumption has led to a better understanding of how individual decision making is affecting global warming. It has been suggested that reducing the consumption of flight travels is one of the most important contributions to lower individuals' total environmental impact from consumption. (McDonald et al., 2015).

Previous literature has shown that there exists a gap between environmental attitudes and actions when it comes to consumption (Diekmann and Preisendörfer, 1998). It means that individuals' attitudes do not transform well into their consumption decisions, a phenomenon referred to as the value-action gap (Hergesell and Dickinger, 2013; Hestermann et al., 2019; Hidalgo-Baz et al., 2017). One example of a value-action gap could be that individuals derive high utility from going on vacation abroad even though they are of the opinion that lowering CO_2-emissions is an important matter. Hidalgo-Baz et al. (2017) study the ability of knowledge to reduce the gap between a consumer's attitudes and behavior, finding that knowledge may work as a transmitter and that a higher level of environmental knowledge entails pro-environmental behavior.

To further explain this phenomenon, previous economic studies has been inspired by theories within the field of psychology. A well acquainted concept within this literature is the theory on cognitive dissonance, developed by Festinger (1976). Economic research has found the use of this psychological phenomenon to explain "green" consumption behavior in relation to economic utility theory (Gilad et al., 1987; Hestermann et al., 2019). Cognitive dissonance appears as an inconvenient sensation that arises from acting in contradiction to one's values (Festinger, 1976). If the utility from consumption is high but also associated with cognitive dissonance, it has been shown that an individual may form motivated beliefs in order to defend her actions, rather than to refrain from consumption (Epley and Gilovich, 2016; Rabin, 1994). As previous literature has found environmental knowledge to reduce the value-action gap in consumption of, for example, meat and ecological products, we want to investigate if the same association exists within the field of transport consumption. This study aims to investigate the relationship between environmental knowledge and consumption decisions in the choice between flight and train, two transport modes that are associated with very different environmental impacts.

The primary research question of this study is: 1) *Does environmental knowledge have an association with the choice between two transport modes, flight and train?* The effect of environmental knowledge on the value action gap has been explained through the concept of cognitive dissonance. However, it has previously been shown that if the utility loss of changing behavior is too high, individuals can reduce disutility by engaging in motivated reasoning. The secondary research question of this study is: 2) *Are indicators of motivated beliefs associated with the choice of transport modes and is there an interaction effect with environmental knowledge?*

To answer the research questions, we conduct a labeled choice experiment, asking respondents to choose between flight and train for a hypothetical vacation scenario. Attributes, such as CO_2-emissions, travel time and cost are presented for each alternative. In addition, we ask respondents to answer eight environmental knowledge questions as well as four questions related to motivated beliefs. The choice outcome is analyzed using a conditional logit model. By interacting individual characteristics with each alternative, we can see a relationship between both environmental knowledge and indicators of motivated beliefs with the probability of choosing an alternative. Thus, our contribution to the existing literature is twofold. First, we expand the existing literature on "green" consumption and environmental knowledge into the field of transport consumption. Secondly, we use a choice experiment to examine the association between the choice of transport mode, environmental knowledge and motivated beliefs. To the best of our knowledge no previous literature has used this approach. We delimit ourselves from measuring underlying environmental knowledge as specific knowledge and therefore we cannot, from a policy relevance perspective, answer which level of knowledge is desirable. We further delimit ourselves from engaging in cost-effectiveness analysis, which is out of the scope of this study.

The main findings indicate that environmental knowledge has a positive association with the probability of choosing train. In the three models (see *Table 3*) estimated for this purpose, the results for environmental knowledge are robust and do not change substantially. For the motivated beliefs indicators, there is statistical significance for three of the four indicators, *Wishful, NWTK ("not wanting to know")* and *Denial*, indicating a negative association with the probability of choosing train. These findings are in line with previous research within the field of "green" consumption behavior, cognitive dissonance and environmental knowledge (Hestermann et al., 2019; Hidalgo-Baz et al., 2017; McDonald et al., 2015).

Section two covers a review of previous literature on green attitudes, environmental knowledge, choice experiments, cognitive dissonance and motivated beliefs. The third section covers the theoretical framework connected to discrete choice models and an economic application to motivated beliefs, inspired by Hestermann et al. (2019). The fourth section presents the data and methodology of the study, including the experimental design and the econometric model. The results are presented in the fifth section, followed by an analysis and at last some concluding remarks.

2. Literature review

This section covers previous literature on green consumption, knowledge, choice experiments, cognitive dissonance and motivated beliefs. The first part assesses green attitudes and behavior, together with the role of underlying knowledge as a bridge between them. The second part provides a review of choice experiments in the field of transport and environmental economics. From the field of psychology, we present literature on cognitive dissonance and motivated beliefs, together with economic literature that incorporates these phenomena into economic theory.

2.1. Green attitudes and knowledge

Previous literature has examined why people seem to act in contradiction to one's beliefs, particularly when it comes to "green" consumption (Diekmann and Preisendörfer, 1998; Ham et al., 2016; Hestermann et al., 2019; Hidalgo-Baz et al., 2017). The inconsistency can be referred to as a value-action gap (Ham et al., 2016; Hidalgo-Baz et al., 2017). Diekmann and Preisendörfer (1998) argue that pro-environmental behavior comes with a cost, and that changing behavior is associated with personal sacrifices in consumption. If people change their behavior, they will to a large extent change it where the associated cost is the lowest, or where the effort can be seen in a good light.

Ham et al. (2016) suggest four reasons behind the value-action gap. 1) *People are too busy to make any changes.* 2) *Environmental products are too expensive.* 3) *Individuals argue that economic actors should take responsibility, not themselves.* 4) *Individuals argue that others do not sacrifice enough and there is nothing they can do alone.* Individuals use this type of motivated reasoning to reduce the disutility when the cost of changing behavior is too high. Literature from psychology examines the value-action gap from a different perspective. They argue that it consists of three main components: cognitive, affective and conative components (Dembkowski and Hanmer-Lloyd, 1994). The affective and conative components regard emotions and intentions about the attitude object, while the cognitive component includes ideas, thoughts and knowledge. For the purpose of this study, we focus on the cognitive component by incorporating the role of environmental knowledge into the choice between train and flight.

The importance of underlying knowledge for environmental behavior has been debated, with disagreement about the relationship between "green" consumption choices and knowledge. A reason is that measuring knowledge is a complex matter (Schahn and Holzer, 1990). One side of the literature argues that there is no, or very small, evidence for a relationship between knowledge and behavior (Grunert, 1993; Hines et al., 1987; Maloney et al., 1975) However, more recent studies investigated the importance of knowledge in green consumption and the results are quite contradictive. These findings indicate that knowledge works as a transmitter to either reduce or increase dissonance. Hidalgo-Baz et al. (2017) find a value-action gap between the attitudes and purchase behavior for organic products in Spain. They also find that knowledge about farm-animals living conditions reduces the value-action gap.

Similarly, Hestermann et al. (2019), examine the value-action gap between attitudes regarding animal-welfare and the purchase behavior of meat. They find that consumers' stated attitudes, when information (knowledge) about animal-welfare is presented, differs from the purchasing behavior in the grocery store. It is argued that lack of product information at the purchase location may reduce the psychological cost of self-deception. The perception of animal welfare was more accurate among vegetarians, suggesting that information about actual conditions pushed the agent to reduce disutility associated with cognitive dissonance by changing the problematic behavior.

2.2. Choice experiments in transport- and environmental economics

Choice experiments are frequently used to extrapolate stated preferences in the fields of transport an environmental economics (Byun et al., 2018; Hergesell and Dickinger, 2013). In choice experiments, individuals make their choices based on attributes connected to a good or service. For this study, a choice experiment design allows to control for important attributes that an individual includes in their utility maximization process when choosing transport mode.

Choice experiment data can be useful to help decision makers evaluate policies for changing people's transport behavior. A frequently recurring result, regardless of context, is that the both travel time and cost are two of the most important attributes in the choice of transportation mode (Bliemer and Rose, 2011; Grigolon et al., 2012; Hergesell and Dickinger, 2013). Excluding them from a choice situation could let the respondent attach to much weight to her attitude when making a choice, not considering other utility costs. In addition to travel time and price, previous studies have shown that CO_2-emissions are also considered when making consumption decisions and that people have a positive willingness to pay for reducing CO_2-emissions (Achtnicht, 2010; Aoki and Akai, 2012; Byun et al., 2018; Daziano et al., 2017). Including CO_2-emissions in the choice experiment introduces an environmental tradeoff to the choice.

In transport economics it is common to use labeled choice experiments to capture preferences beside the ones obtained by the presented attributes. A labeled choice experiment, compared to a generic, provide labels for each alternative rather than using, for example, alternative A and B. This approach allows a respondent to attach preferences for the labels and include them in the utility maximization process. Increasing the number of attributes in a choice experiment increases the cognitive burden. Hence, having labels on the alternatives makes it more convenient for the researcher to analyze preferences for specific alternatives and not only the attributes (Jin et al., 2017).

2.3. Cognitive dissonance and motivated beliefs

From the field of psychology, a theory on cognitive dissonance by Festinger (1976) has been used by economists to explain disutility derived from the value-action gap (Akerlof and Dickens, 1982; Hestermann et al., 2019). The theory suggests that inconsistencies between an individual's attitudes and actions create a psychological discomfort, which is referred to as cognitive dissonance. If cognitive dissonance affects people's consumption choices, it can be useful to explain economic behavior (Akerlof and Dickens, 1982). The psychological discomfort translates into disutility, which in its turn is argued to be a part of the consumer's utility maximization process (Gilad et al., 1987).

Oxoby (2003) examines how individuals' attitudes towards social status are shaped by their relative position in the economy. He finds that, people who experience disutility from the lack of social status and a desire for higher social status can reduce it, either by allocating greater resources to status seeking or by changing attitudes towards status-worthy characteristics. The model shows that individuals from a lower social class, with limited resources for status seeking, reduce their disutility by modifying attitudes and beliefs away from economic status. It is common for individuals to use moral dissonance to increase environmental concerns. The objective is to make individuals believe that their actions are immoral and interfere with their view of themselves as moral individuals. However, if the morality of a person is questioned too hard, cognitive dissonance can drive individuals to defend their acts and reduce the disutility by using motivated beliefs (Rabin, 1994).

McDonald et al. (2015) study consumers' attitudes towards flying and explores why individuals who view themselves as "green consumers" still tend to fly. Four strategies to reduce cognitive dissonance associated with flying are identified, including justifications for flying, as well as three different forms of adaptive behavior. In addition, economic literature suggests that one mean to reduce cognitive dissonance is to modify subjective beliefs such that it eliminates or reduces the experienced dissonance (Epley and Gilovich, 2016; Rabin, 1994). These findings are interesting because they indicate that information processed using motivated beliefs can affect the knowledge level. A consumer's utility is not simply derived from the objective characteristics of a good but rather from the subjective beliefs about those characteristics. It is argued that subjective beliefs are shaped through mental processes and that the reasoning behind an individual's beliefs may be biased due to selective information processing (Epley and Gilovich, 2016). The concepts of motivated reasoning and subjective beliefs have become increasingly explored within the economic literature, a subject which lies in the intersection between rational consumer theory and bounded rationality theory, developed by Simon (1982).

To see why the knowledge level could be affected by motivated beliefs, it is first important to understand the way we receive and process new information. In most societies, information is easily accessible, yet interpretations of certain facts are individual. This can partially be explained by motivated beliefs (Epley and Gilovich, 2016; Zimmermann, 2018). It might be very costly for the individual to change her beliefs and attached values to these beliefs induces a tradeoff between accuracy and desirability when processing information (Bénabou, 2015; Bénabou and Tirole, 2016). It implies that beliefs with strong desirability will be resistant to different forms of evidence that might interfere with a person's self-view. Behaviors associated with selective information processing are: 1) *Not wanting to know.* 2) *Wishful thinking* and 3) *Reality denial* (Bénabou, 2015; Bénabou and Tirole, 2016). Unlike previous studies, this study incorporates the behaviors as indicators to investigate if there exists an association between motivated reasoning the choice of train and flight.

In the context of cognitive dissonance, motivated beliefs are used as a tool to decrease the psychological cost derived from the value-action gap (Festinger, 1976). The most common manifestation of the three behaviors is through overconfidence (Bénabou and Tirole, 2016; Blanton et al., 2001; Zimmermann, 2018). In this context, overconfidence arises from an individual's desire to be perceived as knowledgeable and accurate. While a certain degree of overconfidence may be positive and can improve performance, too much will make people only accept information that is consistent with their view and reject contradictive information as false.

The psychological phenomenon of motivated beliefs has gained increased attention in the economic literature. When it comes to the relation between motivated beliefs and public opinion, Strickland et al. (2011) suggest that people experience a discrepancy between what they want to do and what is expected by public opinion. Acting in a way that is inconsistent with the expectations might cause discomfort, but if changing behavior comes with a high cost, the motivated belief mechanism can serve as a tool to decrease dissonance. A highly relevant area, where public opinion plays a big role, is the current discussion about climate change. The development of consumption patterns has been pinpointed as a big contributor to the climate change. Motivated beliefs have previously been used to explain the polarization in these kind of issues (Kahan, 2012). Movements, such as the "flight shame" movement, form public opinion to target individual's consumption patterns. If the cost of changing the behavior is too high, motivated beliefs can be used to reduce the disutility from acting against public opinion, questioning the long-term effectiveness of such movements.

3. Theoretical framework

The theoretical framework of this study incorporates utility theory and economic theory on behavior. Random utility theory will be presented, which is used as an underlying theoretical framework for discrete choice experiments. Further, we incorporate a deep theoretical framework provided by Hestermann et al. (2019), which introduces an element of cognitive dissonance and motivated beliefs to an economic model on consumer theory.

3.1. Random utility theory

In this section, we present a model on random utility theory, provided by Holmes, Adamowicz and Carlsson (2017, 133-187), which is convenient for explaining the theoretical framework that will be applied for the choice experiment in this study. The main assumption of this model is that individuals know perfectly their own utility function but that it is not perfectly observable for others. In the random utility model, the utility is in its simplest form explained as the sum of all systematic and random components. The unobservable utility function from an alternative i, for individual k can be expressed as:

$$U_{ik} = u_{ik}(Z_i, p_i) + \varepsilon_{ik} \tag{1}$$

where the unobservable utility U_{ik} is the sum of utility derived from a vector of attributes Z_i, the price p_i of alternative i, and an error term ε_{ik}. The condition for an alternative to be preferred over the other alternatives in a choice set is that the utility of an alternative i has to be greater than the utility from each and every alternative $j \neq i$ within the choice set C:

$$u_{ik}(Z_i, p_i) + \varepsilon_{ik} > u_{jk}(Z_j, p_j) + \varepsilon_{jk}; \quad \forall j \in C \tag{2}$$

It is assumed that the utility is a linear function of the vector of attributes, price, plus an error term ε_{ik} such that:

$$u_{ik} = \beta Z_i + \gamma p_i + \varepsilon_{ik} \tag{3}$$

where β is a vector for attribute preferences and γ is the marginal utility of price. Expressing the model for each attribute instead yields an expression such that:

$$u_{ik} = \beta_1 z_{i1} + \beta_2 z_{i2} + \cdots + \beta_n z_{in} + \gamma p_i + \varepsilon_{ik} \tag{4}$$

where the β are coefficients for each attribute z_i, the γ is the marginal utility of price and ε_{ik} is the error term of the random utility.

3.2. Cognitive dissonance and motivated beliefs in an economic model

Hestermann et al. (2019) provides a deep theoretical framework for how to incorporate motivated reasoning into the consumer's utility maximization problem. For the purpose of this study, relevant parts of this theoretical framework will be presented to explain the mechanisms behind motivated reasoning. Based on the equilibria conditions of the framework, we will present four propositions that the authors provide and connect them to the results of this empirical study. The theoretical framework presented by Hestermann et al. (2019) focuses on animal welfare externalities from meat consumption. For the application of the framework to this study, we assume that that awareness about the externalities from emitting CO_2 creates a psychological discomfort for the consumer in choices of transportation. If motivated reasoning is a systematic component in consumption decisions, it has been a part of the random term in the utility function (equation 1) from section 3.1.

The framework covers a scenario where the consumer is exposed to new information about a negative externality and can choose to either process the information or engage in self-deception in order to reduce the cognitive dissonance. It is assumed that an individual receives utility from consumption as well as negative utility from the negative externality of consumption. Uncertainty about the externality of consumption can be captured by a variable X, which can take either a high or a low positive value such that $X = x_{l,h}(0 < x_l < x_h)$, with equal probabilities (Hestermann et al., 2019). An individual's utility maximization can be expressed as:

$$\max_c U(c) - pc - w\tilde{x}c \tag{5}$$

where *c* is the level of consumption, defined as a positive real number, *w* is the degree to which the consumer internalizes the externality into her behavior and $\tilde{x}$ is the subjective expectation of the externality such that $\tilde{x} = \mathbb{E}X$. The subjective expectation is initially based on equally high probabilities for each of the two values of *X.* The last term of equation 5 can be referred to as the moral cost of guilt (Hestermann et al., 2019). Given the price (p), the degree of internalization (w) and the individual expectation ($\tilde{x}$), the level of consumption (*c*) is chosen such that the individual maximizes her utility. The first order condition, with respect to consumption, is:

$$U' - (p + w\tilde{x}) = 0 \tag{6}$$

The objective is to choose the level of consumption as a function of individual expectation ($\tilde{x}$) such that:

$$c^*(\tilde{x}) = max\{U'(c) - (p + w\tilde{x}), 0\} \tag{7}$$

The indirect utility from consumption can further be expressed as (function of the individual expectation):

$$V(\tilde{x}) = U\big(c^*(\tilde{x})\big) - (p + w\tilde{x})c^*(\tilde{x}) \tag{8}$$

The original framework includes an extension, using a memory-management model which was developed by Bénabou and Tirole (2002) and Bénabou and Tirole (2006). For the purpose of this study, we settle with a simplification of the time-management model as intuition around the mechanism is sufficient. The authors visualize the decision making as divided into separate time periods (Hestermann et al., 2019). There are two versions of the "self", which belongs to separate periods. In the first period an individual's "self 1" receives information about the externalities of consumption and can choose to process and transmit information truthfully or to engage in self-deception and deny information. "Self 2" chooses the level of consumption based on the transmitted information from "self 1" and her utility function. Repressing information is related to a cognitive cost (k) for the individual and "self 1" takes into account the utility derived from future consumption as well as the cognitive cost of self-deception. Simplifying the theoretical framework provided by Hestermann et al. (2019), we look at conditions for self-deception or truthful transmission to form equilibria.

There are two equilibrium strategies, realism and denial. It is denoted by either realism ($\sigma = 1$) or denial ($\sigma = 0$) and σ can take no values in between. If "self 1" receives "bad news", i.e. information that $X = x_h$, it can choose to repress the new information ($\sigma = 0$). The individual's expectation about the externality ($\tilde{x}(0)$) does not change from the initial expectation with equal probabilities for either a high or a low value. If "self 1" chooses realism and to transmit information truthfully ($\sigma = 1$), the individual's expectation will be ($\tilde{x}(1) = x_h$). Given that the "self 1" receives new information that $X = x_h$, denial ($\sigma = 0$) is an equilibrium if and only if:

$$V(\tilde{x}(0)) - V(x_h) \geq k \tag{9}$$

It means that if the difference between indirect utility of denial and truthful transmission of information is greater than the cognitive cost of self-deception, denial is an equilibrium. Further, realism ($\sigma = 1$) is an equilibrium if and only if:

$$V(\tilde{x}(0)) - V(x_h) \leq k \tag{10}$$

It means that the if the difference between indirect utility for denial and truthful transmission is smaller than the cognitive cost of self-deception, realism is an equilibrium strategy. Hestermann et al. (2019) provides the full derivation of equilibria conditions under Bayesian game-theory conditions. Here we have presented the framework and equilibria conditions in a simplified manner without taking to account Bayesian updating. The same equilibrium concept is reached through the simplified approach and we can further discuss the mechanisms behind motivated beliefs in the utility maximization process by four propositions suggested by Hestermann et al. (2019). We delimitate ourselves from the full definitions due to spatial constraints.

I. First, the authors show that there exists a unique equilibrium for the "game" which is characterized by threshold values of cognitive cost in which $0 < k_1 < k_2$, where the equilibrium is either to deny "bad news" or accept "bad news". Individuals with lower value of k are more likely to engage in willful denial.

II. In the second proposition, it is shown that individuals with higher demand for a product are more prone to engage in self-deception. If they derive a higher utility from consumption, they are also more likely to benefit from denying information.

III. The third proposition shows that, as the unit price of the product increases, the consumer will get more realistic, i.e. that the probability of ($\sigma = 1$) increases. It is due to the nature of the utility function for a normal good, as price increases, total utility decreases and incentives for self-deception are reduced.

IV. The fourth proposition states that under realism ($\sigma = 1$), the consumer is information-loving. Correspondingly, under denial ($\sigma = 0$), the consumer is strictly information averse.

The four propositions will be used for analysis of the results related to environmental knowledge and motivated beliefs indicators. We argue that mechanisms behind motivated reasoning can be described through the presented theoretical framework and further that environmental knowledge can explain differences in individuals cost of self-deception.

4. Data and methodology

This section covers the data collection process and the methodology of the study. First, we describe the sample together with sample statistics, followed by a description of relevant variables. It is followed by the survey design, the experimental design and a section on the econometric model.

4.1. Data

Data has been collected through an online questionnaire, targeting students at four different faculties at the University of Gothenburg. Between 6000 and 10000 students from four different faculties were reached by a link through email, rendering 1050 responses to the online survey. After structuring and cleaning data, 894 responses were used for further analysis. The excluded observations were respondents who did not report studying as their main occupation. Through a choice experiment, respondents were asked to choose between train and flight for six different choice situations in a hypothetical travel scenario. Each alternative had information on the associated CO_2-emissions, travel time and cost. Choice data was structured in long format, creating one row for each of the two alternatives in the six choice observations. It means that each individual produced 12 rows, resulting in a total of 10728 observations. *Table 1* presents summary statistics for the sample of this study.

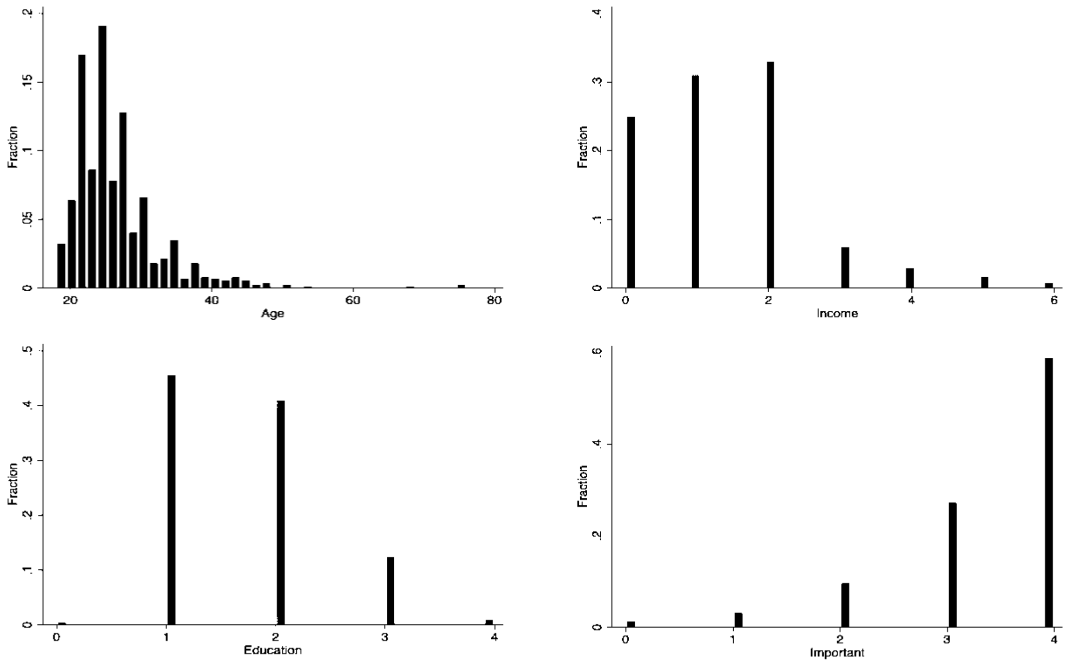
Table 1. Summary statistics (N=894)

Variable	% of sample	Mean	Median	Std.Dev.	Min	Max
Age	.	26.424	25	6.195	18	76
Female	68.1	.		.	.	.
Children	9.28	.0928	0	.290	0	1

(Note: ***Children*** indicates if an individual has got children.)

The sample mean age is approximately 26 years, with a gender distribution of 31,9% males and 68,1% females. Around 9% of the respondents state that they have children. Income is a categorical variable, ranging between 0 and 6 (see *Figure 1*). The minimum income is “0-5000 SEK” and the maximum is “30 000 SEK or more”. Education is also measured as a categorical variable ranging between 0 and 4. The lowest level of education is “Primary education” and the highest level is “Doctor’s degree or higher”. The gender distribution of the sample is representative for the distribution at the University of Gothenburg as whole[1]. The mean income of the sample shows that students in general are low income earners. Accounting for student grants and loans, up to 10 000 SEK can be obtained by a student in Sweden each month[2]. The median income reflects that most students within the sample have reported an income within the range of what can be obtained by student grants and loans. The mean income is slightly higher. In *Figure 1,* we present distributions for age, income, education and how important environmental issues are according to the respondent.

Figure 1. Distributions of Age, Income, Education and Important, as fractions



(Note: ***Important*** is an individual’s self-stated attitude towards the importance of environmental issues in general, ranging from “Not important” to “Very important”. ***Income*** ranges, with 5000 SEK increments, from “0-5000 SEK” to “30000 SEK or more”. The levels of ***Education*** are: “Primary education”, “High school education”, “Bachelor’s degree”, “Magister/Master’s degree” and “Doctor’s degree or higher “.)

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[1] Short version of the year 2019 at the University of Gothenburg, summary statistics. https://medarbetarportalen.gu.se/digitalAssets/1765/1765315_kortversion_2019__webb.pdf

[2] Numbers obtained from CSN (Centrala Studiestöds-Nämnden) https://www.csn.se/bidrag-och-lan/studiestod/studiemedel.html

4.2. Variables

This section covers the included variables, present their type and how they were measured. First, we will present a variable table including the levels and range of each variable as well as a short description. It is followed by a more thorough review of the included variables. In section 4.5, there will be a discussion around how environmental knowledge and indicators of motivated beliefs has been measured, connecting to previous literature on the subject.

Table 2. List of variables

Variable	Range	Description
Choice	0,1	"Outcome variable. Chosen alternative in the choice experiment, 0=Train, 1=Flight"
$\boldsymbol{CO_2}$	See Table 3	"Level of CO2-emissions for each alternative measured in kg"
Traveltime	See Table 3	"Travel time of each alternative. 3 alternative-specific levels measured in number of hours"
Cost	See Table 3	"Cost of each alternative. 6 alternative-specific levels measured in SEK"
Knowledgescore	0,1	"Indicator of knowledgescore below and above median value for the sample"
Flight Frequency	Continuous	"Respondents number of flight travels during the last two years"
Female	0,1	"Gender, 0=Male, 1=Female"
EnvImp	1-5	"Respondents self-stated environmental impact from consumption"
Important	1-5	"Scale question if environmental issues are perceived as important (1=Not important, 5=Very important)"
NWTK	0,1	"Indicator that respondent does not want to know correct answer to environmental knowledge questions"
Wishful	0,1	"Indicator that respondent has wishful thinking"
Overconfidence	0,1	"Indicator if respondent is overconfident about number of correct answers to environmental knowledge questions"
Denial	0,1	"Indicator if respondent believes that general information about climate change is trustworthy"

Choice is the outcome-variable of the choice experiment, indicating if the train or flight alternative was chosen. CO_2 and *Traveltime* are alternative-specific attributes with three levels each. It means that each alternative has specific levels for each attribute. The attribute levels are presented in *Table 3*. CO_2-emissions are measured in kilograms. Travel time is measured in hours and minutes. *Cost* is an alternative-specific attribute, consisting of 6 levels measured as SEK (see *Table 3*). All attributes are measured as the one-way trip, which was clearly communicated to the respondent. Section 4.3 covers the attributes and how their levels were calculated.

Knowledgescore represents the respondents share of correct answers to eight environmental knowledge questions. The variable has been coded into a binary variable, indicating if the share of correct answers is above or below the median value for the sample. The eight environmental knowledge questions are presented in appendix *A2. Flight Frequency* measures the respondents' number of flight travels during the last two years. The variable *EnvImp* indicates how the respondent values their own environmental impact from overall consumption, ranging from "very low" to "very high". The variable *Important* is a valuation question that represents how important environmental issues are according to the respondent. It ranges from "not important" to "very important".

The last four variables of *Table 2*, *NWTK*, *Wishful*, *Overconfidence* and *Denial* are all coded as binary indicators of motivated beliefs. *NWTK* is connected to a survey question if the respondent wanted to know the correct answers to the environmental knowledge questions. The variables *Wishful* and *Denial* are both generated from questions with answers connected to a 5-point scale. *Wishful* is based on a question if the respondent thinks that technology will solve the major problems of global warming. It ranges from "not likely at all" to "extremely likely". *Denial* is based on a question on how trustworthy the respondent believes information about climate change is in general. It ranges from "very trustworthy" to "not trustworthy at all". For *Overconfidence* we ask the respondent to estimate how many correct answers they had on the environmental knowledge question. The individual estimation is then subtracted from the actual number of correct answers to the environmental knowledge questions. If an individual estimated a higher number than the actual number of correct answers, it is coded as overconfidence. The indicator questions are inspired by previous literature on motivated beliefs (Bénabou, 2015; Bénabou and Tirole, 2016). Section 4.5 will present a deepened discussion on how to measure both environmental knowledge and indicators of motivated beliefs based on existing literature.

4.3. Choice experiment

This section covers the overall structure of the choice experiment, presenting a table over the attribute levels for each alternative as well as an example of a choice set. In the first part of the survey, the respondent faced six choices of transportation mode for a hypothetical weekend-trip to a large city. The purpose of the trip was explained and the respondent could choose between either train or flight. Each choice situation had various levels of the three included attributes, CO_2, travel time and cost, making each choice unique. The respondent faced labeled alternatives, meaning that it was clearly stated if the alternative was train or flight. A short cheap talk script was presented, aiming to make the respondent aware about the potential risk for bias caused by the hypothetical nature of the question (see appendix *A1*). Respondents were asked to answer according to their own preferences, as if it was a real-life consumption decision. Cheap talk scripts have been widely used within both contingent valuation methods as well as in choice experiments (Carlsson et al., 2005). *Table 3* presents the attribute levels for each alternative in the choice experiment.

Table 3. Attributes and levels

Attribute	Levels
$\boldsymbol{CO_2}$	**Train** (Levels for train varies depending on the energy source powering the train)**:** • 2 Kg • 12 Kg • 22 Kg **Flight** (Levels for flight vary with airplane type, where number of seats accounts for the major difference)**:** • 50 Kg • 100 Kg • 150 Kg
Traveltime	**Train** (Levels for train vary with number of transits and train model)**:** • 5h • 7h • 9h **Flight** (Levels for flight vary with the number of transits)**:** • 1h 30m • 3h 30min • 5h 30m
Cost	**Train:** 250, 400, 550, 700, 850, 1000 **Flight:** 525, 675, 825, 975, 1125, 1275 (Realistic prices in SEK for the reference trip between Stockholm and Copenhagen. Varies with time of day and between different departures)

The levels for each attribute are based on a reference trip (Stockholm-Copenhagen) which is approximately 650 kilometers, measured as the railway distance. Among several possible reference trips, this one gave us the possibility to vary the travel time for train over and under the threshold of six hours. One previous study has shown that approximately six hours is a threshold value in which individuals will become sensitive to travel time (Hergesell and Dickinger, 2013). Reasonable travel times and price levels were collected from online-booking webpages for both train[3] and flight[4]. We let the number of transits and time of the day vary in order to create reasonable variation in the attribute levels.

The variation in the levels of CO_2-emissions for train was calculated through online emission-calculator tool[5] for the reference trip. The level of CO_2-emissions for the reference trip for flight was collected from the same online-booking webpage as used for travel time and cost. Variations in CO_2-emissions depends on different airplane and train models. *Figure 2* shows an example of how a choice situation was presented to the respondent. It was followed by a question about which alternative the respondent would choose, flight or train.

Figure 2. Example of choice set

ATTRIBUTES	*FLIGHT*	*TRAIN*
CO2-EMISSIONS	50KG	12KG
TRAVEL TIME	3H 30MIN	5H
COST	1275SEK	700SEK

4.4. Experimental design

This section covers the experimental design on how the choice sets were generated. The choice experiment includes two attributes with three levels (CO_2 and $Traveltime$) and one attribute with 6 levels (*Cost*). Since there are two alternatives for each choice situation, the set up yields a full factorial design of $3^{2 \cdot 2} \cdot 6^{1 \cdot 2} = 2916$ different choice scenarios. Presenting too many choice sets can be detrimental to the quality of data. If a choice experiment is cognitively

[3] https://www.sj.se/#/
[4] https://www.sas.se
[5] https://www.engineeringtoolbox.com/CO2-emissions-transport-car-plane-train-bus-d_2000.html

challenging or takes too long to finish, the respondent will eventually not give efficient responses (Johnson et al., 2013). To reduce the number of choices presented to the respondent, a D-efficient design was created. The D-efficient design creates efficient variation when the number of attributes and the sample size is relatively small, which is the case for this study (Bliemer and Rose, 2011; Vanniyasingam et al., 2016). The design yielded 12 different choice situations that were divided into two blocks, creating two survey versions. From this, each respondent faced one of the surveys including six choice sets. Each survey version was answered by approximately 500 respondents.

Prior values for the coefficients used for the D-efficient design were obtained from a pilot study. The pilot study was conducted very similar to the original study but included a smaller sample of approximately 80 responses. Respondents had to be students or at least graduated from a university within the last year. In general, the results from the pilot study are in line with the ones obtained by the main study.

4.5. Environmental knowledge and indicators of motivated beliefs

The second part of the survey consisted of eight environmental knowledge questions (see appendix *A2*). The first two questions specifically addressed emissions from the flight industry while the remaining six questions were general environmental knowledge questions, relating to the effects of CO_2-emissions. Knowledge extrapolated from questions of this nature is called abstract knowledge (Schahn and Holzer, 1990). Abstract environmental knowledge is general information about the environment and climate change, while concrete knowledge is rather the knowledge about environmentally friendly actions. For this study we use abstract knowledge as it has been commonly used in other studies of similar nature (Hestermann et al., 2019; Hidalgo-Baz et al., 2017). Respondents were asked to answer each environmental knowledge question to the best of their knowledge or to provide a best guess of the correct answer. Each question had between three and five alternatives and it was stated that each question had only one correct answer. The second part ended with a question about how many, out of the eight environmental knowledge questions, the respondent believed that they had answered correctly. The purpose of this question was to capture if the respondent is indicating overconfidence (see appendix *A3*).

The last part of the survey asked the respondent socio-economic and demographic questions. Among these questions, three additional questions on motivated beliefs where included (see appendix *A3*). Disentangling motivated beliefs from ordinary beliefs is a complex task (Zimmermann, 2018). As a limitation for this study, we emphasize that the measurements can only be interpreted as indicators, rather than pure measurements of motivated beliefs. Questions for motivated beliefs indicators are based on the behaviors explained in section 2.3 in the literature review. They are *wishful thinking*, *denial*, *"not wanting to know"* and *overconfidence.* Overconfidence was measured adjacent to the environmental knowledge questions and evaluated if the respondent overestimated her ability to answer the questions correctly. Wishful thinking regards the respondent's general view of technology as a future solution to climate change issues. Denial was captured by asking if the respondent believes that general information on climate change is trustworthy or not. It may indicate that the person denies information that does not go along with their own view. Lastly, "not wanting to know" was measured by giving the respondent an option to see the correct answers to the knowledge questions. The respondent could choose to either expose herself to information that might be unpleasant or to abstain from exposure.

4.6. Econometric model

In this section we present the underlying model of the choice experiment, including model type, model specification and underlying assumptions. Discrete choice modelling has a direct connection to the underlying theoretical framework of random utility theory, presented in section 3.1. We use the random utility framework to formulate a model that is relevant for testing the research questions of this study.

Discrete choice models have a primary focus on the tradeoff between attributes connected to a consumption decision between different alternatives. By varying attribute levels, it is possible to estimate tradeoffs between attributes in the consumption choice and further to estimate the marginal willingness to pay for specific attributes. For discrete choice modelling it is common to use a multinomial logit model (MNL). When the utility of an alternative is a function of the attributes of an alternative rather than a function of individual characteristics solely, a conditional logit model is appropriate (Hoffman and Duncan, 1988). Lancsar et al. (2017) also state that if alternative-specific regressors are used in an MNL, the model is usually referred to as a conditional logit model and when both alternative-specific and case-specific regressors are included, some refer to the model as a mixed model. We settle with referring to it as a conditional logit model. The conditional logit model was developed by McFadden (1973).

In this choice experiment we include alternative-specific regressors in terms of the attributes connected to each alternative. In addition, we include case-specific variables in terms of individual characteristics such as environmental knowledge, indicators of motivated beliefs and socioeconomic variables. Connecting to the research questions of the study, we are primarily interested in the association between an individual's environmental knowledge and the choice outcome in terms of the probability of choosing an alternative. Secondly, we are interested in the association between the choice outcome and indicators of motivated beliefs.

The conditional logit model is based on the following log-likelihood function:

$$\log L = \sum_{k} \sum_{i} Y_{ki} P_{ki} \tag{11}$$

where the choice outcome Y_{ki} is equal to one if individual *k* chooses alternative *i* (Hoffman and Duncan, 1988). The probability of choosing an alternative *i* is expressed as:

$$P(Y_{ks} = i) = P\big(U_{iks} - U_{jks} > 0\big) \;\; \forall j \neq i \in C \tag{12}$$

It means that the probability of choosing an alternative i, is equal to the probability that the utility derived from that alternative i is greater than the utility derived from each and every alternative ($j \neq i$) within the choice set C, for positive values of utility. Given two main assumptions about the error terms of the utility function, the probability of choosing an alternative i can be expressed as in equation 13. It is first assumed that error terms are identically and independently distributed and secondly that the error terms follow an extreme value type 1 (Gumbel) distribution. The independence assumption is crucial and states that the choice probabilities for the alternatives within a set solely depends on the characteristics of those alternatives and are not correlated between choice occasions (Hoffman and Duncan, 1988; Lancsar et al., 2017).

$$P_{iks} = \frac{exp\ (\lambda u_{iks})}{\sum_{j \neq i}^{J} exp\ (\lambda u_{jks})} \tag{13}$$

The probability of choosing alternative i is the ratio between the expected systematic utility from alternative i and the sum of the expected systematic utility from all other alternatives within the choice set. For the formality, a scale parameter λ is included in the equation. It is known to have an inverse relationship to the variance, but it is standard within logit models to set the scale parameter to unit as there is no proper way to identify it (Lancsar et al., 2017; Swait and Louviere, 1993). The following is an extension of the utility function, presented in section 3.1, including socioeconomic characteristics (S_k).

$$U_{iks} = u_{iks}(Z_{iks}, p_{iks}, S_k) + \varepsilon_{iks} \tag{14}$$

The total utility of an alternative *i*, for individual *k* in scenario *s*, is the utility derived from a vector of attributes (Z_{iks}), the price (p_{iks}), a vector of socioeconomic characteristics (S_k) and a random error term (ε_{iks}). The systematic component of utility (u_{iks}), can be expressed as:

$$u_{iks} = \alpha_i + \beta Z_{iks} + \gamma p_{iks} + \delta_i S_k \tag{15}$$

where α_i, β, γ and δ_i are the parameters to be estimated (Lancsar et al., 2017). Note that the vector of attributes (Z_{iks}) and price (p_{iks}) vary across alternatives, scenarios and individuals. The constant term (α_i) varies between alternatives and is called an alternative-specific constant. The vector of socioeconomic characteristics (S_k) vary between individuals but stays constant between alternatives and scenarios.

Based on the previous equations (14 and 15), the total utility of an alternative in the choice set for this choice experiment can be expressed as equation 16, breaking out the indicators of motivated beliefs (MB) from the vector of socioeconomic variables. The parameter estimates for motivated beliefs are denoted by τ_i. Unlike a generic choice experiment, we attach labels to each alternative (flight or train), giving way for the respondent to incorporate preferences that are connected to the label of an alternative. These preferences are captured by an alternative-specific constant (ASC_i).

$$U_{iks} = ASC_i + \beta_1 CO_{2_{iks}} + \beta_2 Traveltime_{iks} + \gamma Cost_{iks} + \delta_{\mathrm{i}} S_k + \tau_i MB_k + \varepsilon_{iks} \qquad (16)$$

The attributes CO_2, *Traveltime* and *Cost* are all alternative-specific, scenario-specific and individual-specific. The control variables denoted by δ and τ-parameters are all individual-specific which is also referred to as case-specific variables. For analysis of the attributes and their relative importance for the choice outcome of different alternatives, we calculate the marginal willingness to pay for the attributes (see equation 17) by dividing the coefficients of CO_2 and *Traveltime* with the cost coefficient (Lancsar et al., 2017).

$$\mathrm{MWTP} = -\frac{\beta_{Attribute}}{\gamma_{Cost}} \qquad (17)$$

For the purpose of this study, we are not primarily interested in the MWTP for the attributes per se. It will be used as a contribution to the analysis, providing insights to how the attributes may be valued differently between the flight and train alternative.

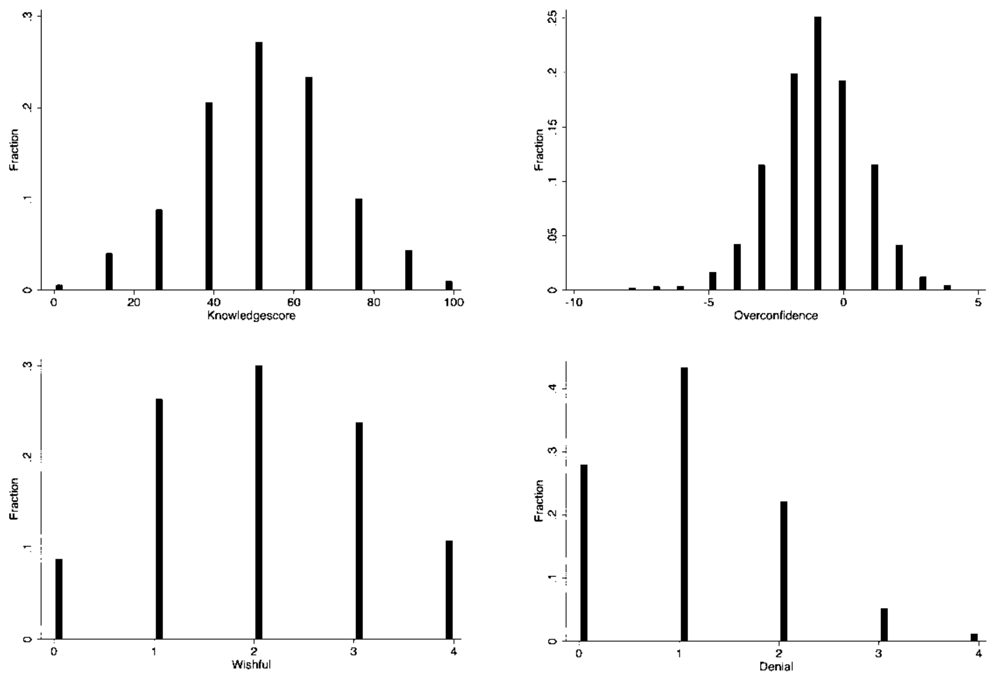
5. Results

In this section the results from the choice experiment are presented. The results are divided into subsections where each research question is processed separately. First, some descriptive statistics are presented. It is followed by the results on the association between environmental knowledge and the choice between flight and train. Lastly, we present the results related to indicators of motivated beliefs. The main findings show that environmental knowledge has a significant and positive relationship with the probability of choosing the train alternative. Three different model specifications are presented, controlling for an individual's gender, the self-stated environmental impact, the attitude towards environmental issues and how many times the individual has traveled by flight the last two years (see *Table 5*). For indicators of motivated beliefs, we find statistically significant and negative coefficients for three out of four indicators, *Wishful, NWTK* and *Denial.* It suggests that an indication of each of these motivated beliefs is associated with a lower probability of choosing the train alternative. For *Overconfidence*, we find no significant results.

5.1. Descriptive statistics

Sample statistics such as gender, income and education level are presented under data in section 4.1 and detailed descriptions for each variable are presented in section 4.2. Distributions for original values of *Knowledgescore* and the indicators of motivated beliefs are presented in *Figure 3.* In *Table 4,* we present descriptive statistics from the choice experiment.

Figure 3. Distributions of Knowledgescore, Overconfidence, Wishful and Denial



(Note: The original variable ***Knowledgescore*** is measured as the share of correct answers to environmental knowledge questions, multiplied by 100. The original question for ***Overconfidence*** measures number of self-estimated correct answers, subtracted from the actual number of correct answers. ***Wishful*** is based on a 5-point scale, measuring if the individual thinks that technology will help solve the major problems of global warming. It ranges from "not likely at all" to "extremely likely". ***Denial*** is based on a 5-point scale, measuring if the individual thinks that information about climate change is trustworthy. It ranges from "very trustworthy" to "not trustworthy at all". See appendix *A3.)*

Knowledgescore and three of the motivated beliefs indicators, *Overconfidence, Wishful* and *Denial* were re-coded as binary variables from the original questions. In *Figure 3,* we present the distributions of the original variables, from which the binary variables were coded. Section 4.2 covers in detail how each original variable was measured before it was re-coded. *Knowledgescore* was coded as binary, based on if the value was above or below the median value of the sample. *Overconfidence* was coded as an indicator if the value was below zero. Both *Wishful* and *Denial* were coded as indicators if the value was above or equal to 2. Appendix *A3* presents the questions for each motivated beliefs indicator.

Table 4. Descriptive statistics (N=894)

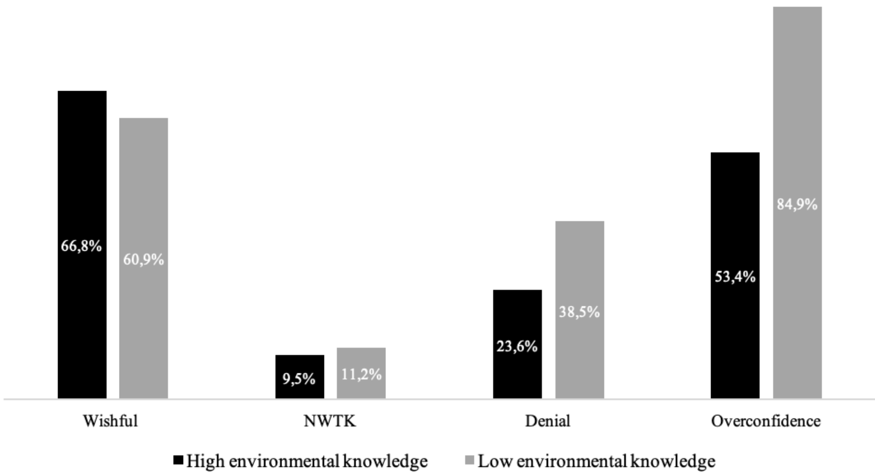
Variable	% of sample	Mean	Median	Std.Dev.	Min	Max
Knowledgescore		.659	1	.473	0	1
High	65,9	.	.	.	.	.
Low	34,1	.	.	.	.	.
Flight Frequency	.	4.573	4	3.496	0	10
Wishful	.	.647	0	.478	0	1
NWTK	.	.100	0	.301	0	1
Denial	.	.286	0	.452	0	1
Overconfidence	.	.634	1	.482	0	1

(Note: ***Knowledgescore*** indicates if an individual was above the median value of correct answers to the environmental knowledge questions. ***Flight Frequency*** measures an individual's number of flight travels during the last two years. ***Wishful*** measures if an individual indicated wishful thinking. ***NWTK*** indicates if an individual did not want to know the correct answers to the environmental knowledge questions. ***Denial*** measures if an individual indicated that they are using denial. ***Overconfidence*** measures if an individual indicated overconfidence. See section 4.2 for detailed variable descriptions.)

Knowledgescore is measuring the share of correct answers to the environmental knowledge questions but was re-coded as a binary variable for the analysis (see *Figure 3* for distribution of the original variable). The re-coded variable indicates if an individual's number of correct answers to the environmental knowledge questions was above or below the median value of the sample. The mean value suggests that 65.9% of the sample belongs to the group of "high environmental knowledge" and 34.1% belong to the group of "low environmental knowledge". The mean and median values for *Flight Frequency* suggest that an individual, on average, has traveled by flight approximately 4-5 times during the last two years. Through the questions that works as indicators of motivated beliefs, we can conclude that approximately 65% of respondents indicate wishful thinking. Approximately 10% indicate "not wanting to know", 29 % indicate denial and 63% indicate overconfidence.

Figure 4 shows the indicators of motivated beliefs as percent of the sample that indicated a motivated belief. The indicators have been divided into percentages for individuals with high respectively low environmental knowledge. Regarding gender differences, the mean values of *NWTK* and *Denial* differs between males and females. The percentage indicating *NWTK* is 13% for males and 9% for females. For *Denial* the distribution of positive indications is 33% for males and 26% for females. For the two remaining indicators, mean values are approximately similar for both genders.

Figure 4. Motivated beliefs indicators in percentage for high and low environmental knowledge



(Note: The figure shows percentages of individuals who had positive indication of each motivated belief. ***Wishful*** measures if an individual indicated wishful thinking. ***NWTK*** indicates if an individual did not want to know the correct answers to the environmental knowledge questions. ***Denial*** measures if an individual indicated that they are using denial. ***Overconfidence*** measures if an individual indicated overconfidence. See section 4.2 for detailed variable descriptions.)

5.2. Estimation results

The main results are presented in *Table 5* and *Table 7*. All models (1-11) are analyzed using a conditional logit model. The model allows us to automate the procedure of a multinomial logit that interacts case-specific variables with each alternative. Alternative-specific variables are the attributes and case-specific variables are variables that vary between individuals but stays constant between choice scenarios (see section 4.6). For all regression tables, the flight alternative is regarded as the base alternative.

5.2.1. Choice of transportation mode and environmental knowledge

Table 5 presents the results from the choice experiment, analyzing the association between environmental knowledge and the choice of transportation mode. For the purpose of this study, signs of the coefficients will be used to assess the direction of the probabilities. Coefficients for the attributes will later be used to calculate the marginal willingness to pay.

Table 5. Regression output, environmental knowledge

Alternative specific variables	**Model. 1**	**Model. 2**	**Model. 3**
$CO_{2_{Flight}}$	0.00114	0.00108	0.00114
	(0.00114)	(0.00117)	(0.00119)
$CO_{2_{Train}}$	-0.0280***	-0.0287***	-0.0302***
	(0.00854)	(0.00850)	(0.00861)
TT_{Flight}	-0.341***	-0.351***	-0.362***
	(0.0349)	(0.0349)	(0.0353)
TT_{Train}	-0.414***	-0.439***	-0.455***
	(0.0245)	(0.0251)	(0.0256)
$Cost_{Flight}$	-0.00192***	-0.00201***	-0.00209***
	(0.000160)	(0.000163)	(0.000165)
$Cost_{Train}$	-0.00352***	-0.00366***	-0.00377***
	(0.000167)	(0.000170)	(0.000173)
Case specific variables			
Flight: (Base alternative)	-	-	-
Train:			
Knowledgescore	0.637***	0.627***	0.663***
	(0.0717)	(0.0730)	(0.0764)
Important		0.490***	0.464***
		(0.0403)	(0.0418)
EnvImp		-0.219***	-0.149***
		(0.0404)	(0.0418)
Female			0.219***
			(0.0743)
Flight Frequency			-0.119***
			(0.0102)
ASC_{Train}	2.983***	1.870***	2.332***
	(0.354)	(0.387)	(0.399)
Observations	10,728	10,728	10,728

(Note: $\boldsymbol{CO_2}$ is measured in kilograms. ***TT*** is short for travel time and is measured in hours and ***Cost*** is measured in SEK. Alternative-specific variables assess the probability of choosing an alternative if the attribute level increase. Case-specific variables asses the probability of choosing train compared to flight. ***Knowledgescore*** is binary and indicates if a person has a high or low environmental knowledge ***ASC*** is the alternative-specific constant for train.)

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

For all three models in *Table 5,* the attributes are statistically significant at 1 % level, except for $CO_{2_{flight}}$. As could be expected, *Cost* and *Traveltime* for both flight and train have negative and significant coefficients, implying that higher cost and longer travel time decreases the probability of choosing an alternative. For CO_2-emissions, the attribute is negative and statistically significant only for train. In the choice, variations in the level of CO_2-emissions do not seem to be of considerable importance for the flight alternative.

Knowledgescore, which is the main variable of interest for the first research question, is statistically significant at 1% level (see model 1 in *Table 5*). It means that environmental knowledge has a significant association with the choice of transportation mode and that the probability of choosing train is higher if an individual has high environmental knowledge. The alternative-specific constant (ASC) indicates that the sample, on average, has stronger preferences for train after controlling for the attributes and socioeconomic variables. It is significant at 1% level. In model 2 and model 3, we add variables to control for attitudes and other sociodemographic factors that may be associated with the probability for choosing an alternative. The variables *Important* and *EnvImp* are included to control for the respondent's self-stated attitude and behavior which could be correlated with both choice outcome and underlying environmental knowledge. Controlling for attitude and behavior is important as a pro-environmental individual can have incentives to increase her knowledge to support her beliefs. If this would be the case, then the supposed impact of knowledge could be due to attitudes and behavior, rather than the knowledge itself. As shown in *Table 5,* both variables indicate a significant association with the choice outcome. It means that if a person believes that climate change issues are important, they are more likely to choose train. Higher self-stated environmental impact decreases the probability of choosing train.

As can be seen in model 2, the coefficient for *Knowledgescore* is robust and does not change much when *Important* and *EnvImp* are controlled for. Model 3 adds gender and a consumer's number of travels by flight during the last two years (*Flight Frequency*). The only sociodemographic control variable included in the model is gender[6] (statistically significant at 1% level). In line with previous studies on environmental behavior, females are more prone to adapt environmentally friendly behavior (Hoyos et al., 2015). The coefficient for *Knowledgescore* is robust for the different model specifications.

Calculating the marginal willingness to pay for *Traveltime* shows that respondents have a higher willingness to pay to reduce travel time for flight than for train (see *Table 6*). It may indicate a diminishing valuation of a one-hour increase in *Traveltime* as the total travel time

[6] Age, income, education level and whether the respondent has children, could all be argued for. However, students are overall a quite homogenous group in these aspects. Including them did not improve the model and were therefore left out in the final version

increases (further discussed in the analysis). The marginal willingness to pay for decreased CO_2-emissions is calculated as 8 SEK/kg for train. The coefficient for flight is not significant and therefore not included in *Table 6*.

Table 6. Marginal willingness to pay for CO_2 and travel time

$CO_{2_{Flight}}$	$CO_{2_{Train}}$	TT_{Flight}	TT_{Train}
-	8 SEK/kg	173 SEK/h	121 SEK/h

(Note: Coefficients for calculating MWTP are based on model 3 in *Table 3*. The MWTP for $CO_{2_{Flight}}$ is excluded as the coefficient is not significant.)

5.2.2. Indicators of motivated beliefs and interaction effects

In this section we present results connected to our second research question. We introduce indicators of motivated beliefs to the model to see if each indicator is associated with the probability of choosing a specific alternative. In addition, we examine interaction effects between indicators of motivated beliefs and environmental knowledge. Each indicator is interacted with environmental knowledge to see if the indicators of motivated beliefs have different associations with the choice outcome for individuals with high respectively low environmental knowledge. The attributes and the alternative-specific constant are interpreted as in previous regression tables. The models 4-7 in *Table 7* includes separately each indicator of motivated beliefs. Models 8-11 in *Table 8* also present each interaction effect between motivated beliefs indicators and environmental knowledge separately (see appendix *A4)*.

Model 4 show the output when we include *Wishful thinking* as an indicator. Given a 95% confidence level for all interpretations of statistical significance, the coefficient on *Wishful* is negative and statistically significant. It means that indicating wishful thinking is associated with a lower probability of choosing the train alternative. Model 5 and model 6 also shows negative and significant coefficients, meaning that both "not wanting to know" and denial are indicators that are associated with a lower probability of choosing train. The coefficient on *Overconfidence,* in model 7, is positive but not statistically significant.

Table 7. Regression output, indicators of motivated beliefs

Alternative specific variables	**Model. 4**	**Model. 5**	**Model. 6**	**Model. 7**
$CO_{2_{Flight}}$	0.00118	0.00117	0.00115	0.00117

	(0.00119)	(0.00119)	(0.00119)	(0.00119)
$CO_{2_{Flight}}$	-0.0306***	-0.0303***	-0.0301***	-0.0302***
	(0.00861)	(0.00861)	(0.00862)	(0.00865)
TT_{Flight}	-0.364***	-0.364***	-0.363***	-0.363***
	(0.0353)	(0.0353)	(0.0353)	(0.0354)
TT_{Train}	-0.457***	-0.455***	-0.454***	-0.453***
	(0.0256)	(0.0256)	(0.0256)	(0.0256)
$Cost_{Flight}$	-0.00210***	-0.00209***	-0.00209***	-0.00209***
	(0.000165)	(0.000165)	(0.000165)	(0.000165)
$Cost_{Train}$	-0.00378***	-0.00378***	-0.00377***	-0.00377***
	(0.000173)	(0.000173)	(0.000173)	(0.000173)
Case specific variables				
Flight: (Base alternative)	-	-	-	-
Train:				
Knowledgescore	0.656***	0.647***	0.649***	0.694***
	(0.0766)	(0.0764)	(0.0766)	(0.0806)
Wishful	-0.279***			
	(0.0749)			
NWTK		-0.322***		
		(0.121)		
Denial			-0.168**	
			(0.0837)	
Overconfidence				0.105
				(0.0779)
ASC_{Train}	2.566***	2.406***	2.500***	2.266***
	(0.405)	(0.400)	(0.407)	(0.404)
Observations	10,728	10,728	10,728	10,728

(Note: Co_2 is measured in kg of emission. ***TT*** is short for travel-time and is measured in hours and ***Cost*** is measured in SEK. ***Knowledgescore*** is binary and indicates if a person has a high or low environmental knowledge. ***ASC*** is the alternative-specific constant for train. Alternative-specific variables assess the probability of choosing an alternative if the attribute level increase. Case-specific variables asses the probability of choosing train compared to flight. Indicators of motivated beliefs are represented by ***Wishful*** as wishful thinking, ***NWTK*** as "not wanting to know", ***Denial*** as denying new information and ***Overconfidence*** as overestimation of abilities.)

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Coefficients for interaction effects between environmental knowledge and indicators of motivated beliefs are presented in *Table 8* in appendix *A4.* Two of the four indicators of motivated beliefs, *Wishful* and *Overconfidence,* show significant interaction effects. The interpretation is that the negative association between wishful thinking and the probability of choosing train is even stronger for individuals with high environmental knowledge. It is significant on 5% level. For the interaction between overconfidence and environmental knowledge, there is a significant but positive coefficient, implying the opposite association. The two remaining interactions between motivated beliefs and environmental knowledge are not statistically significant and we refrain from commenting on them further.

6. Analysis

In this section, we will analyze results in relation to the research questions and discuss around the implications of the results. First, we go through the theoretical implication related to the primary research question. It is followed by an analysis of the results from the indicators of motivated beliefs, connected to the second research question. Finally, we discuss policy implications, limitations and suggestions for further research.

6.1. Theoretical implications

The main aim of this study is to examine the association between underlying environmental knowledge, connected to emissions of CO_2, and the choice between flight and train. The findings suggest that higher environmental knowledge increases the probability of choosing train, which is associated with a lower environmental impact. The results are in line with previous literature on “green behavior”, suggesting that underlying environmental knowledge can work as a transmitter between attitudes and consumption behavior (Hestermann et al., 2019; Hidalgo-Baz et al., 2017).

In the survey, respondents were faced with tradeoffs between three different attributes, including cost, in the choice between flight and train. The ratio between coefficients for each attribute and the cost-attribute provides information about the marginal willingness to pay (MWTP) for an increase in the attribute level (see equation 17 in section 4.6). Longer travel time is usually an unattractive attribute for transport decisions and it is expected to reduce the utility of an alternative. Increasing travel time has a negative relationship for both flight and train but the MWTP to reduce travel time for flight is significantly higher (173 SEK for flight compared to 121 SEK for train). One reason may be that decreasing travel time by one hour for flight is higher, in percentages, than it is for train. Another explanation may be that flight, in most cases, is the fastest way to travel. It indicates that individuals have a high valuation of time in the utility maximization process.

In addition, presenting CO_2-emissions as an attribute is expected to assess a feeling of personal responsibility for the environmental impact of the consumption, even though the valuation of the attribute differs between individuals. For the choice situation where the respondent chose train, the result suggests that CO_2-emissions matters and there is a negative utility associated with an increase in the attribute-level. For flight on the other hand, there are no such indications, meaning that the variation in CO_2-emissions for flight is not decisive in the evaluation of the flight option. One explanation may be the large gap between emission levels for the two alternatives. Choosing flight may be seen, on beforehand, as the environmentally "bad" decision, implying that respondents disregard the CO_2-emissions attribute when other attributes makes flight a preferred alternative. Another one could be diminishing marginal utility from reducing emissions.

These findings are interesting, because they give a deeper understanding to why the value-action gap really appears. As we can see from the alternative-specific constant, it suggests that the sample reported stronger preferences for train after considering the assigned attributes. Together with the fact that the sample reported a generally high concern for climate change, these finding suggests an awareness and concern about environmental issues among respondents. However, many of the choice situations fell in favor of flight. In line with previous research, it indicates that there is a value-action gap in the consumption behavior. The value-action gap, which creates the cognitive dissonance, suggest that respondents suffer from moral guilt when choosing flight. Since the respondents also derives positive utility from the other attributes, she can still maximize utility by choosing flight, implying that the cost of moral guilt needs to be large enough to eventually affect the choice. When this happens, utility derived from the attributes is neutralized by the disutility of cognitive dissonance. Hence, to choose flight, the respondents need to derive enough utility from the attributes to compensate for the moral guilt.

Since the value-action gap creates cognitive dissonance, we further investigate knowledge as a driver of the dissonance. The results show that knowledge is significantly associated with positive probability of choosing train. If an individual does not know that their behavior is undesirable by others, the moral cost will not be high either. However, if the knowledge level increase, the cognitive dissonance will increase the moral cost, as long as the individual does not switch to train. Translated into the utility function, higher moral cost increases the disutility, making it less beneficial for the respondent to choose flight.

In more general terms, the findings support that underlying knowledge about negative externalities of consumption affects consumption choices as it increases the cognitive cost of choosing a "bad" alternative. If an action/alternative is highly valued, we have previously mentioned that increased cognitive dissonance creates incentives for engaging in self-deception, in terms of forming motivated beliefs. Instead of changing behavior, a respondent can form motivated beliefs to reduce the experienced cognitive dissonance. If an individual forms motivated belief around the environmental impact from flying, she may be more prone to choose flight. As we can see from *Figure* 4, the group of low environmental knowledge, has a higher probability of indicating three out of the four motivated beliefs, *Denial, NWTK ("not wanting to know")* and *Overconfidence.* It implies that information processing could differ between the two groups. In the next session, we discuss the results related to indicators of motivated beliefs.

6.2. Extension with motivated beliefs

The second research question of the study aims at analyzing how indicators of motivated beliefs are associated with the choice outcome of the choice experiment. The results suggest that there are statistically significant associations between the choice outcome and three of the motivated beliefs indicators, *Wishful, NWTK* and *Denial*. The signs of the estimated coefficients suggest that an indication is associated with a higher probability of choosing the flight alternative. For *Overconfidence* we did not find a significant association with the choice outcome.

As mentioned in section 2.3, previous literature has suggested that overconfidence is the most common manifestation of motivated beliefs, overlapping with the other forms (Bénabou and Tirole, 2016; Zimmermann, 2018). Our findings cannot support that overconfidence has a significant association with the choice outcome. However, the interaction term between *Overconfidence* and *Knowledgescore*, presented in *Table 8* in appendix *A4,* implies that overconfidence has a significant and positive association with the probability of choosing train, only for individuals with high environmental knowledge. An intuitive explanation for this may be that individuals with a relatively high environmental knowledge are more prone to overestimate their ability to answer the questions correctly. On the other hand, *Figure 4* in section 5.1 suggests that this is not a reasonable explanation. A larger share of individuals with low environmental knowledge indicates overconfidence than individuals with high environmental knowledge. Another explanation may be that the underlying question for measuring overconfidence was not able to disentangle the motivated belief properly. We may also have captured other aspects related to the question. In section 6.4, we will critically discuss the difficulties related to measuring motivated beliefs as a cognitive phenomenon.

The theoretical framework provided by Hestermann et al. (2019), in which motivated beliefs are connected to an economic model, has worked to theorize on the mechanisms behind motivated reasoning in a consumer's utility maximization process. The framework is extensive and for the purpose and scope of this study we focus on relating the results to the relevant propositions presented in section 3.2. We will sometimes refer to motivated reasoning as "engaging in self-deception". It is not possible to test for the equilibria conditions suggested in the economic model but use the theoretical propositions as a foundation for reasoning around the implications of the results.

The first proposition of the theoretical framework in section 3.2 states that there exist equilibria such that a dominant strategy is either to deny or to accept new information. It also states that individuals with a low cognitive cost of self-deception are more prone to engage in motivated reasoning. As denial, wishful thinking and "not wanting to know" are all different forms of self-deception, we can relate our results to the mechanisms that creates incentives for self-deception. An individual who has underlying preferences for flight and is confronted with the relatively high emissions compared to the train alternative is expected to experience cognitive dissonance, given that she cares about the environment and future generations. If underlying environmental knowledge increases the cognitive cost of engaging in self-deception, we would see that individuals with low environmental knowledge are more prone to indicate motivated beliefs. *Figure 4* show that a larger share of individuals within the group of low environmental knowledge indicate motivated beliefs, except for wishful thinking. This support the first proposition, given that environmental knowledge increases the cognitive cost of self-deception.

The results suggest that indications of wishful thinking, denial and "not wanting to know" are associated with a lower probability of choosing train. An interpretation connected to the theory is that individuals with underlying preferences for the flight alternative are more prone to engage in self-deception. These findings go well in line with the second proposition, presented in section 3.2. An individual with relatively high utility from consumption of a product or service has stronger incentives to engage in self-deception than an individual with relatively low utility from consumption. The third proposition of section 3.2 is connected to how the unit price of a product affects incentives for self-deception. As the price increases, an individual gets more realistic. The study does not aim to investigate this specific relationship, but still it is relevant for how one could reason around different attribute levels. If it was the case that the cost of the two alternatives, flight and train, were about the same, the theory predicts that there would be stronger incentives for self-deception. If the price levels between the two alternatives were equal, the flight alternative would be relatively more attractive compared to the price levels presented in the choice experiment. The same goes if travel time were to change in the opposite direction, flight would become relatively less attractive and incentives for self-deception would decrease.

The fourth and final proposition states that under denial, an individual is strictly information averse and that the other way around. The indicator *NWTK* measures if an individual is information averse in the sense that they do not want to expose themselves to the correct answers to the correct answers of the environmental knowledge questions. The share of individuals indicating *NWTK* is slightly higher for the group of low environmental knowledge, but it is still relatively low with a share of 10% of the whole sample indicating that they did not want to know the correct answers (see *Figure 4*). Not all individuals who choose the flight alternative were information averse and it is also the case that respondents had been exposed to information about the CO_2-emissions of the alternative. To critically discuss the structure of the question connected to *NWTK,* we consider the possibility that the environmental knowledge questions may have induced an element of competitiveness, not between individuals but for each individual's own interest. As a result, individuals may have been more prone to actually know the correct answers if they expected to derive more utility from informing themselves about their own performance, than disutility from exposing themselves to potentially unpleasant information about environmental conditions. A complication would be that, without the potentially competitive element, more individuals may have indicated that they did not want to know the correct answers to the environmental knowledge questions.

Another interesting finding is the interaction term between *Wishful* and *Knowledgescore.* It suggests that the negative association between wishful thinking and the probability of choosing train is even stronger for individuals with high environmental knowledge (see *Table 8* in appendix *A4)*. An interpretation could be that the negative utility from being aware of the negative environmental impacts from consumption of flight travels may be suppressed by the use of wishful thinking. If it is the case, it shows that an individual can reduce cognitive dissonance from a choice by keeping an optimistic view about the importance of their own choices for future environmental conditions. It is also supported by the fact that the share of individuals indicating the motivated belief was higher among individuals with high environmental knowledge (see *Figure 4* in section 5.1).

6.3. Policy relevance

The results of this study may have some relevant policy implications. Firstly, the results show that underlying environmental knowledge is associated with more "environmental-friendly" behavior. If policy makers want to change consumption behaviors, our study shows that underlying environmental knowledge could be an important underlying factor in consumption choices. Instead of targeting a change in people's attitudes it may be more effective to educate people on general environmental issues, making an individual's awareness about consequences of certain consumption stronger.

We have shown that individuals with preferences for flight are more prone to indicate motivated beliefs around environmental issues. If it is easy to form motivated beliefs around environmental issues to reduce dissonance, we want to argue that attacking morals, like for example the flight shame movement, might not be the most effective way to change consumption behaviors. A higher environmental knowledge level can instead increase the cost of engaging in self-deception which makes it harder for an individual to form motivated beliefs. We argue that knowledge should be spread in a more bolstering way, reducing incentives to deny, distort or avoid unpleasant information.

6.4. Limitations and further research

This study has provided interesting insights on students' choices of transport mode, well supported by literature on similar topics but different fields of consumption. To the best of our knowledge, there are no studies that addressed the importance of underlying environmental knowledge in the field of transportation consumption. Another twist to existing literature is the use of a choice experiment. This approach gives us several observations of choice situations from one individual and it lets us disentangle environmental knowledge by controlling for aspects that might interfere with the effect.

Although there are several advantages of choice experiments, there are also drawbacks. One constantly recurring discussion in stated preference methods, is the risk of hypothetical bias. Since the choices that respondents state do not have real consequences, the choices might be preferred in theory but might hard to actually follow through in practice. In this case, the bias will probably be tilted towards choosing train. The fact that respondents on average believe that climate change issues are very important makes it reasonable to assume that there is a possibility that they also regard the train option as a morally correct alternative. Hence one needs to understand the nature of a hypothetical bias and take it into account when interpreting the results of this study and other choice experiments. We approached the hypothetical bias by including a cheap talk script, reminding the respondent to answer as if it was a real-life decision. It has previously been proven useful to reduce the bias, but not eliminate it completely.

Another potential problem for external validity of the study is the focus on a student population. Students are in many aspects quite homogenous, making generalization to other groups of people very difficult. Sociodemographic variables like age, income and education that are often associated with knowledge in more general terms and they do not provide much explanatory power when students are such a homogenous group in these aspects. This is in many aspects a good thing, as it makes it easier to disentangle the effect of environmental knowledge. However, for policy relevance, these kinds of variables can be valuable. As respondents are students from the University of Gothenburg, a university that teaches with a sustainability focus, it is reasonable to think that respondents have a relatively good perception of environmental issues in general.

The final limitation that we need to discuss is the difficulty of measuring motivated beliefs. Interest for the phenomenon in economic research has increased rapidly. However, studies that process and disentangles the economic effects are very complex and out of the scope for a master's thesis. Hence it is important to only interpret the results as tendencies rather than true causal effects. In our case, we would like to extend the survey parts of motivated beliefs so that each indicator could be disentangled from individuals' preferences, providing a more accurate measurement of the phenomenon. As both time and funds where limited for this study, we hope for future research to take a more extensive approach to measuring and disentangling motivated beliefs in consumption choices.

7. Concluding remarks

This study has analyzed, through a labeled choice experiment, the association between an individual's underlying environmental knowledge and the choice between two transport modes, associated with different environmental impacts. Secondly, it has investigated the association between indicators of motivated beliefs and the choice outcome.

As general attitudes towards climate issues are positive in the sample, the results indicate that, to certain extent, there exists a value-action gap in the choice between flight and train. These findings support existing literature on attitudes and consumption, suggesting that individuals' attitudes towards an issue do not transform well into their consumption decisions (Hestermann et al., 2019; Hidalgo-Baz et al., 2017). From the results, obtained through a conditional logit model, we first conclude that, after controlling for an individual's environmental attitude, environmental knowledge is associated with a higher probability of choosing train. It implies that underlying environmental knowledge is associated with "environmental-friendly" behavior, as traveling by train is associated with a significantly lower environmental impact than flying. Secondly, we conclude that indicators of motivated beliefs, except for overconfidence, are associated with a significantly lower probability of choosing train. Connecting to the underlying theoretical framework, our results support that individuals with preferences for flight have stronger incentives to form motivated beliefs around the impacts of their consumption and are more prone to engage in self-deception.

Through interactions between environmental knowledge and each motivated belief indicator, we conclude that wishful thinking has a stronger association with the probability of choosing flight for individuals with high environmental knowledge. It may imply that wishful thinking can be used to reduce cognitive dissonance from knowing about the environmental impact of one's consumption. We also find that the interaction effect for overconfidence is the opposite, implying that overconfidence would have a stronger positive association with the probability of choosing train for individuals with high environmental knowledge. We find no clear explanation to this finding and consider the possibility that we may not have succeeded in disentangling the phenomenon of overconfidence and therefore have captured other aspects related to the question.

We have contributed to existing literature by applying relevant economic theory and methodology to the area of green consumption, providing insights to the association between underlying environmental knowledge and choices within transport consumption. Further we have contributed with a methodology for applying existing theories on cognitive dissonance and motivated beliefs to the areas of transport economics and "green" consumption. Finally, it is important to note that this study has only measured motivated beliefs as indicators, constructed from questions that reveal tendencies rather than actual behaviors. The area of behavioral economics is complex and to perfectly disentangle effects of the psychological phenomena, more extensive studies are needed. We hope that future research can develop effective ways to disentangle the effects of motivated reasoning in consumption choices.

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Appendix

A1. Information provided before choice experiment

"Welcome to take part in this survey, performed as a part of a master thesis project from the department of economics at the University of Gothenburg. The goal of the survey is to investigate the choice between two transport modes and environmental knowledge. All responses will be treated anonymously. The survey is expected to take approximately 8-10 minutes. The survey will consist of three different parts. The first part is a choice experiment in which you will face eight choices between different kinds of transportation. In the second part, we ask questions about your knowledge on environmental issues. The last part consists of general questions about you. Answer each question carefully as the questions will be locked when you move on to the next one. Thank you for taking part in our research!"

"You will be faced with a hypothetical scenario where you will be asked 6 questions about which mode of transportation you prefer (train or flight). Each question will have information about the travel time, the CO2-emissions (carbon dioxide) and the cost of each alternative. Before you answer the questions, the hypothetical scenario will be described. As we ask you to make a hypothetical decision, there is risk for a "hypothetical bias". It means that respondents may not answer as if it was a real life decision. We therefore ask you to answer truthfully and to consider your own budget when making the decision."

"The hypothetical scenario is the following:
Imagine that you are going for a weekend trip to a large city with a couple of friends. The purpose of the trip is mainly to enjoy the culture, the food and other recreational activities. Assume that both flight and train are equally available for your trip. You will be given information about the type of transport and the three corresponding attributes for each alternative (CO2 emissions, travel time and cost). All attributes are measured as the one-way trip. Remember to take your own budget into consideration. All responses will be anonymous. Here follow 6 choice sets."

A2. Environmental knowledge questions

(Correct answers are marked with **bold**. However, it was not shown for the respondent.)

1) How large share of the world's total CO_2-emissions comes from the flight industry (approximately)?

- 18%
- 45%
- **3%**

2) How much CO_2 is released per person from a return (tur och retur) flight between Stockholm and New York (approximately 12600 km)?

- 100 Kg (CO_2)
- **2200 Kg (CO_2)**
- 800 Kg (CO_2)

3) Which is the main effect on the environment from emitting CO_2?

- It contributes to acidification (försurning) of rain
- CO_2 has no specific effect on the environment
- Too high concentration is toxic for living organisms
- **It contributes to the greenhouse effect**
- High levels of CO_2 is polluting, which affects air quality and causes health problems

4) What share of the world's total coral reefs have been destroyed due to both direct human impact and warming of the oceans during the last 30 years (approximately)?

- **27%**
- 10%
- 66%

5) Which sector has the largest share of CO_2-emissions globally?

- Industry sector
- Agricultural sector
- Flight transport sector
- **Energy sector**
- Forestry and land management sector

6) How would the earth be different if there were no greenhouse effect?

- Fewer species would become extinct
- There would be no acid rain
- The ozone layer would be much thicker
- **The average temperature would be much lower**

7) What is the main drawback of renewable energy sources?

- They are expensive to run and environmentally unfriendly
- **They are geographically selective and relatively inefficient**
- They are inefficient and polluting

8) What is The Paris Agreement temperature goal for limiting global warming before the end of the century?

- **Maximum increase of 2°C**
- Maximum increase of 1°C
- No increase
- Maximum increase of 4°C

A3. Questions for motivated beliefs

NWTK ("not wanting to know"):

1) Would you like to know the correct answers to the knowledge questions in part 1? (If you answer yes you will get the correct answers in the next step. Please remember to finish the study)

- No
- Yes

Denial:

2) On a scale from 1-5, how trustworthy do you believe information about climate change is in general?

- 1 (Not trustworthy at all)
- 2
- 3
- 4
- 5 (Very trustworthy)

Wishful Thinking:

3) On a scale from 1-5, how likely do you think it is that technology will solve the major problems of global warming?

- 1 (Not likely at all)
- 2
- 3
- 4
- 5 (Extremely likely)

Overconfidence:

4) Out of the 8 questions you just answered, how many questions do you think that you answered correctly?

- 0
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8

A4. Regression output, motivated beliefs and interaction terms

Table 8. Regression output, motivated beliefs and interaction terms

Alternative specific variables	**Model. 8**	**Model. 9**	**Model. 10**	**Model. 11**
$CO_{2_{Flight}}$	0.00121	0.00117	0.00115	0.00118
	(0.00119)	(0.00119)	(0.00119)	(0.00119)
$CO_{2_{Flight}}$	-0.0308***	-0.0303***	-0.0301***	-0.0304***
	(0.00863)	(0.00861)	(0.00861)	(0.00863)
TT_{Flight}	-0.366***	-0.364***	-0.363***	-0.364***
	(0.0354)	(0.0353)	(0.0353)	(0.0354)
TT_{Train}	-0.457***	-0.455***	-0.455***	-0.455***
	(0.0257)	(0.0256)	(0.0256)	(0.0256)
$Cost_{Flight}$	-0.00211***	-0.00209***	-0.00209***	-0.00210***
	(0.000166)	(0.000165)	(0.000165)	(0.000165)
$Cost_{Train}$	-0.00378***	-0.00378***	-0.00377***	-0.00378***
	(0.000173)	(0.000173)	(0.000173)	(0.000173)
Case specific variables				
Flight: **(Base alternative)**	-	-	-	-
Train:				
Knowledgescore	0.890***	0.645***	0.696***	0.465***
	(0.133)	(0.0803)	(0.0879)	(0.120)
Wishful	-0.158*			
	(0.0927)			
*Wishful*Knowledgescore*	-0.353**			
	(0.159)			
NWTK		-0.326**		
		(0.152)		
*NWTK*Knowledgescore*		0.0133		
		(0.246)		
Denial			-0.114	
			(0.100)	
*Denial*Knowledgescore*			-0.166	
			(0.168)	
Overconfidence				-0.0671
				(0.103)
*Overconfidence*Knowledgescore*				0.424***
				(0.157)
ASC_{Train}	2.495***	2.407***	2.493***	2.395***
	(0.406)	(0.400)	(0.407)	(0.407)
Observations	10,728	10,728	10,728	10,728

(Note: Co_2 is measured in kg of emission. ***TT*** is short for travel-time and is measured in hours and ***Cost*** is measured in SEK. *Knowledgescore* is binary and indicates if a person has a high or low environmental knowledge. ***ASC*** is the alternative specific constant for train. Alternative specific variables assess the probability of choosing an alternative if the attribute level increase. Case specific variables asses the probability of choosing train compared to flight. Indicators of motivated beliefs are represented by ***Wishful*** as wishful thinking, ***NWTK*** as "not wanting to know", ***Denial*** as denying new information and ***Overconfidence*** as overestimation of abilities Interaction terms are generated in Stata, using ##, in order to tell the program to deal with interactions in non-linear models.)

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1