

# UNDERSTANDING ONLINE PAYMENT METHOD CHOICE: AN EYE-TRACKING STUDY

*Research-in-Progress*

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## Abstract

*Due to the impact of online payment on the development of e-commerce, this article seeks to deepen the current understanding about the determinants of online payment method choice. Based on an extensive literature review, we identified perceived trustworthiness of the seller and perceived product uncertainty as major determinants, and we theorize that product type, product price, and product description are antecedents of product uncertainty. In our theoretical framework, we model perceived trustworthiness of the seller and perceived product uncertainty as independent variables, which are hypothesized to predict the dependent variable, namely online payment method choice (credit card, debit card, or cash on delivery). Moreover, we define payment method characteristics (e.g., information security) and buyer characteristics (e.g., trust propensity, online shopping experience) as control variables. Also, we describe a laboratory experiment in which we test our theoretical framework. Considering the recent calls for the use of neurobiological and physiological approaches to advance information systems (IS) theorizing (see, for example, [www.NeuroIS.org](http://www.NeuroIS.org)), we suggest using eye-tracking data to complement traditional data sources, particularly those captured through survey research. Specifically, we propose that eye-tracking data can be used to measure product uncertainty, a major predictor of online payment method choice, which is associated with unconscious and automatic information processing that cannot be articulated easily through self-reports.*

**Keywords:** NeuroIS, online payment method choice, trust, uncertainty, eye-tracking

## Introduction

Information and communication technologies, in particular the Internet, have dramatically changed the context in which economic transactions take place. As a consequence of several advantages (e.g., effortless price comparison, availability of customer reviews; Chiou and Ting 2011), online shopping has become a significant concept in modern societies. With the rapid growth of online shopping, online consumer behavior has emerged as a major research area in various scientific disciplines such as psychology, marketing, as well as Information Systems (IS) research. While many of the early studies in these disciplines focused on how consumers adopt and use online shops (e.g., Gefen et al. 2003), more recent investigations pay specific attention to purchase and repurchase behavior (e.g., Liu and Hung 2010). However, despite this increasing shift towards (re)purchase behavior, only a limited number of studies so far have investigated *online payment*, a fundamental process necessary to complete business transactions on the Internet.

With the development of e-commerce, there is an ongoing transformation of payments from bricks-and-mortar to online methods (e.g., electronic-cash-equivalents, third party payment such as *PayPal*). The Hamburg-based market research firm *yStats.com*, for example, recently analyzed the global e-commerce payment trends, based on data from 41 nations on 6 continents (see the *Global Online Payment Methods 2011 Market Report*). The results show that in North America and Europe the market share of credit card payments in e-commerce accounted for approximately 40% in 2010. The study, however, also reveals that there are significant differences between countries and continents. For example, while credit card payments in e-commerce accounted for 60% in Great Britain and France, credit card purchases in online environments accounted for only 20% in Germany, where the most popular payment method is payment by invoice. Moreover, the study reveals further interesting details. In Latin America, for example, credit card payments are the preferred payment option accounting for 70% of all online purchases, while in China cash payments are the most popular online payment method, with a share of more than 90%. Altogether, however, both scientific and market research show that electronic payment methods are becoming increasingly adopted, mainly due to their advantageous characteristics such as convenience (e.g., Cotteleer et al. 2007; Kousaridas et al. 2008).

At the same time, however, widely publicized cases of fraud, in particular those pertaining to the use of credit cards, have been a major barrier to the acceptance of electronic payment methods. The *Gartner Group*, for example, reported that 95% of customers were concerned about security and privacy issues when they use credit cards on the Internet (cited after Kim et al. 2010). Obviously, the anonymity afforded by the Internet is a main driver of strong uncertainty perceptions, which in turn make Internet users report security and privacy issues in surveys.

Due to the significance of online payment for the prosperous development of e-commerce, as well as the fact that there are only a few studies available today on this topic, we address two main research questions in this article to contribute to a more complete theoretical understanding about the determinants of online payment method choice:

1. *What factors influence users' online payment method choice?*
2. *How can eye-tracking data be used to measure product uncertainty, which is a major determinant of online payment method choice?*

We have chosen these two questions for several reasons. First, as already indicated, research on online payment methods, in contrast to other topics, is limited. This holds true not only for IS research, but also for research in other scientific disciplines (e.g., psychology, marketing, finance). Second, we have a focus on the trustworthiness of online sellers, as well as product uncertainty, as important determinants of online payment method choice because these two constructs have been made the subject of intensive discussion in the IS literature during the past decade. Hence, a rich body of research exists, which may serve as a conceptual basis for the present study. Third, uncertainty has been described recently as highly appropriate for investigation by means of neurobiological and physiological approaches, because uncertainty perceptions are associated with unconscious and automatic information processing mechanisms that cannot be articulated easily through self-reports (Dimoka et al. 2010; Riedl et al. 2010).

Consequently, traditional questionnaire-based data sources should be complemented by physiological data to strengthen the robustness of research findings.

In the present study, we use *eye-tracking* (i.e., the behavior of the users' visual system) as an additional method to survey instruments in the setting of a laboratory experiment. In the context of the present article, this is expected to make possible a deepened understanding about the role of uncertainty perceptions for online payment method choice. Because eye-tracking is a method which has only recently begun to come into focus in IS research (see, for example, an article using eye-tracking complementary to other methods by Cyr et al. (2009) in the context of online trust research), the present article also seeks to make a contribution to this upcoming stream of research.

The remainder of this article is structured as follows: In the next section, we will review work on (i) online payment methods, (ii) determinants of consumers' payment method choice, (iii) perceived trustworthiness of sellers in online environments, and (iv) product uncertainty perceptions in online environments. Afterwards, we present a theoretical framework in which we summarize the discussions of the previous sections. Then, we continue with a discussion of eye-tracking. In particular, we show how to use specific eye-tracking metrics for the measurement of product uncertainty. Based on these theoretical and methodological foundations, we briefly outline the structure of a laboratory experiment that we plan to conduct in 2011. Finally, we present conclusions.

## Online Payment Methods

Hove and Farhod (2011) identify six groups of payment methods by combining the time dimension (i.e., pay-before, pay-now, and pay-later) and the medium of payment (i.e., paper or electronic). Pay-before requires buyers to deposit funds into an account prior to the actual purchase. This method of payment includes stored-value cards, prepaid cards, and gift cards. Pay-now refers to payments settled (almost) immediately, using methods such as cash on delivery and debit cards. Pay-later allows the buyers to consume the products or services first and then settle the account later, using such methods as credit cards and charge cards. Polaski and Fiszeder (2009) further categorize the electronic payment methods into transactions conducted through banks and transactions without banks' intermediation.

Another important characteristic in online shopping is the separation between payment and delivery. Based on this, online payment methods can be grouped along two categories: payment-before-delivery (e.g., online bank transfers, pre-cards, credit cards, and debit cards) and payment-after-delivery (e.g., cash on delivery). The payment-before-delivery method may make buyers perceive that they are getting the short end of the bargain because they have to pay in advance. They may feel deceived when they receive a product that does not meet their expectations and find that they cannot obtain a refund. Payment-after-delivery, in contrast, grants buyers the advantage of physical examination of the product once they receive it. Buyers have the option to refuse payment, if they are dissatisfied with the product. Therefore, this payment method is better suited in situations in which seller and buyer do not know each other personally.

The separation between payment and delivery highlights the problem of payment security. In essence, payment-after-delivery provides a higher degree of security than payment-before-delivery. Information security is another concern when purchasing online (Pavlou et al. 2007). Detailed credit card information may be misused by sellers or stolen by hackers (Glover and Benbasat 2010-11), resulting in weak customer protection. Moreover, buyers have stronger uncertainty perceptions in online than in traditional environments because they cannot taste, smell, touch, and try products. Importantly, such uncertainty perceptions may increase the chance of demanding refunds. The buyers' ability to cancel their purchase or ask for a refund is a security issue as well, affecting their choice of payment method.

## Determinants of Consumers' Payment Method Choice

Mainstream payment methods in bricks and mortar transactions are cash, checks, debit cards, and credit cards (Foster et al. 2011). In contrast, in online environments electronic-cash-equivalents (Kim et al. 2010), cash on delivery, third party payment (e.g., *PayPal*), as well as credit and debit cards are used. However, a possible starting point for research on the determinants of online payment method choice are

studies investigating payment method choice in traditional environments (Lee et al. 2011). Thus, in the following we review studies on traditional payment methods choice.

Many studies have investigated the effect of transaction types, payment method attributes (risk, convenience, and cost), and demographic variables on consumers' payment method choice (Carow and Staten 1999; Foster et al. 2011; Ho and See-To 2010; Klee 2008; Lo and Harvey 2011; Sorkin 2002; Sprenger and Stavins 2008). More recent papers also discuss the influence of price-related variables such as rewards (Ching and Hayashi 2010), interest charges (Zinman 2009), and price incentives (Simon et al. 2010).

Altogether, extensive investigation of the literature reveals that consumer payment method choice is mainly determined by three types of characteristics (which can be sub-divided into further factors), namely those pertaining to the (i) transaction, (ii) payment method, and (iii) consumer (Bounie and Francois 2009). We summarize the result of our literature review in Table 1. A marked cell indicates that the respective author(s) did discuss this particular determinant, while a blank cell indicates that the respective author(s) did not. In the following, we briefly discuss exemplary studies within each of the three categories.

<b>Table 1. Determinants of Consumer Payment Method Choice</b>						
	Transaction Characteristics			Payment Method Characteristics	Consumer Characteristics	
	Transaction Context	Product Price	Product Type	Perceived Risk	Payment Method Adoption	Demography
Batra and Ahtola (1990)			•			
Bounie and Francois (2009)	•	•			•	•
Carow and Staten (1999)	•	•				•
Ching and Hayashi (2010)	•	•		•	•	•
Chiou and Ting (2011)			•			
Foster et al. (2011)	•			•	•	•
Glover and Benbasat (2010-11)				•		
Hayshi and Klee (2003)	•					•
Ho and See-To (2010)		•				
Jarvenpaa et al. (2000)			•			
Klee (2008)	•	•				•
Lo and Harvey (2011)		•	•			•
Simon et al. (2010)		•				
Tsiakis and Sthephanides (2005)				•		
Zhang and Li (2006)			•	•		•

Prior studies report that transaction characteristics (e.g., transaction context, product price, and product type) may have an influence on payment method choice. Bounie and Francois (2009) report about the major role of the *transaction context* (e.g., store type: small store, supermarket, and department store) in choice between cash and alternative payment methods at the point of sale. Hayashi and Klee (2003) indicate that *product price* affects payment method choice. Similarly, Bounie and Francois (2009) report that the probability of cash use declines as the transaction amount increases. With respect to *product type*, Batra and Ahtola (1990) emphasize two important dimensions of products: hedonic satisfaction and utilitarian function. Typically, hedonic satisfaction is more difficult to evaluate before purchase than utilitarian function. Thus, hedonic satisfaction is more related to product uncertainty than utilitarian function. Zhang and Li (2006) found a positive relationship between the use of cash-equivalents and product uncertainties. However, with the reduction of product uncertainty, more consumers prefer to pay by credit card.

In the context of online shopping, transactions can occur without any human contact. Hence, *perceived risk* has been shown to be an important determinant of consumers' use of e-payment systems (Kim et al. 2010; Tsiakis and Sthephanides 2005). Glover and Benbasat (2010-11) found that perceived risk in online transactions is an aggregate factor with three dimensions, namely risk of functionality inefficiency, risk of information misuse, and risk of failure to gain product benefit. Obviously, in particular the second factor is closely associated with payment methods because using credit cards, for example, implies information disclosure. Moreover, Zhang and Li (2006) investigating eBay traders found that product attributes, especially uncertainty associated with product quality, appears to have a stronger influence on payment method choice than trader characteristics.

In a survey on consumer payment choice (Foster et al. 2011), current and historical *payment method adoption* is identified as an important determinant of payment method adoption behavior, both in traditional and online environments. *Demographic variables* have also been shown to affect payment method choice. For example, older individuals tend to use cash more than younger people, and higher income individuals are more likely to use credit cards than debit cards (Simon et al. 2010).

## Perceived Trustworthiness of Sellers in Online Environments

Trust has been one of the major topics in IS research during the past two decades, both in North America (Sidorova et al. 2008) and Europe (Steininger et al. 2009). Importantly, there is reason to assume that trust will remain an important research topic in the future, particularly due to the continuous expansion of the role of the Internet which is characterized by a high degree of anonymity, thereby increasing uncertainty perceptions of online users (Pavlou et al. 2007), which in turn are strongly interrelated with trust (Pavlou 2003). Over the past years, special issues have been published on trust, signifying the importance of the topic (e.g., *JMIS* 2008, Vol. 24, No. 4, and *MISQ* 2010, Vol. 34, No. 2). Moreover, reviews on empirical research in online trust are available (e.g., Grabner-Kräuter and Kaluscha 2003), indicating the maturity of this research stream.

The analysis of an online trust situation (e.g., buying a product in an online shop) is focused on settings involving two specific parties: a trusting party (trustor) and a party to be trusted (trustee). Once a trustor (typically the buyer) and a trustee (the seller) start to interact via the Internet (i.e., a seller offers a product for sale and a buyer views the offer), the trustor can perceive and process information illustrated on the screen of a computer system. This information may be textual, graphical, or a blend of both (e.g., product price, picture of the product, and product description).

A buyer processes this information to learn more about the product for sale. However, the information is also used to infer the seller's characteristics, thereby making possible predictions regarding his/her trustworthiness (Riegelsberger et al. 2005). From the viewpoint of the seller, information provision serves the purpose of signaling trustworthiness. Important characteristics of a trustee, which together constitute a seller's trustworthiness, are ability, benevolence, and integrity (Mayer et al. 1995). If a buyer believes in the trustworthiness of a seller, he/she believes that the seller (i) has skills and competencies that are important for the relationship (ability), (ii) wants to do good to the buyer aside from an egocentric profit motive (benevolence), and (iii) adheres to a set of principles that the buyer finds acceptable (integrity).

## Product Uncertainty Perceptions in Online Environments

In cyber markets, interaction between sellers and buyers is mediated by technology. Buyers cannot directly inspect the product for sale. Thus, the problem of *information asymmetry* is more pronounced in online than in traditional markets. Information asymmetry often leads to adverse selection (i.e., hidden information), because the evaluation of a seller's intentions and the assessment of a product's true quality are difficult for buyers, especially when sellers intentionally misrepresent themselves and their products. Moral hazard (i.e., hidden behavior) is another problem. After committing to the purchase, it becomes more difficult for consumers to monitor a seller's intentions of honoring their side of the contract, providing aftersales service, and safeguarding private information. As a consequence, buyers develop uncertainty perceptions, which may pertain to sellers and their products (Dimoka and Pavlou 2008; Ghose 2009; Mavlanova and Benbunan-Fich 2010-11; Pavlou et al. 2007). To overcome these perceptions, signaling theory has been successfully used to understand how cues/signals support consumers in making

accurate assessments of seller and product quality (Wells et al. 2011). Examples of applications of this theory can be found in the following studies: Dimoka et al. (2011), Ghose (2009), Kim et al. (2004), Kimery and McCord (2006), Mavlanova and Benbunan-Fich (2010-11), Pavlou et al. (2007), and Yen (2006).

The technology-mediated environment makes evaluating a product's true quality more difficult for buyers. At the same time, product understanding is one of the most salient factors in creating online shopping intention (Jarvenpaa and Todd 1996-1997). However, earlier studies have not distinguished between product uncertainty and seller uncertainty or subsumed product uncertainty under seller uncertainty. Dimoka and Pavlou (2008) first conceptualized the distinction between seller and product uncertainty. Examining the trade patterns in online markets, Ghose (2009) provided further evidence for the necessity to consider seller and product uncertainty as separate constructs. However, although product uncertainty should be distinguished from seller uncertainty, it is affected by the latter (Wells et al., 2011). Moreover, it has been shown that product uncertainty has a stronger effect on price premiums and actual purchase behavior than seller uncertainty (Dimoka et al. 2011). Therefore, in this article we focus on product uncertainty perceptions.

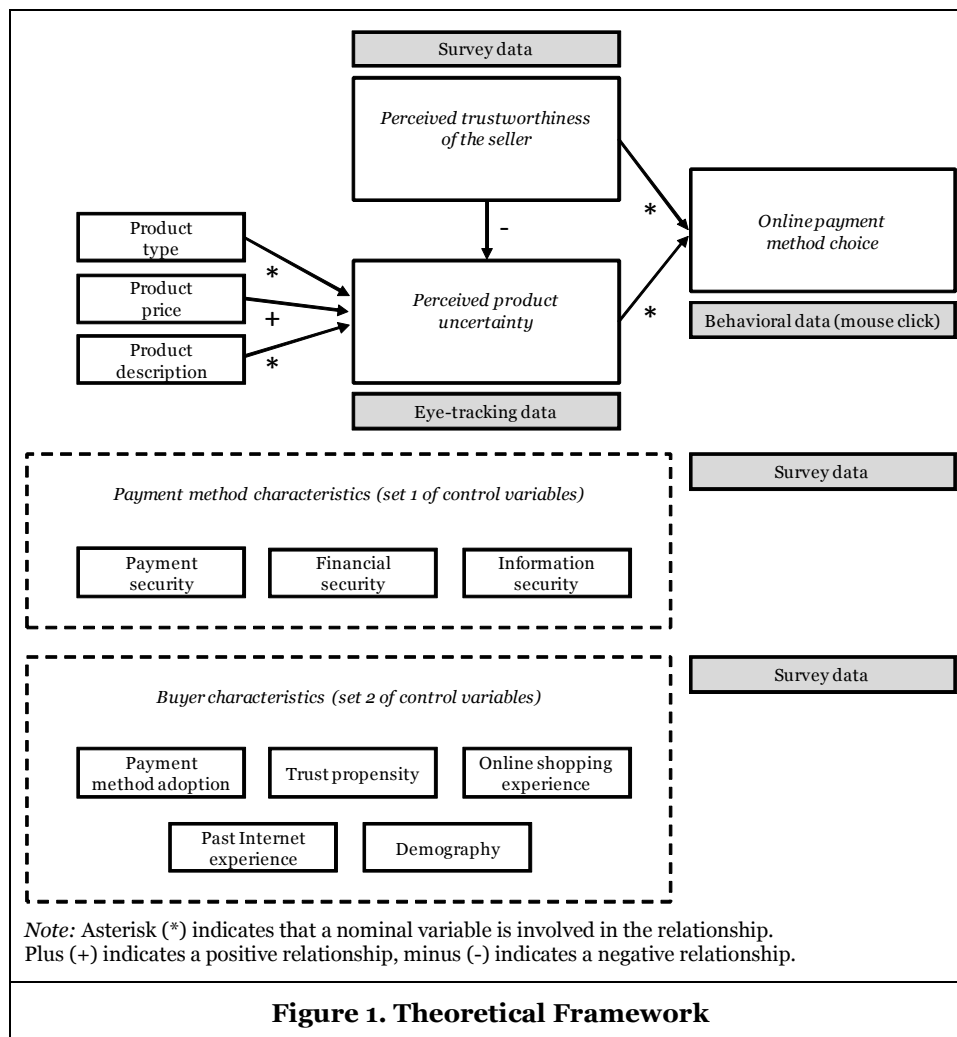
Uncertainty in a product is caused by doubts over the product's true quality and future performance (Dimoka et al. 2011). Generally, buyers can obtain product information from sellers (i.e., product description), buyers (i.e., feedback on product quality), third-parties (i.e., expert review or product certification), as well as product recommendation agents (Mudambi and Schuff 2010). Several effective signals have been identified and used to reduce product uncertainty. Wells et al. (2011) identified the quality of an online retailer's website as a potential signal of product quality, and confirmed that this effect influences online purchase intention. Dimoka and Pavlou (2008) confirmed that third-party product certification may affect a buyer's product uncertainty perceptions.

Product descriptions are a highly effective way to reduce customers' product uncertainty perceptions (Dimoka and Pavlou 2008). Texts are the most common and popular signals of communicating product description and quality. Based on Toulmin's model of argumentation, Riedl et al. (2010) examined the effect of different product descriptions on the perceived trustworthiness of Internet offers. Other advanced product presentations, such as those in video and multimedia formats, dramatically influence customers' potential understanding of a product (Jiang and Benbasat 2007a, 2007b). However, it has been argued that textual descriptions and visual representations can be more effective than multimedia tools (Dimoka et al. 2011).

## **Theoretical Framework**

Based on our discussions in the previous three sections (Determinants of Consumers' Payment Method Choice, Perceived Trustworthiness of Sellers in Online Environments, Product Uncertainty Perceptions in Online Environments), we propose a theoretical framework (see Figure 1) with the following constructs and relationships (measurement techniques are indicated in the boxes with gray background color):

- Dependent variable: Online payment method choice (behavioral data).
- Independent variable 1: Perceived trustworthiness of the seller (survey data).
- Independent variable 2: Perceived product uncertainty (eye-tracking data).
- Antecedents of product uncertainty: product type, product price, and product description (eye-tracking data).
- Control variables (set 1): Payment method characteristics: payment security, financial security, and information security (survey data).
- Control variables (set 2): Buyer characteristics: payment method adoption, trust propensity, online shopping experience, past Internet experience, demography (survey data).



Based on our theoretical framework, we propose the following hypotheses:

- H1: A higher degree of perceived trustworthiness of the seller results in the choice of riskier online payment methods.*
- H2: A higher degree of perceived product uncertainty results in the choice of less risky online payment methods.*
- H3: A higher degree of perceived trustworthiness of the seller results in a lower degree of perceived product uncertainty.*
- H4: Product type: Hedonic products (e.g., sunglasses) result in a higher degree of perceived product uncertainty than utilitarian products (e.g., digital camera).*
- H5: Product price: High-price products (e.g., €500) result in a higher degree of perceived product uncertainty than low-price products (e.g., €25).*
- H6: Product description: Product descriptions based on Toulmin's model of argumentation containing "data + claim + backing + rebuttal" result in a higher degree of perceived product uncertainty than product descriptions containing "data + claim + backing."*

In addition to these main hypotheses, a number of payment method characteristics and buyer characteristics are used as control variables (see Figure 1).

## Eye-Tracking

The eye is our major sense for acquiring information from the external environment. Eye-tracking is a method which makes possible the measurement of an individual's eye movements and pupil dilation when looking at a stimulus (e.g., website). Thus, a researcher knows where a person is looking at any given time, the sequence in which the eyes are shifting from one location to another, as well as the dilation of the pupils (Poole and Ball 2006). The justification of the use of eye-tracking in disciplines like psychology, marketing, human-computer interaction, and IS research is based on the assumption that what an individual is looking at indicates what this individual is currently perceiving, thinking about and/or attending to—this is the so-called *eye-mind hypothesis* (Just and Carpenter 1976). In other words: Eye movements can reveal perceptual, affective, and cognitive processes (Jacob and Karn 2003), which in turn can be used to predict and interpret human behavior.

In order to understand the possible benefits of eye-tracking for theoretical advancements in IS research, a basic understanding about major metrics is necessary. The following discussion is based on four articles: Ehmke and Wilson (2007), Poole and Ball (2006), Russo (2011), and Wang (2011).

The use of eye-tracking technology makes possible the measurement of gaze locations, time length of fixations, and pupil dilation. Thus, researchers can investigate how (i) fixations (a moment where the eye is more or less motionless, typically within a range of 50 to 500 milliseconds), (ii) saccades (a quick movement between two fixations, typically lasting for 20 to 35 milliseconds), and (iii) pupil dilation (enlargement or shrinkage) are related to the visual information provided by a stimulus and subsequent behavioral reactions. Researchers usually define areas of interest (AOI) to analyze eye-tracking data, whereby these AOIs are specified over certain parts of an interface under investigation (e.g., elements of a website such as product picture, product price, and product description). One fundamental question in eye-tracking is the meaning of such metrics. In the present study, we have a focus on two metrics, namely fixation duration and pupil dilation.

What does a *longer fixation duration* on a specific AOI mean? Cognitive neuroscience research (Fiorillo et al. 2003) has shown that attention is a result of uncertainty. Thus, a longer fixation duration is expected to reflect a higher degree of uncertainty. What does *dilation of the pupils* mean? Although research (see, for example, a review by Wang 2011) has shown that pupil dilation responses may be caused by multiple factors (e.g., arousal, pain, listening to sounds, memory load, and stress), it is a well-known fact that dilation of the pupils is often a consequence of the perception of negative emotions such as uncertainty. If the sympathetic division of the autonomic nervous system is activated (usually due to the perception of uncertainty in stressful situations), the pupil is enlarged.

Against this background, we posit that the complementary use of fixation duration and pupil dilation may serve as a reliable indicator to measure perceived product uncertainty. A long fixation duration *and* an enlargement of the pupils indicate a high degree of product uncertainty, while a short fixation duration *and* a shrinkage of the pupils indicate a low degree of product uncertainty.

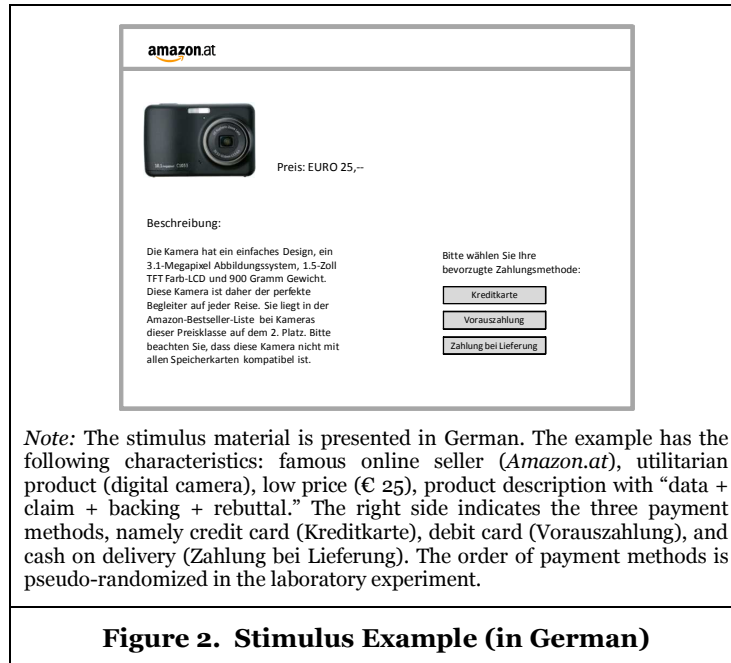
## Laboratory Experiment

We test our theoretical framework (see Figure 1) by using a 2 x 2 x 2 x 2 within-subjects factorial design: two online merchants (famous vs. unknown), two product types (hedonic vs. utilitarian), two price levels (high vs. low), and two types of product descriptions based on Toulmin's model of argumentation. *Amazon.at* is one of the most popular online shopping websites in Austria. We use this site to represent a famous online retailer. To represent an unknown online retailer, we use the site *Icson.com*, a Chinese online firm that is totally unknown in Austria. With respect to product type, we select sunglasses as an example for a hedonic product and digital cameras as an example for a utilitarian product. With respect to product price, we found—based on a pretest—that €25 is an amount that is perceived as a low price in the context of online shopping, while €500 is perceived as a high price. Regarding product description, we use two manipulations based on Toulmin's model of argumentation, namely “data + claim + backing” and “data + claim + backing + rebuttal.”

In Europe, the most popular online payment method is the credit card (56%), followed by bank transfers (28%), and alternative methods of payment include cash on delivery, virtual payment providers (e.g.,



PayPal), and debit cards (Polasik and Fiszeder 2009). Credit cards, debit cards, and cash on delivery are the three most widely used online payment methods in Europe (*Global Online Payment Methods 2011 Market Report*). Hence, this study focuses on these three online payment methods. Figure 2 shows a stimulus example.



Students of an Austrian university serve as participants. Participants are instructed to collect any important information presented on the computer screen (without time pressure), with the goal of choosing a preferred online payment method in placing an order (see the three gray buttons in Figure 2). During the study, we use eye-tracking technology to record eye-related metrics. In particular, we use fixation duration and pupil dilation to measure perceived product uncertainty. Participants also complete questionnaires in order for us to collect our survey data (see Figure 1). We use validated instruments to collect survey data, examples are an instrument published in Pavlou et al. (2007, p. 136) for the measurement of perceived trustworthiness of the seller and the Rotter (1967) scale to measure trust propensity.

## Conclusion

This article attempts to extend the current understanding about online payment method choice using a multi-method approach (eye-tracking and survey data). To our knowledge, there is no study exploring online payment method decisions with eye-tracking technology. Thus, the main contribution of the present study is that it investigates an existing thematic domain (online payment) based on an innovative measurement technique (eye-tracking), thereby attempting to reveal new insights into the determinants of online payment method choice.

Recent neurobiological evidence suggests that emotions play a central role in human decision-making (e.g., Sanfey et al. 2003). Fixation duration and pupil size, in particular, are effective physiological signals of emotions that are based on the visual system (Barreto et al. 2007; Partala and Surakka 2003). Under perceptions of uncertainty, specific targets are typically fixated longer and the pupils are enlarged. Thus, the behavior of the human visual system can complement mainstream measurements (in particular those based on questionnaires), thereby strengthening the conclusions about relationships among constructs. Obviously, an enhanced theoretical understanding of the determinants of online payment method choice will not only contribute to academic research, but also has practical implications for online merchants.

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