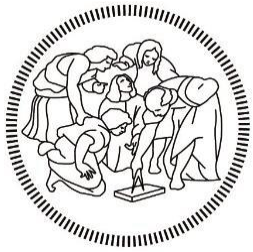

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MILANO 1863

Department of Management, Economics and Industrial Engineering

In the mood for impulse buying

An investigation of the influence of mood on online impulse buying

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POLITECNICO DI MILANO

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Abstract

Recently, in the field of marketing, the online environment became more and more important; in parallel, the focus shifted from the traditional buying decision-making process to the emerging phenomenon of impulse buying. Customers do not always follow the rational five-step choice model, but often make sudden and immediate online purchase with no pre-shopping intentions, grossly violating the assumptions of *homo economicus*. Joining these two concepts, the scope of this research is to investigate what are the precursors of the online impulse buying behavior.

The present thesis starts with a Systematic Literature Review with the aim of gaining a deep understanding on the phenomenon and of the current state of research. The main gap highlighted is the little attention given to customer's internal characteristics. For this reason, this research investigates how the mood influences the online impulse buying behavior.

In order to achieve this objective, a laboratory experiment is designed and implemented. The experimental investigation involves 16 subjects interacting with an e-commerce website after a mood induction procedure, whose effectiveness was previously tested with an online survey with more than 100 respondents. The responses were collected both in form of self-reported surveys and of physiological signals – heart rate, electroencephalogram activity and electrodermal activity – to gain deep insights on the affective and cognitive states of the users.

The results of the experiment provide evidence that both the positive and the negative mood influences the online impulse buying. Furthermore, the study reveals the great importance of the personality traits of the subjects that have an impact on the impulse buying but also on the elicited mood.

Conclusively, based on these empirical results, managerial implications are drawn. From a business perspective the aim is to provide a guideline to trigger impulsive behavior; from a policy makers perspective, the aim is to provide a framework to regulate this behavior and avoid that it leads to a more dangerous compulsive one.

Sintesi

Recentemente, nel campo del marketing, il contesto online è divenuto sempre più importante; al contempo, l'attenzione si è spostata dal tradizionale processo decisionale di acquisto al fenomeno emergente dell'acquisto di impulso. I consumatori non seguono sempre le cinque fasi del modello di scelta razionale, ma spesso incorrono in improvvisi ed immediati acquisti online, senza averne precedente intenzione, violando le assunzioni di *homo economicus.* Questo studio si pone lo scopo di indagare quali sono i precursori del comportamento di acquisto di impulso online.

La presente tesi si apre con una review sistematica della Letteratura con l'obiettivo di approfondire il fenomeno e lo stato attuale della ricerca. La principale lacuna emersa è la scarsa attenzione data alle caratteristiche personali del consumatore. Per questo motivo, questa ricerca indaga come il mood influenza il comportamento di acquisto di impulso online.

A tal fine, un esperimento di laboratorio viene concepito e realizzato. L'indagine sperimentale coinvolge 16 soggetti che interagiscono con un sito di e-commerce in seguito a una procedura di induzione del mood, la cui efficacia è stata testata in precedenza con un survey online a cui hanno risposto più di 100 soggetti. Le risposte sono state raccolte sia sottoforma di auto-dichiarato dai questionari, sia di segnali fisiologici – frequenza cardiaca, attività elettroencefalografica e attività elettrodermica – per raccogliere un'approfondita visione sullo stato affettivo e cognitivo dell'utente.

I risultati dell'esperimento mettono in evidenza come sia il mood positivo che negativo influenzano l'acquisto di impulso online. Peraltro, lo studio rivela la grande importanza della personalità dei soggetti, la quale ha un impatto non solo sull'acquisto di impulso ma anche sul mood.

In conclusione, sulla base dei risultati empirici, vengono proposte implicazioni manageriali. Da una prospettiva di business, lo scopo è quello di fornire una linea guida per innescare comportamenti di acquisto impulsivo; da una prospettiva di policy makers, l'obiettivo è fornire un quadro per regolare questi comportamenti ed evitare che conducano a comportamenti compulsivi più pericolosi.

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INTRODUCTION

Marketing research has been interested in buying behavior since its early days.

Online shopping behavior (also called online buying behavior and Internet shopping/buying behavior) refers to the process of purchasing products or services via the Internet. The process consists of five steps similar to those associated with traditional shopping behavior (Lai & Liang, 2000). In the typical online shopping process, when potential consumers recognize a need for some merchandise or service, they go to the Internet and search for need-related information. However, rather than searching actively, at times potential consumers are attracted by information about products or services associated with the felt need. They then evaluate alternatives and choose the one that best fits their criteria for meeting the felt need. Finally, a transaction is conducted, and post-sales services provided (Li & Zhang, 2002).

Traditionally, online purchasing act is seen as a rational process and thus consumers follow the five-step choice model:

1. problem recognition,
2. information search,
3. evaluation of alternatives,
4. purchase decision,
5. post-purchase evaluation.

Research output reported so far in this field, highlighted that the Theory of Reasoned Action and its family theories including the Technology Acceptance Model and the Theory of Planned Behavior are the dominant theories in this area.

Theory of Reasoned Action (Fishbein & Ajzen, 1975), refers to the willingness of performing a specific action under an established situation, and is determined by the behavioral attitude and the subjective norms.

Theory of Planned Behavior is an extension of the precedent theory and adds two more constructs to the model of "attitude towards behavior" influencing "behavioral intention" influencing "behavior". One is "Subjective norms" defined as perceived social pressure to perform or not to perform the behavior. Other is "Perceived behavioral

control" defined as perception of the ease or difficulty of performing the behavior of interest (Ajzen, 1991).

Technology Acceptance Model is the most cited (Cha, 2011) model which explains adoption of Information Technology through adopting Theory of reasoned action. It is specific to information system usage which is dependent upon six variables namely: "perceived usefulness", "perceived ease of use", "attitude towards use", "intention to use" and "actual usage" (Davis, 1989).

These socio-cognitive models suggest that behavior is inherently intentional and ultimately driven by perceived personal or social consequences.

However, evidence exist that this is not always the case and research studies have often highlighted the existence of deviances from the rational choice model. Indeed, the center of recent marketing studies shifted from the traditional buying decision-making process to the emerging phenomenon of impulse buying. The underlined reason behind this phenomenon relies on the fact that customers do not always follow the rational five-step choice model. Impulsive buying grossly violates the assumptions of *homo economicus*, thus it needs more appropriate models for its description.

A first and simple definition of impulse buying was given by Beatty and Farrell: it is a sudden and immediate purchase with no pre-shopping intentions (Beatty & Ferrell, 1998).

Rook was the first to give importance to emotions, defining impulse buying as "a sudden and immediate purchase with no pre-shopping intentions, that occurs after experiencing an urge to buy; therefore, impulse buying is characterized by reduced information processing and cognitive and affective reactions, thus often being based on a product's ability to evoke excitement or joy" (Rook D. W., 1987).

As this phenomenon gained importance day by day, many studies are trying to identify the factors that influence this behavior (e.g., consumer characteristics, store characteristics, situational stimuli, and product characteristics).

The online impulse buying behavior is an area of interest from many perspectives. First of all, from a managerial point of view. Indeed, even a small proportion of impulse purchases on each shopping trip can contribute significant annual incremental sales (Rostoks, 2003). Impulse purchases can increase retail sales and profits, especially for high-margin products. Impulse buying can be triggered by both factors internal to

consumers and external marketing stimuli. For this reason, it may be possible to identify consumers prone to impulse buying but also specify environmental factors that may encourage impulse buying. Marketers could identify a distinct impulse buying segment and then design the shopping environment to make their impulse buying more likely. Industry characteristics also matter in impulse buying, so managers need to understand how the industry context moderates the impacts of various consumer traits, motives, and resources on impulse buying (Iyer, Blut, Xiao, & Grewal, 2019).

In the context of hedonic products, the large majority of people shows the tendency to buy impulsively. It is mainly due to changes in consumption, related to the increase of the average personal income and to different lifestyles. Customers with greater interest in a product category are more likely to engage in impulse buying, whereas those who lack the necessary resources (time, money) engage less in this behavior (Hoch & Loewenstein, 1991) (Jones, Reynolds, Weun, & Beatty, 2003) (Kacen & Lee, 2002). Moreover, financial constraints suppress impulse purchases (Rook & Fisher, 1995).

With advances in information technology and the enormous growth of e-commerce, online impulse buying has become an epidemic. Since this caused changes in the behavioral patterns, researchers shifted their attention from offline to online impulse buying behavior. In fact, the online environment seems to be more conducive to impulse-buying behavior than its offline counterpart because it frees consumers from any constraint e.g. store location (Chan, Cheung, & Lee, 2017). Technological innovations such as the cash machine, home-shopping television programs, and the Internet facilitate quick and effortless consumption, so that today the opportunities to buy impulsively occur more often than ever before (Strack, Werth, & Deutsch, 2006) (Vohs & Faber, 2007). Additionally, dramatic increases in individual disposable incomes and credit facilities have supported the rise of impulsive consumption (Dittmar & Drury, 2000). This phenomenon is present also if, in the online experience, the tangibility of the object cannot be experienced; indeed, the short delivery time and the one-click purchase can increase the likelihood of this behavior. Specifically, this last mechanism makes the ordering system frictionless, so that the customer can order products with the least amount of effort.

Moreover, approximately 40% of all the money spent on e-commerce sites is attributed to impulse purchase, explaining why online impulse buying has drawn increasing scholarly attention across disciplines (Liu, Li, & Hu, 2013).

The existing Literature has been analyzed in order to gain a deep understanding on the phenomenon of impulse buying and to understand the actual state of art. One main research gap resulted from our studies: the great majority of them only focuses on external factors, considering the internal characteristics of customers just through interviews and thus not fully capturing the affective reactions involved in the impulse buying behavior. Moreover, very often the measurement of those reactions is based on self-declaration with questionnaires and interviews, but it requires more advanced methods.

Indeed, instinctive behaviors can be assessed with the support of Neuroscience techniques, that allow to measure and observe the development of the physiological signals of the subject who is participating in the experiment in order to gain insights on his affective and cognitive states. It has been demonstrated that these latter can be detected by variations of physiological responses. The combination of consumer research with modern neuroscience is called Consumer Neuroscience, whose main focus is on the consumer and how various factors affect individual preferences and purchasing behavior.

The originality of this study stays in the big focus on the mood and, more in general, on internal factors as predictors of the online impulse buying. Furthermore, the use of Neuromarketing techniques to measure and observe the development of the physiological signals of the users during the purchasing experience as a support of the questionnaires represents a distinctive trait. The main research finding opens the path to a new stream of research. Indeed, the online impulse buying behavior is guided by personal traits and is influenced by the mood but there is no discrimination between a positive and negative mood.

The present thesis has three main objectives. Firstly, a systematic Literature review of previous studies aims to provide a comprehensive description of the phenomenon, identifying research gaps and opportunities and building a conceptual framework of online impulse buying. Secondary, the provided work has the objective of defining an experimental paradigm to investigate the effect of mood on the impulse buying

behavior, thus hypotheses are formulated according to the findings in the Literature review. Lastly, it wants to perform an empirical investigation of this important phenomenon, to empirically validate or disconfirm the hypotheses that have been previously formulated.

The proposed thesis is structured in four main chapters:

1. The first part has the objective to provide a complete theoretical overview of the impulse buying phenomenon and of consumer neuroscience.
    a. Impulse buying is conceptualized, analyzing the evolution in time of the definition and the different perspectives and facets of the phenomenon.
    b. The existing Literature is analyzed in order to understand the actual state of art and to highlight research gaps that must be filled.
    c. A detailed description of fundamentals of consumer neuroscience is provided, illustrating the research concept, methodologies and instrumentation.
    d. Research gaps are highlighted.
    e. The mood and related models are described in depth.
2. The second part focuses on the empirical investigation. It includes:
    a. Firstly, a detailed description of the experimental design. It comprehends the outline of the hypotheses to test, the analysis of the existing Literature of mood induction schemes and our choice, the description of the sample and the procedure of the experiment and the variables of interest. Materials and methods used for the implementation are described.
    b. The data analysis and the results of the laboratory experiment.
    c. The discussion on the findings.
3. The third part drafts implications of the results of the work in terms of business, research and societal applications.
4. The present work is concluded with a resume of the results and illustrates the main findings and contributions of this study, together with limitations and future research development.

PART I:

THEORETICAL BACKGROUND

Part I: THEORETICAL BACKGROUND

1. Impulse buying conceptualization

The term ‘impulse buying’ was formally defined in the DuPont’s studies in 1948 as an ‘unplanned purchase’ without predefined shopping lists. However, this use of the term was refined in the following years by other scholars, since considered too generic and not very descriptive in respect of what impulse buying phenomena is.

In fact, in 1987, Rook was the first to give importance to emotions, defining impulse buying as “a sudden and immediate purchase with no pre-shopping intentions, that occurs after experiencing an urge to buy; therefore, impulse buying is characterized by reduced information processing and cognitive and affective reactions, thus often being based on a product’s ability to evoke excitement or joy” (Rook D. W., 1987). As Rook and Hoch (1985) assert, “it is the individuals, not the products, who experience the impulse to consume”.

In other words, customers do not plan in advance their purchases and they are exposed to a stimulus when shopping both in-store or online. Moreover, during purchasing situations, customers experience thoughts and emotions that can trigger their desire to make a not pre-planned purchase. Thus, impulse buying is characterized by being unplanned, the result of an exposure to a stimulus, decided “on-the-spot”, and an “hedonically" experience.

Stern (1962) identifies four distinct types of impulse purchasing: planned, pure, reminder and suggestion impulse purchasing. Planned impulse purchasing occurs when shoppers do not plan their purchases but search for and take advantage of promotions in order to maximize their buying power. Pure impulse purchasing is when consumers reflects the impulse buying in a novelty or in an escape purchase which breaks a normal buying pattern. Reminder impulse purchasing occurs when the consumer remembers to buy a needed item when seeing it. Finally, suggestion impulse buying occurs when a shopper immediately visualizes the need for a product that sees for the first time.

Nowadays, impulse buying is a phenomenon that is more studied in the online context rather than in the offline one, due to the proliferation of e-commerce activities. In fact, e-commerce has seen a huge growth in the last 10 years, and we expect it will continue

to do so in the upcoming ones. Thus, we talk about **online impulse buying**. Shopping online removes the constraints that consumers might experience in physical stores, increasing the likelihood of impulse buying. In addition to testing, the extent to which the dynamics of offline retailing are applicable to the online environment, research on online impulse buying emphasizes the effects of website features. Although these two lines of research have enriched our scientific understanding of online impulse buying, the divergence between the theoretical conceptualization and the operationalization of the concept resulted in a fragmentation of the online impulse-buying literature. Therefore, it was necessary to summarize existing findings to develop meaningful conclusions based on existing studies.

1.1 Wave of research

The scholars cited previously were those who give a major contribution to the conceptualization of impulse buying. However, many other researchers added value to this stream of research. During several decades of impulsive buying behavior research there were tons of studies and several both direction and focus revivals of the research. Depending on the main research premises, the theoretical findings can be summarized in three parts. It is important to notice that the difference between the three waves is not in terms of time.

The *first wave of research* was oriented toward the elements that were exact opposite in their nature from the elements consisted in definition from rational planned buying behavior standpoint. Table 1 offers the review of the first definitions of impulsive buying behavior (Park & Choi, 2013).

Table 1: first wave of research

Author	**Definitions and findings**	**Year**
Stern	Truly impulsive buying, the novelty or escape purchases which break the normal buying pattern.	1962
Kollat and Willett	The cell in the intention-outcomes matrix that corresponds to the situation where no explicit recognition of a need for such a purchase existed prior to entry into the store.	1967

D'Antoni and Shenson	Impulsive buying characterized by the rapidity. A decision in which the *bits of information* processed and thru the time taken relative to the normal decisional time lapse are significantly less with respect to the same or quite similar products or services.	1973
Bellenger, Robertson and Hirschman	Impulsive purchasing defined in terms of whether or not the purchaser makes the decision to purchase the product before or after entering the store.	1978
Engel	Impulsive buying is a buying action undertaken without a problem previously having been recognized or buying intention having been formed entering the store.	1982
Gerbing, Ahadi, and Patton	Impulsiveness is defined as a "tendency" to respond quickly to a given stimulus, without evaluation of consequences.	1987
Iyer	Unplanned purchasing behavior is related to knowledge of the store environment and time pressure. Unplanned purchases are over and above routine purchases, which are fulfilled invariably.	1989
Rook and Garder	An unplanned purchase that is characterized by relatively rapid decision-making and a subjective bias in favor of immediate possession.	1993
Jeon	Impulsive buying is a sudden and immediate purchase with no pre-shopping intentions either to buy the specific product category or to fulfil a specific buying task.	1990
Weun, Jones and Beatty	The degree to which an individual is likely to make unintended, immediate and unreflective purchases.	1998

The *second wave of research* introduced and focused on the role of emotions in the definition of impulsive buying behavior. Their main contribution was realizing the powerful combination of both rational and emotional side of every impulsive buying behavior. The answers about emotional and affective side of expressing urge to buy is

also found in psychology, which performed research about both cognitive and affective side of the impulsive buying behavior. Table 2 presents the main contribution of the second wave of research on impulsive buying behavior (Park & Choi, 2013).

Table 2: second wave of research

Author	**Definitions and findings**	**Year**
Weinberg and Gottwald	Impulsive buying encompasses purchases with high emotional activation, low cognitive control and largely reactive behavior	1982
Rook and Hoch	Impulsive buying behavior involves a sudden and spontaneous desire to act, representing a clear departure from the previous ongoing behavior stream followed by psychological disequilibrium-	1985
Rook	Impulsive buying happens when a consumer experiences a sudden and often powerful and persistent urge to buy something immediately.	1987
Iyver	All impulsive buying is at least unplanned, but all unplanned purchases are not necessarily decided impulsively. The key dynamic element of impulsivity is the customers' internal psychological motivations.	1989
Holbrook and O'Shaughnessy	It ties together the complementary roles of reasons and emotions in consumer behavior.	1990
Piron	A purchase that is unplanned, the results of an exposure to a stimulus, decided "on the spot".	1991
Hoch and Loewenstein	A change in either desire or willpower can cause the consumer to shift over the buy line, resulting in a purchase. Emotions influence cognitive factors and vice versa	1991
Han, Morgan, Kotisopulos, and Kang-Park	Impulsive buying behavior is a sudden compelling hedonically complex purchasing behavior in which the rapidly of the impulsive purchase decision process predicts thoughtful deliberate consideration of information and choice alternative	1991

Rook and Fisher	Buying impulsiveness is defined as a consumer' tendency to buy spontaneously, unreflectively, immediately, and kinetically.	1995

The *third wave of research* brings the research back to the field of marketing. Their point is less in different definitions to impulsive buying behavior and more in different little details that could explain a broader picture of impulsivity. Table 3 presents the definitions and perception of the most important aspects of impulsive buying behavior (Park & Choi, 2013).

Table 3: third wave of research

Author	**Definitions and findings**	**Year**
Youn and Faber	Impulsive buying may be influenced by internal states or traits experienced by consumers, or by environmental factors/sensory stimuli. Lack of control, stress reaction, and absorption are the main general personality factors that underlie the tendency the buy impulsively	2000
Dholakia	Introduces a model examining cognitive and volitional processes and makes distinction between consonant (harmonious) impulses and dissonant (conflicting) impulses and elaborates on the role of the impulsivity trait, situational variables, and constraining factors in enactment or resistance of the consumption impulsive.	2000
Hausman	Shopping experience may encourage emotions such as feeling uplifted or energized. Consumer shop not only to buy to satisfy their different needs.	2000

As the summary of the third wave of research, Muruganantham and Bhakat (2013) suggested a framework for impulsive buying behavior offering four different perspectives depending on the most influential factors: external stimuli, internal stimuli, situational product related factors and demographics with socio-cultural factors.

1.2 Different perspectives

Impulse buying has been approached from different angles in consumer, economic, social, and clinical psychology. In this section, we provide a description of these perspectives, representing different views on the phenomenon.

Desire and willpower. Recent behavioral economic research envisions human behavior as driven by two different decision-making systems, e.g. (Kahneman, 2011). The first system, called System 1, corresponds to intuitive decision making and is quick, efficient, present-oriented, related to desire and emotion, and often relies on unconscious processes. The second system, called System 2, is slow, rule-based, controlled, and comprises the abilities of willpower and cognition. Whereas System 1 is assumed to exist in both animals and humans, System 2 is unique to humans (at least in its disproportionately large size).

Impulsive behavior is seen as the outcome of a struggle between the two opposing forces, namely desire and willpower, corresponding respectively to System 1 and System 2 (Hoch & Loewenstein, 1991).

System 1's role in intertemporal choices has gained less attention than that of System 2. The intuitions in System 1 are sometimes biased and thus can explain why behavior diverges from rational benchmarks and lead to impulsive behavior when System 2 is not able to control System 1.

Commonly, it is assumed that System 1 is myopic and strives for immediate gratification. However, very often it is assumed that only products that are hedonically pleasing can induce urges to consume impulsively (Rook D. W., 1987) (Fedorikhin & Shiv, 1999). That a product is hedonically appealing, however, is not sufficient to explain why strong visceral urges to consume occur and make System 1 myopic. Many products are hedonically appealing, but do not induce such urges to consume impulsively. What is needed is a mechanism that explains why System 1 becomes myopic from time to time. One potential mechanism underlying impulsive consumption has been suggested by (Hoch & Loewenstein, 1991). Their explanation considers a shift in the consumer's reference point: not being in possession of a product is a consumer's default reference point, whereas being in possession of a product is his or her reference point after a purchase has been made. However, if a consumer has the sudden urge that is typical for an impulsive purchase, these feelings may shift the reference point to a position that normally is taken after the purchase and so the consumer experiences

"already possessing" the product before any purchase has been made. In other words, the individual reference points shift from not mine to mine. When the individuals nevertheless refrain from the purchase, they feel as though they have lost the product and experience deprivation and loss.

Visceral influences. In later papers, Loewenstein elaborates on the tendency of System 1 to become myopic (Loewenstein G. , 1996) (Loewenstein G. F., 2000). He argues that the sensory proximity of rewards, together with the activation of visceral influences, cause individuals to act more impulsively. The activation of drive states such as hunger and thirst, i.e. homeostatic dysregulations (Strack, Werth, & Deutsch, 2006), as well as some negative emotions such as exhaustion, pain, and fear for physical safety belong to the visceral influences. They put the individuals in hot states and thus produce short-sighted impulsive behavior. Due to hot-cold empathy gaps, such short-sighted behavior is not anticipated (Loewenstein G. , 1996). Visceral influences mainly influence the intuitive decision making in System 1 and sometimes overwhelm the rational forward-looking goals set in System 2 during cold states. The theory of visceral influences has led to significant progress in understanding how impulsive behavior occurs and what its determinants are; strengthening the focus on System 1 seems to be a good strategy to obtain more insights about what drives impulsive consumption.

Cue-triggered 'wanting'. Recent biopsychological findings suggest that need deprivation states can induce impulsive behavior by a motivational mechanism called cue-triggered 'wanting'. It is based on the dissociation between 'wanting' (the core process of motivation) and 'liking' (the core process of hedonic reward). In some specific situations, the unconscious core processes of 'wanting' and 'liking' diverge (Berridge, 1999). The cue-triggered 'wanting' mechanism suggests that certain cues can lead to motivational 'wanting' peaks without changing 'liking' (Berridge, 2002) (Berridge & Aldridge, 2008), thus inducing impulsive behaviors. Cue-triggered 'wanting' can occur when individuals perceive stimuli that were previously associated with immediately available consumption goods. However, these cues can increase 'wanting' to consume only when individuals are currently deprived in a strong physiological or psychological need that corresponds to an activation in the brain's mesolimbic dopamine system. Moreover, the cues trigger 'wanting' to consume only when individuals explicitly or implicitly know that the cued consumption goods are able to satiate the currently deprived need. The motivational strength of these cues crucially

depends on the degree of dopamine activation, so that stronger deprivation corresponds to a higher possibility of impulsive consumption. For example, when an individual is very hungry, the sight of a pizza-delivery car can trigger a strong and immediate urge to 'want' pizza, although the sight of the car does not change how much the pizza is 'liked' or expected to be liked (Lades, 2012). As a result, individuals can sometimes impulsively 'want' to consume goods although they do not expect to like these goods; this is a behavior called irrational 'wanting' (Berridge, 2002). Hence, cue-triggered 'wanting' occurs when individuals are deprived of a specific need and additionally perceive a cue that is associated with an immediately available consumption good known to satisfy the deprived need. When not effectively self-regulated by willpower, cue-triggered 'wanting' translates into impulsive consumption. With this mechanism, it can be explained why only some goods tend to be bought impulsively: only those consumption goods closely related to strong and salient need deprivation states that activate the brain's mesolimbic dopamine system are objects of impulsive consumption.

Proximity bias. People's judgments are strongly influenced by the proximity of the objects they consider (Trope & Liberman, 2010). Trope and Liberman's (2010) construal level theory of psychological distance comprehensively accounts for effects of spatial, temporal, and social distance. They argued that certain responses are more likely to emerge as a function of distance. For instance, excitement is typically triggered at low levels of construal, such as when being directly confronted with an object.

Limited information processing. Consumers' decision-making processes are usually simpler than the ones adopted by the traditional models of the homo economicus. Thus, we refer to "bounded" rationality (Simon, 1955) and to "adaptive decision maker" (Payne, Bettman, & Johnson, 1993). In this perspective, there are many descriptive models which involve reduced choice processes in terms of information processing and decision rules, such as the elimination-by-aspects rule (Tversky, 1972), the lexicographic model, or the conjunctive model (Coombs, 1964). Simon's (1955) satisficing heuristic is the simplest one. According to it, the decision maker considers alternatives one at a time in the order they occur to him. A cut-off level is used to compare each option, and the first one that meets the criterion is chosen. In this framework, impulsive choices may be considered as driven by simple and heuristic processes. For instance, an impulsive purchase may be based on whether or not a product generates a certain level of excitement, joy, and urge to buy.

The impulse buyer personality. There may be chronic individual differences in the tendency to buy on impulse (Verplanken & Herabadi, 2001). Consequently, impulse buying tendency should correlate with other stable individual differences.
Firstly, differences in impulsivity are addressed. Gray (1975) postulated the existence of two systems in the brain. The first one is the behavioral activation system (BAS), responsive to incentives and cues for reward; the second one is the behavioral inhibition system (BIS), responsive to cues for punishment, frustration, and uncertainty. Each of the two systems varies in sensitivity across individuals. People with a highly reactive BAS are prone to impulsivity and are less able to resist stimuli that trigger impulsive behavior.

Differences in impulsive buying between individuals may stem from chronically held goals or values. For instance, there is empirical evidence that impulsive buying is associated with adhering to materialistic values, e.g. (Dittmar & Bond, 2010).

The results of a study by (Verplanken & Herabadi, 2001) suggested that impulsive buying has an individual component which is rooted in personality. They found relatively strong correlations between impulse buying tendency and an assessment of the Big Five personality traits, which represent five basic personality dimensions: extraversion, agreeableness, conscientiousness, emotional stability and openness. Impulse buying tendency correlated positively with extraversion and negatively with conscientiousness and autonomy.

Purchasing Symbols of Values and Identity. Products may have symbolic meaning. For instance, products may symbolize lifestyle, social groups, status, class, values, religion, regional identities, or political positions. Wicklund and Gollwitzer (1982) proposed the theory of symbolic self-completion. This theory argues that we have a need to define and confirm our identity and do so through “symbols of completion”. Possessions and purchases of products may be a way to do so. This motivation to affirm one’s self-definition becomes especially salient when individuals feel uncertain or threatened, or when their identity is in any way compromised (Verplanken & Herabadi, 2001). Impulsive purchases may thus also function to affirm or express an aspect of a person’s identity, for instance because the product symbolizes an aspired social group. Dittmar and Bond (2010), for example, show that consumer goods with high identity-expressive

potential (clothes, jewelry, sports gear) elicit a stronger tendency for impulsive buying behavior than consumer goods lacking this feature. To evaluate themselves, individuals use their ideal self-images as reference standards. Differences between how the individuals ideally want to be (normative, ideal, or ought self-images) and how they actually view themselves (descriptive or actual self-images) lead to psychological discomfort (Higgins, 1987). When an individual consumes a good with an identity-relevant symbolic meaning that is congruent with the individual's ideal self-image, the individual can move closer to her ideal self-image and thereby temporarily satisfy her need for self-enhancement, i.e. the tendency to reduce self-image discrepancies. As mesolimbic activation does not only occur during physiological need deprivation states, but also in many emotional situations that can be either rewarding or stressful (Berridge & Aldridge, 2008), self-image discrepancies are also likely to induce cue-triggered 'wanting'.

Hunting for Pleasure and Forgetting Your Sorrows. Pleasure is what most people associate with impulse buying. For instance, Rook and Gardner (1993) found that the act of buying on impulse may thus be an expression of feeling good. Impulse buying may also cause positive emotions and thus may fulfil hedonistic motives, since people are motivated to seek pleasure and avoid pain. Holbrook and Hirschman (1982) introduced the view that consumers are often driven by the hedonistic and aesthetic nature of consuming. A good mood may thus be an important goal of impulsive buying. Holbrook and Gardner (2000) presented a dynamic model in which mood is an outcome of a consumer experience. The model suggests that an initial mood combines with a consumption experience and thus produces an "updated" mood. This cycle may repeat over time and may induce variations in mood depending on the emotional tone of the consumption experience. Herabadi et al. (2009) demonstrated that impulsive shoppers do experience positive emotions at the time and place of the actual purchase. Impulsive purchases are not exclusively associated with positive emotions. Rook and Gardner's (1993) also reported that a significant portion of participants mentioned negative moods as causing them to buy on impulse. Verplanken et al. (2005) found that general impulse buying tendency was correlated with long-term negative mood and low self-esteem.

Lack of Self-Control. Impulsive buying has been framed as a result from a lack of self-control (Baumeister, 2002) (Vohs & Faber, 2007) (Vohs, Baumeister, Schmeichel, Nelson, & Tice, 2008a).

Effective self-control requires a certain amount of mental resources, and sometimes people lack them, for instance due to mental exhaustion. This is referred to as ego-depletion. Depletion of resources may occur for various reasons. For instance, Vohs et al. (2008) demonstrated that making choices could deplete mental resources, and thus could result in less self-control, making customers more vulnerable to impulsive buying. This lack of self-control has been linked to 'wanting'–'liking' dissociations mentioned above in the cue-triggered 'wanting'. Vohs and Faber (2007) suggest that when individuals are low on willpower and have depleted their self-regulatory resources, 'wanting'–'liking' dissociations and impulsive buying might occur more often.

Compulsive Buying. In our work, we are not referring to this particular and serious aspect of impulse buying, which however needs to be mentioned. Impulsive shopping is less innocent if it takes the form of compulsive shopping. We are entering the arena of psychopathology, where this form of consumer behavior is known as compulsive buying disorder and may lead to extreme suffering in the form of financial debt and the disruption of family life and personal relationships. Compulsive buying is linked to factors that also drive impulsive purchases but, while the former is also related to emotional instability, the latter is not.

There are many views on impulse buying, none of which is true or false; each perspective reflects a different piece of reality and highlights different psychological mechanisms. Taken together, these different perspectives can lead to seemingly contradictory or paradoxical findings. Impulsive buying occurs as part of wider psychological functioning, in particular in the form of self-regulatory behavior. Self-regulation refers to the ability to regulate thoughts, feelings, and behaviors such that the outcome is in line with a standard (Vohs & Baumeister, 2004).

Self-regulation theories represent a system approach. Key features of system models are the presence of a standard, the monitoring of the current status of the system, a comparison of the current status with the standard, and the potential for action to balance out discrepancies. Standards can be held in the form of goals, norms, rules, ideals, or values; monitoring occurs through our perceptions, which include both the external and our internal world, such as emotional states; "action" may involve overt behavior but may also imply shifts of attention, attempts to change emotional states, or reviewing standards.

Verplanken and Sato (2001) aimed at integrating the seemingly contradictory perspectives on impulse buying by drawing on the regulatory focus theory proposed by Higgins. Higgins' (1997, 1998) theory of self-regulatory focus can be used to categorize the various perspectives on impulse buying as either a promotion or a prevention focus. This theory proposes two distinct basic motives, each of which is associated with a different self-regulation strategy. The first motive is referred to as promotion focus and makes a person focus on accomplishments, growth, wishes, or aspirations. The second motive is called prevention focus and is based on the need to avoid bad things and makes us focus on duties, obligations, or responsibilities. It induces a state of vigilance so as to avoid pain and losses and thus regulates the presence or absence of punishments and negative outcomes.

One of the reasons why impulsive buying has been found associated with such a diversity of antecedents and perspectives may be that this behavior may serve different self-regulatory functions, according to which type of self-regulation strategy is in place. The perspectives on impulse buying reported in our work may fit in one of the two motives of the self-regulation strategy. For instance, the proximity bias, the purchase of symbolic products and seeking pleasure are promotion-focused strategies; limited information processing, dealing with low self-esteem and mood repair are prevention-focused strategies.

Higgins' theory seems particularly useful for bringing together the perspectives on impulsive buying and has the potential to provide a deeper understanding of this ubiquitous phenomenon.

1.3 Three layers of impulse buying

It is now clear that impulse buying has multiple facets. It is possible to distinguish between three layers:

1. Behavioral impulsivity: impulsivity manifested as the propensity to make unplanned purchasing decision;
2. Psychological impulsivity: impulsivity manifested as a sudden feeling, desire or urge to buy;
3. Process impulsivity: impulsivity manifested as a bounded will to perform a comprehensive evaluation of the product attributes.

The first layer focuses on consumers' behavior and, in this perspective, impulsive purchases are considered as "escape purchases which break the normal buying pattern"

(Stern, 1962). According to Stern, impulse buying is related to ease of buying. The purchase of an item involves the expenditure of a number of resources: money, time, physical effort and mental effort. When the act of buying requires a relatively low expenditure of these resources, the buying becomes easier and there is a greater likelihood that the purchase will be an impulse purchase. Koufaris (2002) highlighted an important characteristic of online purchases: web consumers can buy at any time and from anywhere, possibly increasing the number of products they buy on impulse. Indeed, a simple click on banner ads allows to be transported to the store, in front of the product advertised, making it easier for consumers to make unplanned purchases.

The second layer focuses on feelings and emotions of consumers. In this perspective, we can recall Rook's definition (1987) provided at the beginning of chapter 2 and recognized as the classical definition of impulsive buying behavior: "a sudden and immediate purchase with no pre-shopping intentions, that occurs after experiencing an urge to buy; therefore, impulse buying is characterized by reduced information processing and cognitive and affective reactions, thus often being based on a product's ability to evoke excitement or joy".

Another important definition was given by Piron (1991): "A purchase that is unplanned, the results of an exposure to a stimulus, decided on the spot. Five crucial elements that distinguish impulsive from non-impulsive: feeling a sudden and spontaneous desire to act, being in a state of psychological disequilibrium, experiencing a psychological conflict and struggle, reducing cognitive evaluation and consuming without regard for the consequences". This definition focuses on four main elements:

1. Unplanned purchasing. An unplanned purchase is a buying action undertaken without a problem having been previously recognized or a buying intention formed prior to entering the store (Engel, Kollat, & Blackwell, 1968).
2. Exposure to stimuli, which can be categorized along four broad dimensions. First, impulse purchases can be made in response to marketers' suggestions or reminders (Stern, 1962). Second, as a result of marketers' environmental manipulations. Third, non-satisfactory or unavailable planned purchases may translate into impulse purchases. Finally, Hirschman (1985) identified autistic stimulation as a potential origin of impulse purchasing.
3. "On-the-spot". This is the main new dimension introduced by Piron and focuses on the time and location of the purchase. It is defined as the immediate time and place

where the purchase decision is processed and made. Thus, impulse purchasing occurs when the decision of the purchase is made immediately upon seeing the product or the stimulus representing the product; the whole purchase decision process for impulse goods takes place at the point of sale and may take only a few seconds time (Settle & Alreck, 1986).

4. Emotional and Cognitive Reactions, that relates to the consumer him/herself. The reactions incorporated in the proposed definition are those identified by previous research. Specifically, the ones identified by Rook (1987) such as "excitement and stimulation," "hedonic elements", "purchasing in response to moods," and a "sudden and imperative desire to purchase". Another interesting cognitive reaction is the "reduced evaluation of consequences" used by Navarick (1987), stating that impulsive behaviors result from choosing an immediately available option over a future option as a result of a mental accounting where the present value of the future outcome compares unfavorably with the value of an immediate outcome. Finally, a cognitive trait labelled: "discounting of own responsibility" is introduced.

Piron's contribution was mainly in realizing the powerful combination of both rational and emotional side of every impulsive buying behavior.

The third layer brings the attention on the reduced evaluation of products' attributes. There are many studies about this phenomenon, addressing it from different perspectives. Research has shown that the same individual will often use a variety of strategies to make a decision, contingent on task demands (Payne, 1982). Creyer et al (1990) suggests that for an individual to adapt the decision strategies to a particular decision task, he must have some ideas about the degree of effort and accuracy characterizing the decision process; thus, this study examined the roles of effort and accuracy feedback on decision processes and the role of goals that emphasize accuracy on strategy selection. The results show that accuracy feedback led to more normative-like processing of information and improved performance, instead effort feedback led to decreased accuracy when the goal was to minimize effort, and to increased accuracy when the goal was to maximize accuracy, thus amplifying the effect of the goal.

Pieters and Warlop (1999) wanted to explain the adaptation of consumers' visual attention to time pressure and task motivation, using indicators derived from eye-movement data. Specifically, time pressure regulates the amount of information that can be processed, and results showed that an increased time pressure leads to acceleration,

more filtration, and to more information acquisition by attribute. Increased task motivation, instead, leads to deceleration, less filtration, and to less information acquisition by attribute. This study offers support for the hypotheses that consumers react to decreased opportunity and increased motivation by changing their information acquisition patterns in systematic ways.

Theoretically, attention is conceived as an important mediating role in information processing. Some research also established a theoretical link between arousal and attention. For example, in Kahneman's (1973) capacity model of attention, arousal increases the total capacity of attention and narrow the attention focus by concentrating on the dominant aspect of the situation, leading to improved performance. Furthermore, a study from Wearden and Penton-Voak (1995) has demonstrated that at a higher level of arousal corresponds to a shortening of perceived available time, which in turn helps to push the participants to speed up their cognitive responses. Consequently, arousal may cause attention narrowing and speed up response so that a decision is taken before all relevant information has been assimilated.

Patalano et al. (2010) analyzed the role of indecisiveness during decision making, which can give rise to differences in information search strategies. The findings show that indecisive individuals, while predisposed toward use of compensatory strategies, desire so much information that they eventually have to refocus on a narrow set of dimensions. Moreover, indecisive individuals relative to decisive ones spent more time viewing noninformation cells, confirming the evidence, given by previous studies, of delay behavior by indecisive individuals (Frost & Shows, 1993). Thus, indecisive individuals are motivated to seek as much information as possible about the alternatives, in order to use all of it to make an optimal choice. But this desire for the best solution, combined with the difficulty of identifying it in some situations given the limits of cognitive resources, might give rise to decision delay and ultimately choice dissatisfaction.

A more recent research by Pieters and Wedel (2007) investigates the influence of consumers' processing goals on visual attention to ads and four design objects that they comprise, to assess the extent to which advertising informativeness is contingent on consumers' processing goals. Processing goals focus consumers' attention on the stimuli that they are exposed to and on the information contained in them. In case of impulsive buying behavior, there is a lack of attention and a bounded will to perform a comprehensive evaluation of the product.

2. Systematic literature review

A rigorous approach has been used to guide the search process, thus reducing data collection bias (assessing the best evidence available, collating the findings and presenting them in a way that was accessible and relevant to decision-makers). The methodology can be described through 4 phases:

1. Identification of relevant keywords
2. Choice of the database and research of the articles
3. Selection of the articles through inclusion and exclusion criteria
4. Analysis

2.1 Identification of relevant keywords

In the first stage, we identified the keywords needed for the research. Since every aspect important for the analysis should have one or more keywords and, given the plurality of meaning embedded in the term "impulse", we identified synonymous and related terms.

In our specific research, the areas of interest were three: the phenomenon of impulse buying, the online environment and the experimental aspect of the analysis.
For each of these areas, related keywords have been identified:

Table 4: keywords used in the SLR

Impulse buying	Online environment	Experimental aspect
Impuls* buy*	Online	Experim*
Impuls* purchas*	Internet	Empiric*
Impuls* shop*	E-commerce	
Unplan* buy*	Web	
Unplan* purchas*	E-business	
Unplan* shop*	Social media	
Urge to buy		
Urge to shop		
Urge to purchas*		

To be able to carry out the research in the database, Boolean operators are needed to link the chosen keywords.
The Boolean operators we used are three: AND, OR, NOT. The operator AND implies that all the keywords must appear in a record; the operator OR selects also the record containing only one of the keywords; the operator NOT excludes the keywords.

Our keywords have been linked and the string for the research has been the following:

TITLE-ABS-KEY (("impuls buy*" OR "impuls* purchas*" OR "impuls* shop*" OR "unplan* buy*" OR "unplan* purchas*" OR "unplan* shop*" OR "urge to buy" OR "urge to shop" OR "urge to purchas*") AND ("online" OR "internet" OR "e-commerce" OR "web" OR "e-business" OR "social media") AND ("experim*" OR "empiric*"))*

2.2 Choice of the database and research of the articles

We used academic and peer-reviewed journals as our data source, as their findings are considered to be validated.

There are many scientific databases and the most popular are Google Schoolar, Web of Science e Scopus. Our analysis has been carried out by using a single software: *Scopus.*

Scopus is Elsevier's abstract and citation database launched in 2004. It is periodically updated and covers nearly 36.000 titles, of which 34.346 are peer-reviewed journals in top-level subject fields. It allows to directly visualize abstracts and information related to the year of publishing, the referred journal, the authors. In the software it is also possible to search articles by selecting the years of publishing, the category of research and the types of documents.

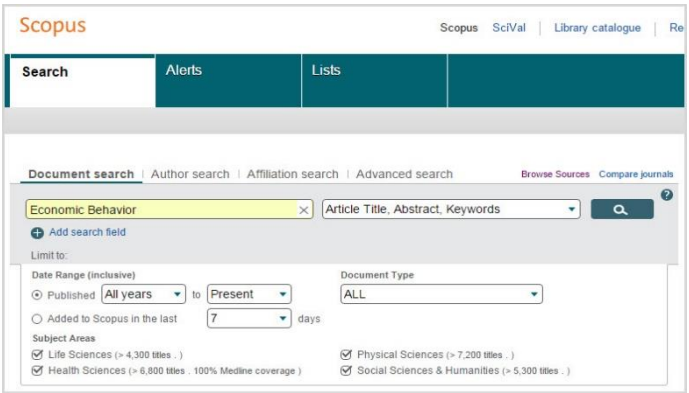


Figure 1: Scopus

We used the string highlighted above, but results were further filtered, including only related subject areas and papers in English language. Furthermore, we decided to only include articles and conference proceedings. In order to put these filters in practice, the resulting string were:

TITLE-ABS-KEY (("impuls buy*" OR "impuls* purchas*" OR "impuls* shop*" OR "unplan* buy*" OR "unplan* purchas*" OR "unplan* shop*" OR "urge to buy" OR*

"urge to shop" OR "urge to purchas") AND ("online" OR "internet" OR "e-commerce" OR "web" OR "e-business" OR "social media") AND ("experim*" OR "empiric*")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (SUBJAREA , "COMP") OR LIMIT-TO (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "SOCI") OR LIMIT-TO (SUBJAREA , "PSYC") OR LIMIT-TO (SUBJAREA , "ECON") OR LIMIT-TO (SUBJAREA , "DECI") OR LIMIT-TO (SUBJAREA , "ENGI")) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "cp"))*

67 articles emerged from this research. To simplify the management, they were collected in the software Mendeley.

2.3 Selection of the articles through inclusion and exclusion criteria

The third step requires to start the systematic study of the resulted articles with the aim of selecting the most relevant ones, finding inclusion and exclusion criteria.

There are many tools to organize the articles, but one of the easier ones is the software *Mendeley*. It is a free but not open-source software that provides a desktop app to manage and share research papers. It allows to upload articles directly from Scopus, in order to have them all grouped in a single screen. It is possible to visualize all the information related to the article and their abstracts; moreover, it is possible to associate the related PDF files.

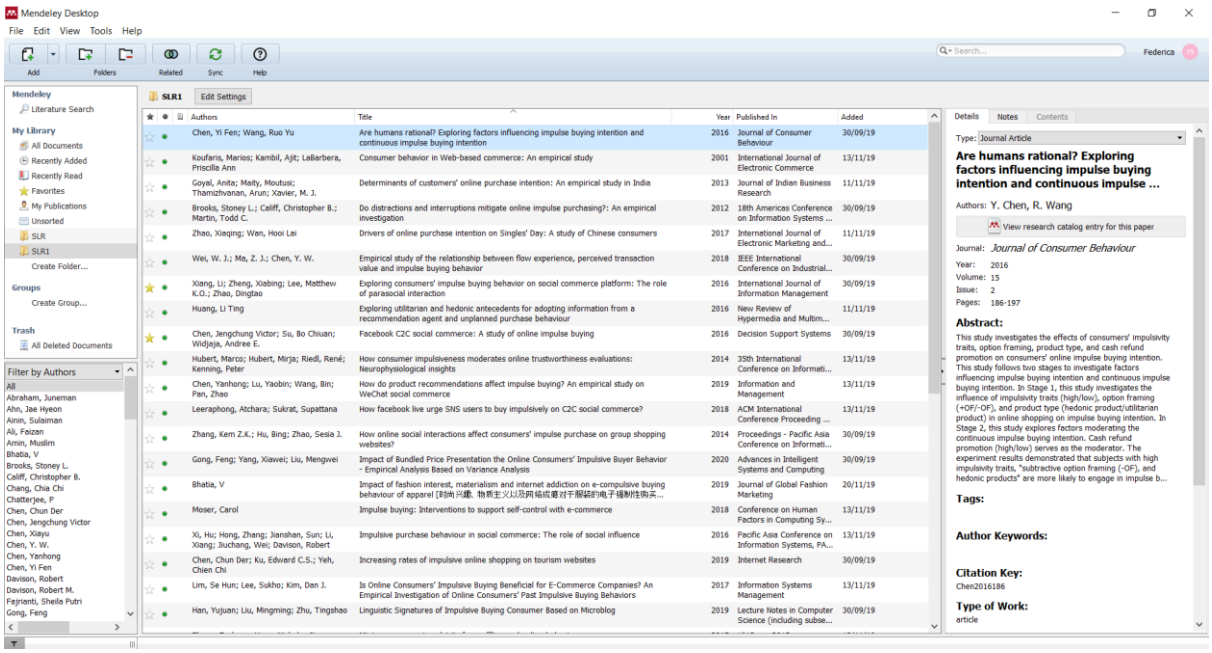


Figure 2: Mendeley

At this stage, we applied inclusion and exclusion criteria to the initial set of articles to ensure that the articles were relevant and require further analysis. Specifically, we only included studies whose core focus was online impulse buying, and we excluded those ones with no empirical results or with no direct linkage between the key concepts (online and impulse buying).

Once read the abstracts, we believed that some of the initial 67 articles were not suitable for our analysis since they did not respect our inclusion criterium; specifically, 49 papers were left. We also excluded 3 papers because of the exclusion criteria. One paper more was a duplicate.

We found the full text for all the articles.

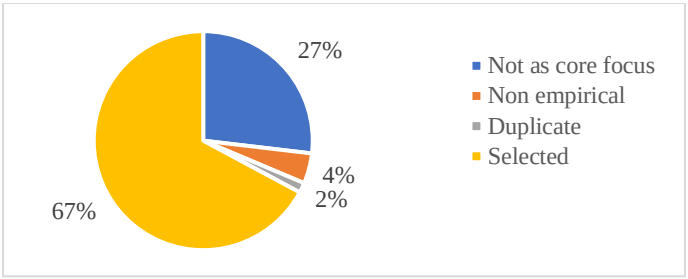


Figure 3: excluded and included papers

Finally, 45 online impulse buying articles were identified.

To be sure of considering all the major papers, we decided to conduct a further research starting from the identified articles (*snowballing*) and we were able to identify 8 additional studies.

Together, we identified 53 relevant online impulse buying articles, reported in *Table 1*.

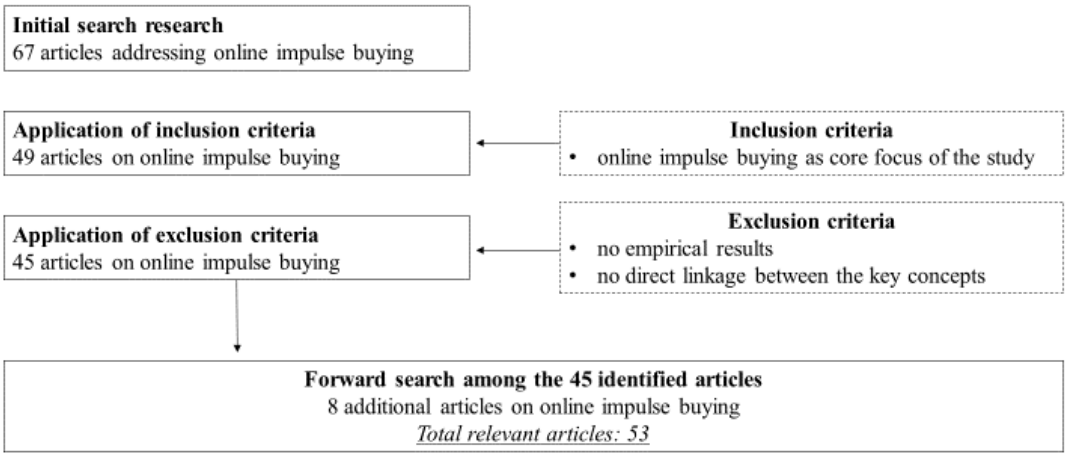


Figure 4: Process of SLR

Table 5: Total relevant articles

TITLE	AUTHORS	YEAR
Consumer behavior in Web-based commerce: An empirical study	Koufaris, M.; Kambil, A.; LaBarbera, P.A.	2001
Applying the Technology Acceptance Model and flow theory to online Consumer Behavior	Koufaris, M.	2002
Effects of media formats on emotions and impulse buying intent	Adelaar, T.; Chang, S.; Lancendorfer, K. M.; Lee, B.; Morimoto M.	2003
Ordering versus grabbing: The influence of temporal proximity on impulsive online buying behavior	Schneider, C.	2006
External and internal trigger cues of impulse buying online	Dawson, S.; Minjeong, K.	2009
Cues on apparel web sites that trigger impulse purchases	Dawson, S.; Minjeong, K.	2010
Online impulse buying: Understanding the interplay between consumer impulsiveness and website quality	Wells, J.D.; Parboteeah, D.V.; Valacich, J.S.	2011
The influence of online store beliefs on consumer online impulse buying: A model and empirical application	Verhagen, T.; Van Dolen, W.	2011
Do distractions and interruptions mitigate online impulse purchasing?: An empirical investigation	Brooks, S.L.; Califf, C.B.; Martin, T.C.	2012
Flow experience and internet shopping behavior: investigating the moderating effect of consumer characteristics	Hsu; C.L.; Chang, K.C.; Chen, M.C.	2012
System design effects on online impulse buying	Shen, K.N.; Khalifa, M	2012
A Study on Youth Online Impulsive Purchase: The Relationship between Individual Difference, Shopping Environment, Emotion Response and Purchase	Lin, J.; Chuan, C.H.	2013
The influence of delivery time on online impulse buying of Chinese customer	Xuan	2013
Influence of online store belief and product category on impulse buying: An empirical investigation on consumer perceptions	Zhou, Q.; Chen, X.; Chen, Y.W.	2013

The role of atmospheric cues in online impulse-buying behavior	Floh, A.; Madlberger, M.	2013
Website attributes in urging online impulse purchase: An empirical investigation on consumer perceptions	Liu, Y.; Li, H.; Hu, F.	2013
How online social interactions affect consumers' impulse purchase on group shopping websites?	Zhang, K. Z.K.; Hu, B.; Zhao, S. J.	2014
Mining Consumer Impulsivity from Offline and Online Behavior	Zhang, F.; Yuan,B.J; Zheng, K.; Lian, D.; Xie, X.; Rui, Y.	2015
Are humans rational? Exploring factors influencing impulse buying intention and continuous impulse buying intention	Chen, Y.F.; Wang, R.Y.	2016
Defining key drivers of online impulse purchasing: A perspective of both impulse shoppers and system users	Wu, I.-L.; Chen, K.-W.; Chiu, M.-L.	2016
Exploring consumers' impulse buying behavior on social commerce platform: The role of parasocial interaction	Xiang, L.; Zheng, X.; Lee, M.K.O.; Zhao, D.	2016
Facebook C2C social commerce: A study of online impulse buying	Chen, J.V.; Su, B.C.; Widjaja, A. E.	2016
Flow and social capital theory in online impulse buying	Huang, L.T.	2016
Impulsive purchase behavior in social commerce: The role of social influence	Xi, H.; Hong, Z.; Jianshan, S.; Li, X.; Jiuchang, W.; Davison, R.	2016
Online impulse buying of tourism products: The role of web site personality, utilitarian and hedonic web browsing	Rezaei, S.; Ali, F.; Amin, M.; Jayashree, S.	2016
Exploring utilitarian and hedonic antecedents for adopting information from a recommendation agent and unplanned purchase behavior	Huang, L.T.	2016
The Impact of Atmospherics in Virtual Community on Online Impulse Buying Intention: The Moderating Effect of Product Types	Li, W.; Cui, H.; Cheng, Y.	2016
The impact of presentation mode and product type on online impulse buying decisions	Liao, C.; To, P.-L.; Wong, Y.-C.; Palvia, P.; Kakhki, M D	2016
The effect of social and ambient factors on impulse purchasing behavior in social commerce	Ju, J.; Ahn, J.-H.	2016

Development of E-commerce: Factors influencing online impulse shopping in China	Akram, U.; Khan, M.K.; Hui, P.; Tanveer, Y. Akram, Z.	2017
Role of local presence in online impulse buying	Vonkeman, C.; Verhagen, T.; Van Dolen, W.	2017
The influence of media multitasking on the impulse to buy: A moderated mediation model	Chang, Y.	2017
Understanding online impulsive purchase intention: The role of extrinsic product cues	Shih, Y.-W.; Hsiung, C.-Y.; Wu, Y.-L.	2017
Analysing the critical factors influencing consumers' e-impulse buying behavior	Dewi, M.A.A.; Nurrohmah, I.; Sahadi, N.; Sensuse, D.I.; Noprison, H.	2018
Empirical study of the relationship between flow experience, perceived transaction value and impulse buying behavior	Wei, W. J.; Ma, Z. J.; Chen, Y. W.	2018
How facebook live urge SNS users to buy impulsively on C2C social commerce?	Leeraphong, A.; Sukrat, S.	2018
How website quality affects online impulse buying: Moderating effects of sales promotion and credit card use	Akram, U.; Hui, P.; Kaleem Khan, M.; Tanveer, Y.; Mehmood, K.; Ahmad, W	2018
Impact of recommender systems on unplanned purchase behaviors in e-commerce	Ying, Z.; Caixia, C.; Wen, G.; Xiaogang, L.	2018
Intrinsic and extrinsic motivations affecting impulse-buying tendency in mobile shopping	Lee, H.	2018
Online impulse buying: The role of self-construction and online shop aesthetics	Himawari, R.C.; Prayoga, T.; Fajrianti, S.P.; Abraham, J.	2018
Online reviews and impulse buying behavior: the role of browsing and impulsiveness	Zhang, K.Z.K.; Xu, H.; Zhao, S.; Yu, Y.	2018
The effects of Facebook browsing and usage intensity on impulse purchase in f-commerce	Leong, L.Y.; Jaafar, N.I.; Ainin, S.	2018
The impact of instagram "Call-to-action" buttons on customers' impulse buying	Handayani, R.C.; Purwandari, B.; Solichah, I.; Prima, P.	2018
The impact of social media celebrities' posts and contextual interactions on impulse buying in social commerce	Zafar, A.U.; Qiu, J.; Li, Y.; Wang, J.; Shahzad, M.	2019

How do product recommendations affect impulse buying? An empirical study on WeChat social commerce	Chen, Y.; Lu, Y.; Wang, B.; Pan, Z.	2019
Linguistic Signatures of Impulsive Buying Consumer Based on Microblog	Han, Y.; Liu, M.; Zhu, T.	2019
Social Support, Source Credibility, Social Influence, and Impulsive Purchase Behavior in Social Commerce	Hu, X.; Chen, X.; Davidson, R.	2019
Study on the influencing factors of mobile users' impulse purchase behavior in a large online promotion activity	Liu, Z.; Zhang, F.	2019
Increasing rates of impulsive online shopping on tourism websites	Chen, C.; Ku, E.C.S.; Yeh, C.C.	2019
The impact of impulse buying and network platforms on consumer purchasing behavior: A case study of a technical product	Wen, X.; Li, Y.; Liu, Q.	2019
The relationship between online shopping environments, sales promotions, website quality, and impulsive buying behavior: A structural equation modelling approach	Hasim, M.A.; Ishak, M.F.; Hassim, A.A.	2019
Understanding impulse buying in mobile commerce: An investigation into hedonic and utilitarian browsing	Zheng, X.; Men, J.; Yang, F.; Gong, X.	2019
Upward social comparison on social network sites and impulse buying: A moderated mediation model of negative affect and rumination	Liu, P.; He, J.; Li, A.	2019

2.4 Analysis

All the selected 53 articles have been studied and an Excel file has been created in order to report the most important information and to focus the attention on some aspects that we retained of fundamental importance. For every paper, we analyzed:

1. General information: title, authors, the year of publishing, the journal and the related quartile of the Scientific Journal Ranking to look at its quality, the approach theory.
2. Information related to the study of the phenomenon: the context, the research methodology, the size and the type of the sample, the design structure;
3. Specific information related to the experiment or the survey: the variables used, grouped per type, and the existence of correlation.

2.4.1 General information

First of all, it is important to highlight the distribution of these papers over the years.

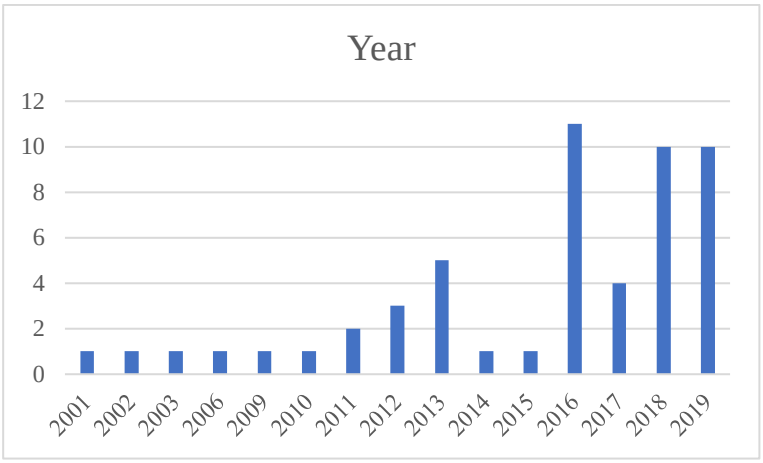


Figure 5: year distribution

This graph clearly shows that the main concentration of the studies is in the last 4 years, starting from 2016 with the peak of 11 papers.

A subsequent classification of the papers has been done depending on whether they were articles from scientific journals or conference proceedings. Specifically, this latter category represented the 25% of the total.

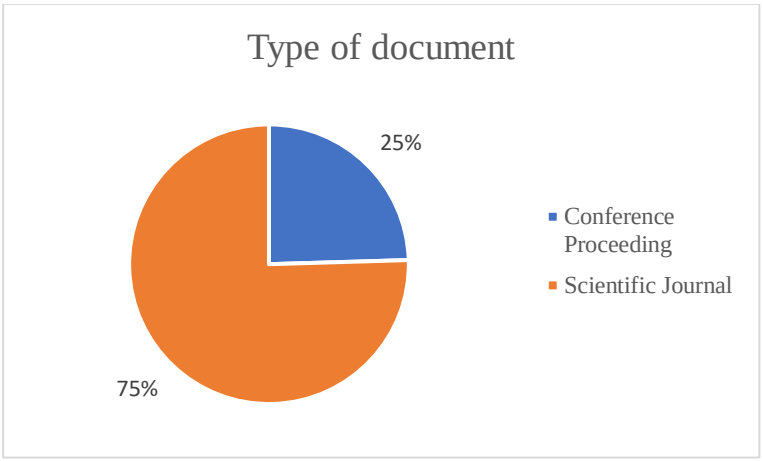


Figure 6: Type of document

After a further analysis on the journals, which counted the greater number of articles, we were able to identify that the main field for this study is the one of *Human Behavior*.

In addition, the quality of the 53 articles was measured and evaluated by looking at the journal in which they were published. Specifically, we relied on the *SCImago Journal & Country Rank*, a publicly available platform that includes journals and country

scientific indicators contained in the Scopus database. This system allows to classify the different journals and to group them by subject category. In particular, the SJR impact indicator is assigned. Based on the PageRank algorithm developed by Google to organize its search results, SJR shows the visibility of the journals by considering the number of citations and the prestige of the citing journal. Subsequently, the journals are ranked in descending order into four quartiles based on their SJR index: Q1, Q2, Q3, Q4. The most reliable journals in scientific terms within a subject category are those occupying the first quartile (Q1). As we move down along the quartiles, the importance of the other journals decreases.

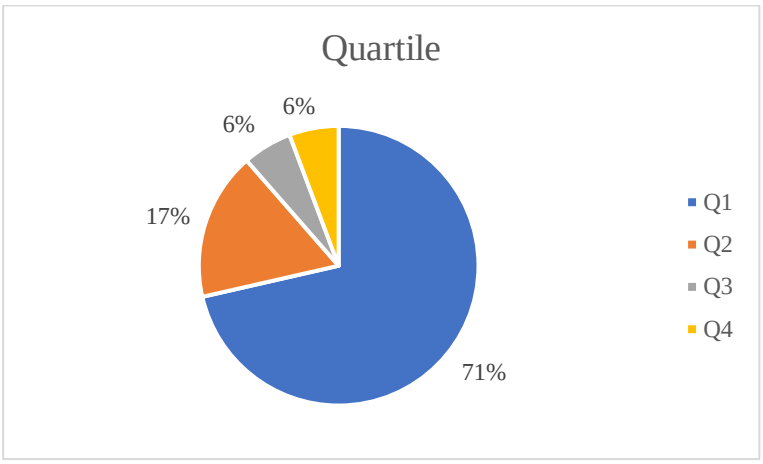


Figure 7: Quartile of the journals

In practice, all the quartiles related to our selected papers were found out by searching the journal titles on the platform one at a time.

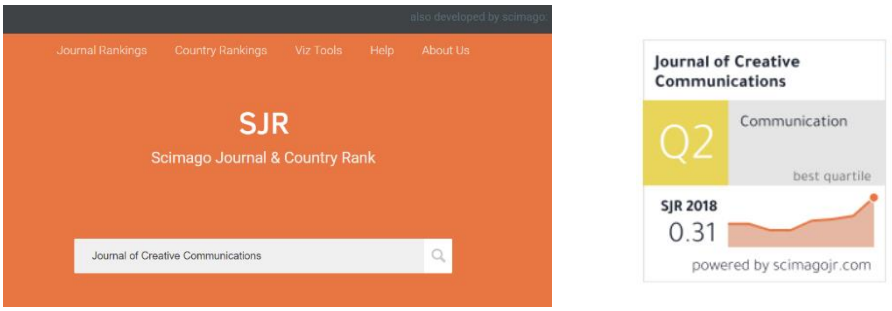


Figure 8: SJR

Once collected and compared together in a pie chart, it could be seen that the majority of the articles belongs to prestigious journals, since they correspond mainly to the first quartile (Q1) and then to the second quartile (Q2), with 71% and 17% respectively.

Moving on to the approach theory, another pie chart is used to presents a summary of the theories adopted in these studies.

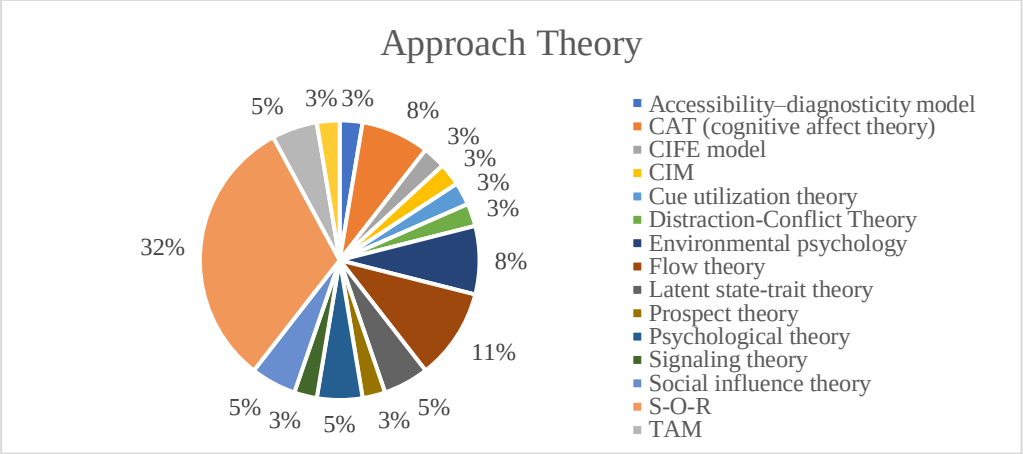


Figure 9: Approach Theory

The *S–O–R framework* is resulted to be the most applied theoretical framework to describe the online impulse-buying behavior. In general, it states that an arousing trigger (S - stimuli) perceived from the environment induces consumers' internal evaluation (O - organism), which subsequently leads to their propensity to move towards or away from that specific stimuli (R - response).

The second most used theorical perspective is instead the *Flow Theory*, according to which flow is a psychological state that individuals experience when they are deeply engaged in an activity in such a way that nothing else seems to matter.

Finally, another noteworthy perspective is the *Environmental Psychology* which studies the transactions and the interplay between people and their surroundings (natural, social, built and virtual, learning, and informational environments).

Anyway, these two last theories and the remaining ones presented in the pie chart provide a more comprehensive explanation of the mechanisms behind the S-O-R framework.

2.4.2 Information about the study

In this section, we will discuss the main characteristics of the research.

From the analysis, it emerged that these studies are always evolving and considering new technologies. The main reason why it is not possible to obtain a definitive result is the continuous development of technology, that causes the introduction of new different devices and creates opportunities to buy online. Indeed, the context of study changed during

the years. The papers from which definitions were extracted were published at the beginning of this century, and since the attention was mainly given to the offline environment, they also include physical stores. However, in the modern era the evolution of e-commerce leads to move the considerations about impulse-buying on online stores.

Moreover, the proliferation of social networks, such as Facebook, Twitter and Instagram, has influenced consumer behavior, thus research pushes its effort on these so-called social commerce platforms.

New e-commerce trends emerged too. Particularly relevant in this case is online group shopping by providing daily discount for various high-quality services and products.

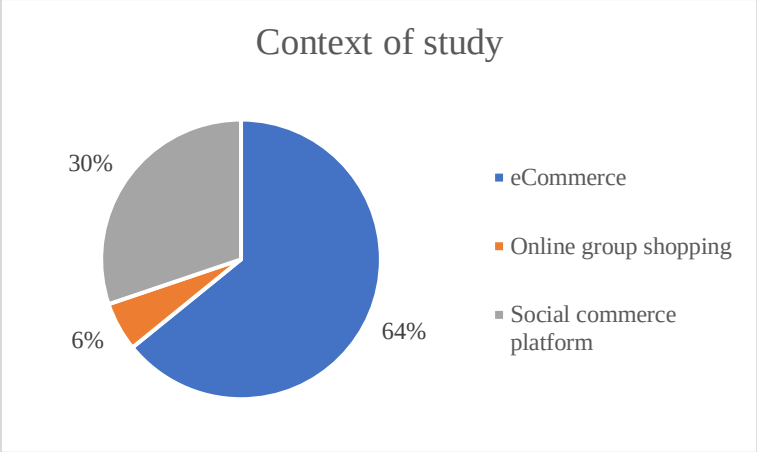


Figure 10: Context of study

These papers examine online impulse buying through two main research methods: surveys and experiments. The former collect data from a sample group which represents the target population, through in-person contact, telephone, mail, or online. The latter, instead, collect data from controlled field or within designed environment; through manipulation of at least one variable, the researchers observe customers' reactions to different stimuli.

Moreover, an irrelevant part of the studies is based on interviews and especially on focus groups which involve a group of people fitting the target demographic in a room, to discuss the (open-ended) research questions designed by the researching party under the guidance of a moderator.

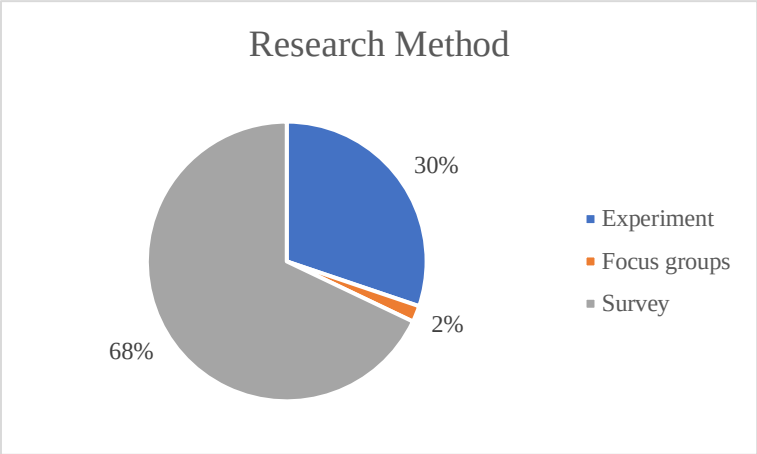


Figure 11: Research method

All of the papers used primary data for their study.

Looking at the sample of each study, the main categories were three and quite balanced:

1. College students. They are often used since they have low opportunity costs and steep learning curves;
2. Online buyers: people who usually buy online on various websites;
3. Users of the specific website analyzed.

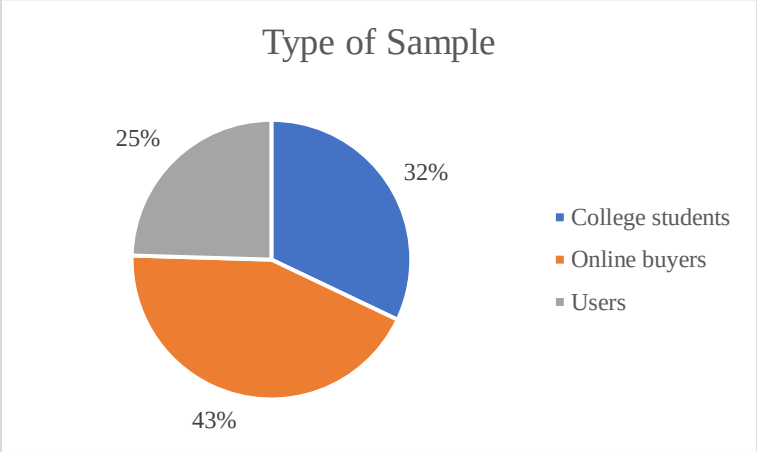


Figure 12: Type of sample

Another important characteristic of samples is the numerosity. Because of the great variety of samples in term of sizes, we decided to refer to interval values. Moreover, it is important to distinguish between the cases of experiments and surveys. In the former, the average sample size is 239 with a standard deviation of 195; in the latter, the average sample size is 394 with a standard deviation of 264. Details are shown in Figure 13 and Figure 14.

It is a reasonable and expected result: a large sample is always preferable in order to provide more accurate statistic values and provide a smaller margin of error. However, in

experimental economic sample sizes are usually not especially large because it would require larger financial and time commitments; in surveys, instead, larger samples are more manageable, especially in case of closed-ended questionnaires.

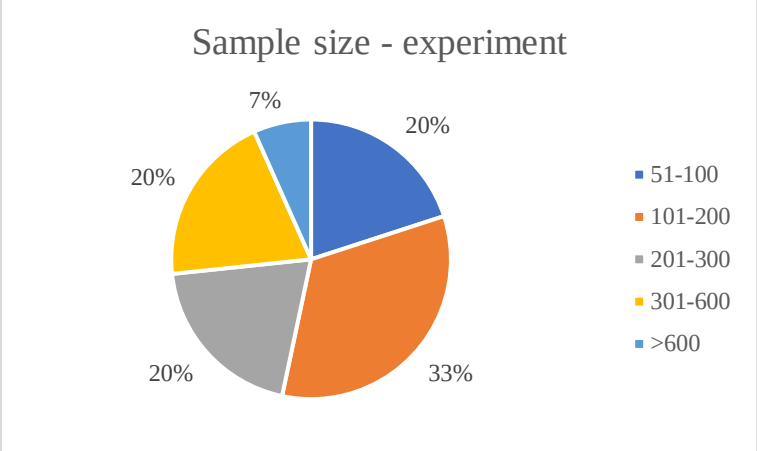


Figure 13: Sample size of experiments

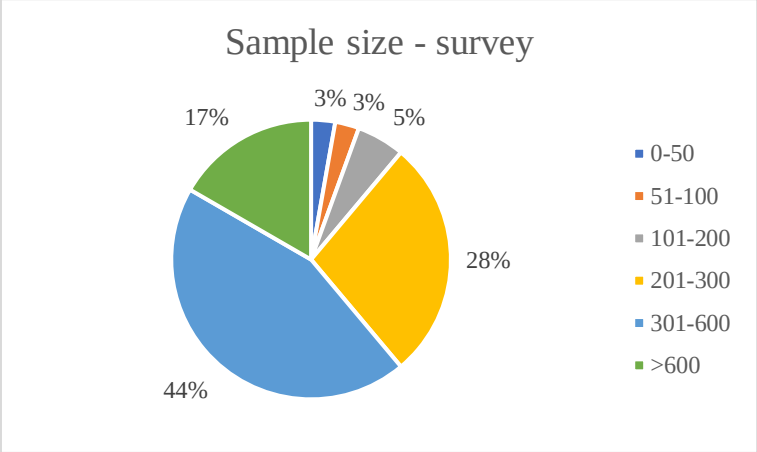


Figure 14: Sample size of surveys

The last important general information about the studies is the design structure of the experiment, which is crucial to define. For example, if the treatments are three institutions and there are two different subject pools, their combination gives six conditions to cover. If it was possible to run them simultaneously, there would not be any time issues. Usually, this is impossible due to software limitations, different oral instructions, etc. Thus, it is important to decide on the appropriate way to conduct the sessions.

Of course, it can be only analyzed in case of experiments and not of surveys. In the papers we analyzed, four different structures emerged:

1. Completely randomized. Most of the studies presented this design. In each session the condition is drawn randomly (with replacement) from the list of possible conditions.

Thus, the chosen condition is an independent, identically distributed random variable with the uniform distribution on the set of possible conditions.

2. Factorial design. This design is similar to the completely randomized design, except that the conditions are drawn without replacement until the finite number of copies (replications) is exhausted. It not only achieves complete independence among control variables in moderate numbers of trials, but also allows the examination of all the interactions.
3. Within-subject design: each subject sees all levels of a treatment variable. It is conservative but it controls for subjects' personal idiosyncrasies, which sometimes are an important nuisance.
4. Between-subjects design: each subject just sees one level, but different subjects (possibly in different sessions) see different levels.

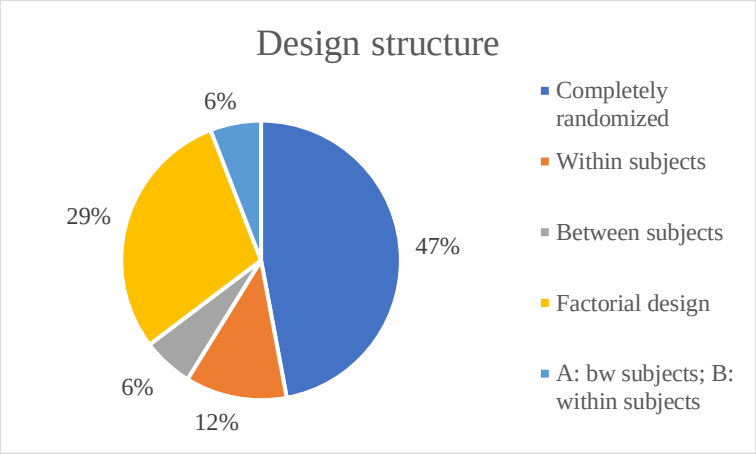


Figure 15: Design structure

2.4.3 Specific information about experiments and surveys

Regardless of the theoretical framework adopted, existing studies on online impulse buying have analyzed the relationships between environmental cues, consumers' cognitive and affective reactions, and the resulting behavior, largely relating to the environmental psychology paradigm, that focuses on the interplay between individuals and their surroundings; it can be reconciled with the S–O–R framework, which is the most commonly used theoretical foundation in the papers we analyzed. Therefore, we adopted the S–O–R framework for the classification of variables in online impulse-buying studies.

The S–O–R framework is an extension of the classical stimulus–response (S–R) approach. The three major elements of the S–O–R framework are:

- stimulus (S): a trigger that arouses consumers,

- organism (O): an internal evaluation of consumers,
- response (R): an outcome of consumers' reactions toward the impulse-buying stimuli and their internal evaluations.

Stimuli

There are two types of stimuli: external and internal. The formers are related to the environment surrounding the customer, while the latter are customer's characteristics.

In the papers of our analysis, many different **external stimuli** were considered, thus we decided to group them into categories:

- Website stimuli: cues embedded in a shopping website that are visible and audible to consumers (Eroglu, Machleit, & Davis, 2001). A further difference was found according to the research method used. Indeed, experiments investigated the effects of website features on online impulse buying, while surveys analyzed how the perceptions of websites influence online impulse buying. In Table 2 the main website stimuli used as variables are shown.
- Marketing stimuli: marketing cues that marketers use to entice consumers to make a purchase (Youn & Faber, 2000). Researchers used both qualitative and quantitative approaches. They are shown in Table 3.
- Situational stimuli: social or environmental factors associated with a particular consumption occasion that affect consumers' buying responses (Dholakia, 2000). They can be seen in Table 4.

Table 6: Website stimuli

Website stimuli		
Experiment		
Information quality	Content attributes such as the details, accuracy, amount and relevancy of the information provided	(Lin & Chuan, 2013)
Interactivity of stimuli	Includes features such as sequential browsing, customization of the database search	(Shen & Khalifa, 2012)
Media format	Text, still images or video	(Adelaar, Chang, Lancendorfer, Lee, & Morimoto, 2003)
Presentation mode		(Liao, To, Wong, Palvia, & Kakhki, 2016)

Textual information quality	The quality of the written information	(Chen, Su, & Widjaja, 2016)
Web atmospheric	Features include graphics, colors and links	(Huang L. , 2016), (Huang L. T., 2016), (Li, Cui, & Cheng, 2016)
Website quality	Features include usefulness, ease of use, entertainment, and complementary relationship	(Akram, et al., 2018), (Rezaei, Ali, Amin, & Jayashree, 2016), (Wells, Parboteeah, & Valacich, 2011), (Liu Z., 2019)
Survey		
Aesthetic appeal	The use of fonts, colors, layout, and graphics in product recommendation posts to attract consumers	(Chen, Lu, Wang, & Pan, 2019)
Informational social support	Being supported by others from a social group in forms of information provision	(Xi, et al., 2016)
Informational social influence	An influence to accept information obtained from another as evidence about reality	(Xi, et al., 2016)
Linguistic features		(Han, Liu, & Zhu, 2019)
Navigation	The organization and hierarchical layout of the content and pages in a website	(Floh & Madlberger, 2013)
Social presence	The feeling of being together	(Ju & Ahn, 2016)
Source credibility	The perceived reliability of the source	(Zhang, Hu, & Zhao, 2014) (Xi, et al., 2016)
Review quality	The quality and comprehensiveness of reviews	(Zhang, Hu, & Zhao, 2014)
Search mechanism	The belief about the information generated by the website	(Koufaris M. , 2002) (Koufaris, Kambil, & LaBarbera, 2001)
Vendor characteristics	The characteristics of the seller	(Leeraphong & Sukrat, 2018)
Visual appeal	The perceived visual appeal through website design	(Zheng, Men, Yang, & Gong, 2019) (Liu, Li, & Hu, 2013)
Website design	The perceived quality of the design	(Chen, Ku, & Yeh, 2019)

Table 7: Marketing stimuli

Marketing stimuli		
Experiment		
Product type	Hedonic or utilitarian	(Dewi, Nurrohmah, Sahadi, Sensuse, & Noprison, 2018) (Liao, To, Wong, Palvia, & Kakhki, 2016)
Promotions	Additional item with purchase, coupon, percentage off	(Dawson & Kim, 2010) (Akram, Khan, Hui, Tanveer, & Akram, 2018) (Dawson & Kim, 2009)
Survey		
Ideas	New styles/fashions, featured items, favorites	(Dawson & Kim, 2010)
Product availability	The presence of a diversity of various products in the online store	(Handayani, Purwandari, Solichah, & Prima, 2018)
Recommendations	Suggested items, customer recommendations, last thing the consumer looked at	(Akram, Khan, Hui, Tanveer, & Akram, 2018) (Dawson & Kim, 2009)
Sales	On sale (clearance, sales, and markdowns), bold sale price on product	(Akram, et al., 2018)

Table 8: Situational stimuli

Situational stimuli		
Experiment		
Browsing activity	The time spent browsing on that website	(Dewi, Nurrohmah, Sahadi, Sensuse, & Noprison, 2018) (Rezaei, Ali, Amin, & Jayashree, 2016) (Leong, Jaafar, & Ainin, 2018)
Delivery time	The amount of time it takes for goods that have been bought to arrive to the buyer	(Xuan, 2013)
Survey		
Influence of celebrities' posts		(Zafar, Qiu, Li, Wang, & Shahzad, 2019)

Para-social interaction	Feeling of intimacy with media personalities	(Xiang, Zhenga, Lee, & Zhao, 2016)
Stimuli from social networks	Friends' or celebrities' posts	(Zhang, et al., 2015)

Internal stimuli are impulsive consumer characteristics: inherent factors of consumers that are related to their propensity to act impulsively (Kacen & Lee, 2002). As shown in Table 5, the most common one is the impulse buying tendency: a consumer's internal trait of responding quickly to a given stimulus without deliberating regarding action outcomes.

Table 9: Impulsive consumer characteristics

Internal stimuli		
Experiment		
Impulse buying tendency	Responding quickly to a stimulus without deliberating regarding action outcomes	(Lin & Chuan, 2013) (Dewi, Nurrohmah, Sahadi, Sensuse, & Noprison, 2018) (Xiang, Zhenga, Lee, & Zhao, 2016) (Dawson & Kim, 2009) (Lee H. , 2018) (Han, Liu, & Zhu, 2019) (Zhang, et al., 2015) (Rezaei, Ali, Amin, & Jayashree, 2016) (Himawari, Prayoga, Fajrianti, & Abraham, 2018) (Liu Z., 2019) (Wen, Li, & Liu, 2019) (Zafar, Qiu, Li, Wang, & Shahzad, 2019)
Impulsiveness	Both the tendencies to experience spontaneous and sudden urges to make on-the-spot purchases and to act on these urges with little deliberation or evaluation of consequence	(Chen & Wang, 2016) (Chen, Su, & Widjaja, 2016) (Wells, Parboteeah, & Valacich, 2011) (Zhang, Xu, Zhao, & Yu, 2018)
Survey		
Informational social influence	Tendency to obtain information by observing or directly seeking information from other people	(Hu, Chen, & Davidson, 2019)

Instant gratification	The instant feeling of gratification following the purchase	(Zhang, Chen, Gu, & Liu, 2018) (Liu, Li, & Hu, 2013)
Normative social influence	Need to use a website to identify with, or enhance his or her image in the eyes of significant others, and willingness to conform to the expectations of others in making purchase decisions	(Hu, Chen, & Davidson, 2019) (Xi, et al., 2016)

Organisms

In the S-O-R framework, organism refers to consumers' internal evaluations. There are two types of organisms: cognitive and affective.

- Cognitive reactions: mental processes that take place when consumers interact with stimuli. They occur when consumers become aware of potential constraints during the online impulse-buying process (Parboteeah, Valacich, & Wells, 2009). These reactions are positive when stimulate buying responses; they are negative when deter consumers' buying responses (Hoch & Loewenstein, 1991).
- Affective reactions: emotional responses that arise when consumers interact with an environment (Sun & Zhang, 2006). The most commonly examined positive affective reactions are shopping enjoyment, pleasure and arousal.

Table 10: Organisms

Organisms		
Cognitive reactions		
Cognitive absorption	Being deeply immersed in a system	(Lee H. , 2018) (Shih, Hsiung, & Wu, 2017)
Cognitive trust in recommender	Feeling of trust of the recommendation	(Chen, Lu, Wang, & Pan, 2019)
Concentration	The consumers' responses in putting their attention to the web store	(Koufaris M. , 2002)
Hedonic or utilitarian motivation		(Zheng, Men, Yang, & Gong, 2019)
Merchandise attractiveness	The perception of the size and attractiveness of the assortment	(Zhou, Chen, & Chen, 2013) (Verhagen & Van Dolen, 2011)

Normative evaluation	The consumer judgments regarding the positive appropriateness of impulse-buying behavior	(Dawson & Kim, 2009) (Liu, Li, & Hu, 2013)
Observational learning		(Zafar, Qiu, Li, Wang, & Shahzad, 2019)
Perceived control	The perception of being in control over what to see and do in the web store	(Koufaris, Kambil, & LaBarbera, 2001)
Perceived ease of use	The degree to which a person believes that using a particular system would be free from effort	(Zhou, Chen, & Chen, 2013) (Verhagen & Van Dolen, 2011) (Zhang, Chen, Gu, & Liu, 2018) (Lee H. , 2018) (Handayani, Purwandari, Solichah, & Prima, 2018)
Perceived usefulness	The extent to which the online user believes that his or her shopping productivity will be enhanced by using a particular website	(Wu, Chen, & Chiu, 2016) (Xiang, Zhenga, Lee, & Zhao, 2016) (Leeraphong & Sukrat, 2018) (Zhang, Hu, & Zhao, 2014)
Perceived risk		(Lin & Chuan, 2013) (Akram, Khan, Hui, Tanveer, & Akram, 2018) (Vonkeman, Verhagen, & Van Dolen, 2017) (Hu, Chen, & Davidson, 2019)
Affective reactions		
Affective state	A person's emotional state, mood, and self-feelings	(Dawson & Kim, 2009) (Huang L. T., 2016) (Chen, Lu, Wang, & Pan, 2019)
Arousal	A state of feeling that varies from feelings of excitement, stimulation, to feelings of being tired, bored	(Adelaar, Chang, Lancendorfer, Lee, & Morimoto, 2003) (Ju & Ahn, 2016) (Liao, To, Wong, Palvia, & Kakhki, 2016)
Dominance	The extent to which an individual feels in control of a particular affective state	(Adelaar, Chang, Lancendorfer, Lee, & Morimoto, 2003)
Emotional social support	Emotional support provided by other people of the community	(Xi, et al., 2016) (Hu, Chen, & Davidson, 2019)

Flow experience	A state of optimal psychological experience when the customer becomes entirely focused on the activity and feels positive experiential characteristics	(Lin & Chuan, 2013) (Hsu, Chang, & Chen, 2012)
Negative affect	The extent to which a person feels distress, irritation, and disturbance	(Verhagen & Van Dolen, 2011) (Liu, He, & Li, 2019)
Positive affect	The extent to which a person feels enthusiastic, excited, and inspired	(Wei, Ma, & Chen, 2018) (Zhang, Hu, & Zhao, 2014)
Pleasure	The degree to which a person feels good, joyful, happy, or satisfied with a particular situation	(Akram, Khan, Hui, Tanveer, & Akram, 2018) (Adelaar, Chang, Lancendorfer, Lee, & Morimoto, 2003) (Ju & Ahn, 2016) (Liao, To, Wong, Palvia, & Kakhki, 2016)
Products affection	Psychological reaction derived from value-expressive or affective motives	(Vonkeman, Verhagen, & Van Dolen, 2017)
Shopping enjoyment	The pleasure obtained during a shopping experience	(Dewi, Nurrohmah, Sahadi, Sensuse, & Noprison, 2018) (Koufaris M. , 2002) (Koufaris, Kambil, & LaBarbera, 2001) (Brooks, Califf, & Martin, 2012) (Xiang, Zhenga, Lee, & Zhao, 2016) (Huang L. , 2016) (Leeraphong & Sukrat, 2018) (Zhang, Chen, Gu, & Liu, 2018) (Floh & Madlberger, 2013)

Responses

A response is a consumer's reaction to online impulse-buying stimuli and organisms. Table 7 shows the responses considered in the studies we analyzed. The most common ones are the urge to buy impulsively and the impulsive buying behavior.

Indeed, measuring the actual impulse-buying behavior resulted challenging and sometimes problematic because of the tendency of respondents to behave in a socially desirable manner when being observed. Therefore, these two responses were commonly used in studies as surrogates to estimate actual online impulse buying.

Table 11: Responses

Responses		
Impulsive buying behavior	A sudden and immediate online purchase with no pre-shopping intentions. It is unplanned, spontaneous, and decided on the spot	(Dewi, Nurrohmah, Sahadi, Sensuse, & Noprison, 2018) (Akram, Khan, Hui, Tanveer, & Akram, 2018) (Hu, Chen, & Davidson, 2019) (Wen, Li, & Liu, 2019) (Xuan, 2013) (Hasim, Ishak, & Hassim, 2019) (Shih, Hsiung, & Wu, 2017)
Unplanned purchase	Any purchases made in addition to what consumers had initially said they would buy	(Zhang, Chen, Gu, & Liu, 2018) (Ju & Ahn, 2016) (Leong, Jaafar, & Ainin, 2018)
Urge to buy impulsively	Sudden, often powerful, and persistent urge to buy something immediately	(Brooks, Califf, & Martin, 2012) (Leeraphong & Sukrat, 2018) (Zhang, Hu, & Zhao, 2014) (Wells, Parboteeah, & Valacich, 2011) (Zhang, Xu, Zhao, & Yu, 2018) (Vonkeman, Verhagen, & Van Dolen, 2017) (Leong, Jaafar, & Ainin, 2018) (Liao, To, Wong, Palvia, & Kakhki, 2016) (Zafar, Qiu, Li, Wang, & Shahzad, 2019) (Zheng, Men, Yang, & Gong, 2019)

Moderator and control variables

Besides the adoption of the S-O-R framework, it is important to consider some peculiarities of the variables in the case of experiments.

Indeed, in experiments, there can be *focus* variables, those whose effects one wants to understand, and *nuisance* variables, that may also have an effect that must be accounted for in order to not reach incorrect conclusions. It is important to deal appropriately with both kinds of variables: the effects of focus variables must be clear and not confounded with the effects of nuisances. To separate out the effects, in the papers we have analyzed,

nuisance variables were treated as controlled variables and held constant. The most common controlled variables were:

- Age
- Gender
- Income
- Occupation
- Online experience

Another important characteristic of experiments is the presence of moderators. They are external variables that affects the strength of the relationship between the dependent and independent variable. In our analysis, various variables have been used as moderators, but the most interesting ones were the following:

- Anticipate pleasure
- Distraction
- Positive and negative emotion

2.5. Results

Once adopted the S–O–R framework to classify the factors that can have an impact on online impulse purchasing, the SLR analysis highlighted on the one hand some studies in which impulse-buying responses are the immediate result of the exposure to internal and external stimuli; on the other hand, other studies stated that stimuli have a mediated effect on online impulse-buying behavior because of the presence of affective and cognitive reactions. Thus, in a nutshell, online impulse-buying stimuli could have both a direct and an indirect relationship with the online impulse-buying response. Moreover, there can be also a moderated relationship due to the presence of moderators.

The objective of each study is to assess the presence of one of these relationships by making first some hypothesis that, once tested, can be supported or rejected.

A big portion of the selected 53 articles demonstrated complete correlation between factors and online impulse decisions, since what hypothesized was fully validated. In particular, external factors refer mostly to website stimuli than to marketing and situational ones, and they principally have a direct relationship with online impulse-buying than indirect one; the moderating effect does not appear (see Table 8).

Instead, for what concerns internal stimuli, it is easily demonstrated that consumers with low impulse buying tendency make more difficult online purchasing decisions with respect to consumers with high impulse buying tendencies (Dawson & Kim, 2009).

Table 12: complete correlation

Hypothesis

Website stimulus	*Relationship*	
Information quality	Indirect	(Lin & Chuan, 2013)
Interactivity of stimuli	Indirect	(Shen & Khalifa, 2012)
Media format	Direct	(Adelaar, Chang, Lancendorfer, Lee, & Morimoto, 2003)
Textual information quality	Direct	(Chen, Su, & Widjaja, 2016)
Web atmospheric	Direct	(Huang L. , 2016), (Huang L. T., 2016), (Li, Cui, & Cheng, 2016)
Website quality	Direct	(Akram, et al., 2018), (Rezaei, Ali, Amin, & Jayashree, 2016), (Wells, Parboteeah, & Valacich, 2011), (Liu Z., 2019)
Source credibility	Direct	(Zhang, Hu, & Zhao, 2014) (Xi, et al., 2016)
Review quality	Direct	(Zhang, Hu, & Zhao, 2014)
Vendor characteristics	Indirect	(Leeraphong & Sukrat, 2018)
Visual appeal	Indirect	(Zheng, Men, Yang, & Gong, 2019) (Liu, Li, & Hu, 2013)
Website design	Direct	(Chen, Ku, & Yeh, 2019)

Other papers demonstrated again complete correlation, however with some exceptions. We can talk about partial correlation and this means that some of the hypothesis tested in the studies were rejected, while some others were supported. In this case, most of the factors that do not demonstrate correlation with impulse-buying behavior are those related to the

consumers' internal evaluations (Organism), both cognitive and affective ones (see Table 9). Thus, indirect relationships do not seem to affect online impulse-buying decisions.

Table 13: partial correlation

Hypothesis

Organism – Cognitive	*Relationship*	
Normative evaluation	Indirect	(Dawson & Kim, 2009) (Liu, Li, & Hu, 2013)
Perceived control	Indirect	(Koufaris, Kambil, & LaBarbera, 2001)
Perceived ease of use	Indirect	(Zhou, Chen, & Chen, 2013) (Verhagen & Van Dolen, 2011) (Zhang, Chen, Gu, & Liu, 2018) (Lee H. , 2018) (Handayani, Purwandari, Solichah, & Prima, 2018)
Perceived usefulness	Indirect	(Wu, Chen, & Chiu, 2016) (Xiang, Zhenga, Lee, & Zhao, 2016) (Leeraphong & Sukrat, 2018) (Zhang, Hu, & Zhao, 2014)
Organism – Affective		
Affective state	Indirect	(Dawson & Kim, 2009) (Huang L. T., 2016) (Chen, Lu, Wang, & Pan, 2019)
Emotional social support	Indirect	(Xi, et al., 2016) (Hu, Chen, & Davidson, 2019)
Shopping enjoyment	Indirect	(Dewi, Nurrohmah, Sahadi, Sensuse, & Noprison, 2018) (Koufaris M. , 2002) (Koufaris, Kambil, & LaBarbera, 2001) (Brooks, Califf, & Martin, 2012) (Xiang, Zhenga, Lee, & Zhao, 2016) (Huang L. ,

		2016) (Leeraphong & Sukrat, 2018) (Zhang, Chen, Gu, & Liu, 2018) (Floh & Madlberger, 2013)

Finally, going ahead with the analysis of the results, it can be seen that just a few factors have a moderating effect on online impulse buying. Table 10 shows whether these moderators affect the strength of the relationship with the independent variable or not.

Table 14: moderators correlation

Hypothesis

Moderator	*Influence*	
Anticipate pleasure	Yes	(Xuan, 2013)
Celebrities' post authenticity	No	(Zafar, Qiu, Li, Wang, & Shahzad, 2019)
Customer tenure	Yes	(Koufaris, Kambil, & LaBarbera, 2001)
IBT	Yes	(Zafar, Qiu, Li, Wang, & Shahzad, 2019) (Liao, To, Wong, Palvia, & Kakhki, 2016)
Impulsiveness	Yes	(Wells, Parboteeah, & Valacich, 2011)
Income	No	(Leong, Jaafar, & Ainin, 2018)
Perceived hedonic value	Yes	(Chen, Ku, & Yeh, 2019)
Product involvement	Yes	(Liao, To, Wong, Palvia, & Kakhki, 2016)
Scarcity	Yes	(Ju & Ahn, 2016)

3. Fundamentals of consumer neuroscience

As a consequence of the literature review, the evidence of cognitive and affective variables' impact on the impulse buying behavior opens up the possibility to use new methods to study

this type of purchasing and, in particular, the causes behind it. Indeed, once asked people to fully explain their behavior in front of marketing stimuli, they are usually not able to do that. For instance, when filling a scoring questionnaire after the exposure to a commercial advertisement, individuals faces difficulties in expressing their preferences. Moreover, it is even more difficult for them to convey their emotions, again in return to a marketing stimulus. Given this assumption, there is a growing interest in measuring emotions through their physiological exteriorizations (Vecchiato, et al., 2014). According to Damasio's considerations, the decision-making process is mainly ruled by emotions. Human's decisions do not follow a rational path that much, but they rely on unconscious, automatic and affective mechanisms which guide human's choices although they cannot be completely controlled (Bechara, Damasio, & Damasio, 2000). Thus, a deep examination on emotions is crucial to understand the human behavior. In this respect, the importance of the field of consumer neuroscience emerged as the scientific proceeding to gain considerable insights in human brain to enhance the understanding of consumers behavior through the application of neuroscientific methods to marketing research questions. Specifically, its aim consists in studying the cognitive and affective reactions of customers by measuring their physiological signals, such as Electroencephalographic (EEG), Heart Rate (HR), Skin Conductance Response (SCR) or Eye-Tracking (ET), in order to gain consumer insights and marketing effects (Ramsøy, 2019).

These neuroscientific tools support the traditional methods of marketing theory and they constitute a complementing advancement for further investigation of specific decision-making behavior (Fugate, 2007). In particular, the attention on emotions and their effect on how human being make decisions is one of the main interesting contributions of this research field through the estimation of cortical, subcortical and bodily activations during costumer experience (Hubert & Kenning, 2008). Hence, neuroscience metrics might complete the conventional marketing techniques focused on the evaluation of the emotional states - surveys, questionnaires, focus groups - that conversely are based on the fact that consumers are completely rational and on collecting answers before or after the experience. Moreover, they avoid all the cognitive biases that affect the responses to these classic self-reported measures, such as social desirability, consistency motif or acquiescence biases and by the questionnaire's structures related to common scale anchors and scale lengths (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003).

To measure consumers' emotions in affective science, these might be organized along at least two fundamental dimensions: valence and arousal. The former measures pleasantness versus unpleasantness of emotions, while the latter measures emotions' activation and deactivations.

These two factors together define the so-called Circumplex model of Affect (Russell J. A., 1980), that will be explained in detailed in paragraph 2.4.

3.1 Metrics

At this stage, it is noteworthy to go more in depth in explaining the common physiological responses cited in the previous paragraph in order to understand the consumers' behavior in an online environment.

First of all, the tools used in consumer neuroscience research can be classified into those which record the neural activity inside the brain (EEG, fMRI) and those that do not (ECG, ET, SCR) (Figure 16). Then, by following this division, an overview on the measurement of these signals and on their correlation with affective and cognitive reactions is conducted. However, the discussion on the methods related to the activity inside the brain is not going to go into detail on the metabolic branch (fMRI), since this study's flow of interest is rapid in nature and fMRI is not able to map the brain activity during the exposure to a marketing stimulus in a short time.

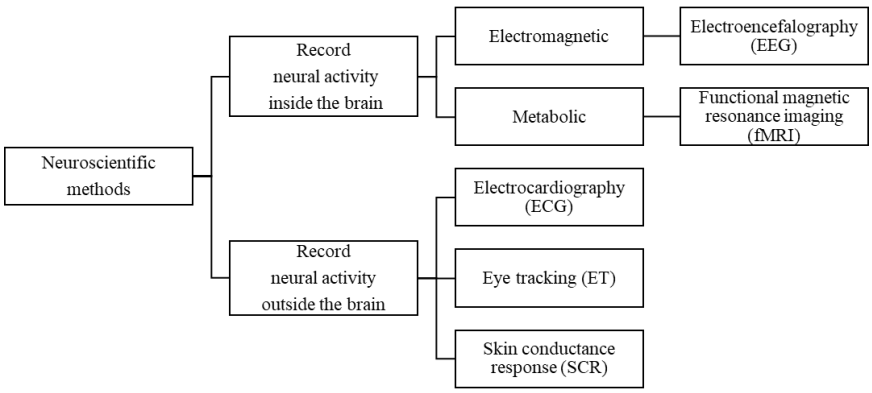


Figure 16: Classification of neuroscientific methods (Lim, 2018)

3.1.1 Neural activity inside the brain

Electroencephalography (EEG)

The human brain has about 100 billion neurons that communicate via electrical impulses and manage the way people think and take actions. In this respect, even if widely used some years

ago, functional Magnetic Resonance Imaging (fMRI) is an available method for measuring what behind human brain. In particular, this technology measures and maps cerebral activity in a non-invasive way through the detection of changes associated with blood flow using MRI scanners (Venkatraman, et al., 2015). However, even if it provides a high spatial resolution of the brain activity, the lack of temporal resolution made fMRI to be replaced by electroencephalography (EEG).

EEG is a method to record the spontaneous neural activity inside the brain thanks to the positioning of multiple electrodes on the scalp – sometimes embedded in caps or nets – in order to cover the different specific areas of the brain. Hence, once subjects are exposed to a marketing stimulus, the electrical currents' fluctuations produced by neurons in each brain area are detected in a non-invasive way (Morin, 2011) (Plassmann, O'Doherty, & A., 2007) with the aim of studying their correlation with humans' cognitive and affective states. Moreover, in contrast with fMRI, EEG is able to follow the brain activity on a millisecond base during the exposure to a marketing stimulus at relatively low cost, despite the fact that it can record only signals coming from the cortical structure of the brain. Hence, high resolution EEG was applied in order to be effective in detecting signals with a better spatial resolution, equal to a squared centimeter (Vecchiato, et al., 2011).

Then, it is noteworthy to highlight that EEG data must be visualized and analyzed by looking at their frequency domain thanks to the Fourier transform, known for transforming signals tested in time (or space) to the same signals tested in frequency. In general, the term 'frequency' refers to the number of times something happens in a given time interval so, the EEG frequency is connected to how many times the brainwaves signal occurs in specific timeframes. In particular, EEG waves are classified based on their frequency range, the so-called frequency band, which is defined by using the Greek alphabet. The division that can be universally considered is the following: 0,5-4 Delta, 4-8 Hz for Theta, 8-13 Hz for Alpha and 13-22 Hz for Beta. In particular, each of these ranges defines a group of frequencies associated to the activation of different process (Lubar, Swartwood, Swartwood, & O'Donnell, 1995). Indeed, Delta waves are usually detected during the deep and unconscious sleep; Theta waves are associated to reduced consciousness and some states of sleep like dreams; Alpha, instead, refers to a state of physical and mental relaxation; Beta waves are correlated to normal alert consciousness; finally, Gamma waves are equated heightened perception related to a visual stimuli (Abo-Zahhad, Ahmed, & Abbas, 2015).

In addition to the frequency bands, another dimension through which analyzing EEG data is the Regions of Interest. As already said, EEG is measured by electrodes placed along the scalp

since it is made up of different regions whose activation covers specific mental process. Thus, electric signals coming from one of these areas catch states that are very different from those resulted from signals of another area. The position of the electrodes can vary research by research, but there is a standard known as 10-10 International System (Figure 17) for electrodes placement, also adopted by Vecchiato et al. (2010). The site of each electrode is identified by a letter and by a number. The letter corresponds to a specific region of the brain (F: frontal, T: temporal, P: parietal, O: occipital, and C: central), except for 'z' that, standing for 'zero', represents the vertical midline of the brain cortex. The number, instead, is related to the cerebral hemisphere (even and odd numbers correspond respectively to the right and the left hemisphere).

EEG is able to follow the brain activity on a millisecond base during the exposure to a marketing stimulus, despite the fact that it can record only signals coming from the cortical structure of the brain. Hence, high resolution EEG was applied in order to be effective in detecting signals with a better spatial resolution, equal to a squared centimeter (Vecchiato, et al., 2011).

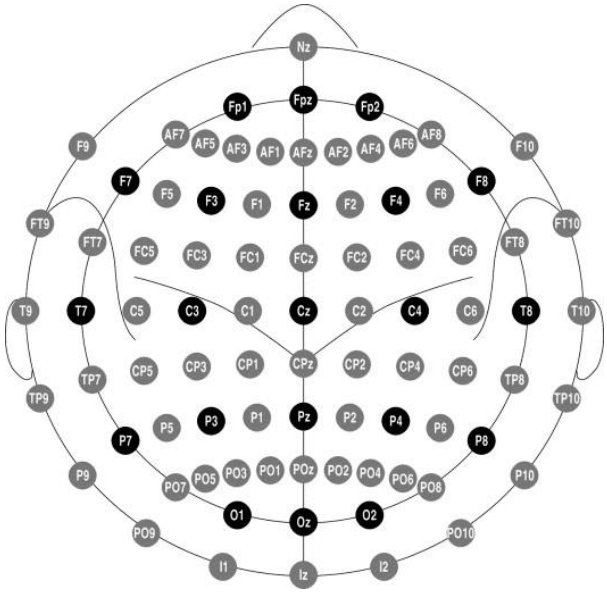


Figure 17: Placement of electrodes according to 10-10 International System

In this way, EEG signals can be used to detect mental processes through the computation of indexes which measure them. In particular, temporal and frequency patterns of EEG signals could convey information about the cognitive and emotional processes in subjects observing TV advertisements (Vecchiato, et al., 2011). Moreover, since it is known that the signs of this cognitive activity can be found within the alpha, beta and theta bands, these range of frequencies

have been employed to calculate the global field power (GFP), a technique able to detect real time Hertz changes and covert these data for statistical analysis.

However, the brain activity related to theta and alpha bands linked to the pre-frontal cortex (PFC) is the most responsive during the observation and the memorization tasks. Indeed, always considering the 10-10 International System, the attention index is calculated thanks to GFP of the lower alpha frequencies measured by the electrodes Fpz, AF3, F3, AF4, F4, Fz of the PFC. Instead, the memorization index is given by the GFP of the theta signals measured by the AF3 and F3 pre-frontal electrodes. Finally, the pleasantness index is calculated using the upper alpha signals by the placements AF3, AF4, F3, F4 by taking into account the asymmetry between the right and the left hemisphere of the PFC (Vecchiato, et al., 2012). In addition to these indices, the beta frequency band divided by the sum of the theta and alpha frequencies has been figured out as the engagement index (EI) (Prinzel, Freeman, W., Mikulka, & Pope, 2000). In this way, EEG signals are correlated to attention, memorization and pleasantness, but that's not all since with respect to the virtual environments , they are also related to self-reported measures of cognitive and affective variables such as presence (Fp1, Fp2, Fz, T7), familiarity with the environment (in Fz, Pz) and comfort (Fz, Fp1) (Vecchiato, et al., 2015). To conclude, it is important to mention also that EEG is used to track the mental workload in situations of different levels of difficulty, by using the power spectra variables of the signals from the electrodes C3-C4, Cz-PO, F3-Cz, Fz-C3, and Fz-PO (Berka, et al., 2007).

3.1.2 Neural activity outside the brain

Skin Conductance Response (SCR)

The Skin Conductance Response (SCR), also known as Galvanic Skin Response (GSR) or Electrodermal Activity (EDA), refers to a temporary increase in the electrical conductivity of human skin in response to a skin surface perspiration following an exposure to certain stimuli. Sweat activity is mainly influenced by the temperature of the environment, but the sweat glands located on hands are more responsive to psychological stimuli rather than to thermal ones (Greenfield & Sternbach, 1972). Hence, by recognizing a higher density of these sweat glands in hands and by assuming the symmetry in the two hands' responses, SCR is typically measured from the palmar surface of the non-dominant hand in order to avoid impediments in the movements of the dominant one.

Emotions affect the responses of different biological systems, among which the activity of the Autonomic Nervous System which comprise the sympathetic and the parasympathetic one.

Since there is no parasympathetic innervation of eccrine sweat glands, EDA reflects only activity within the sympathetic branch of the autonomic nervous system (ANS). As such, EDA measures have been used recently to assess the sympathetic nervous system arousal (Posada-Quintero, Florian, Orjuela-Cañón, & Chon, 2018) (Critchley, 2002). Still, SCR does not express a reliable correlation to emotional valence (Potter & Bolls, 2012).

Electrocardiography (ECG)

The heart-based biometrics are typically measured by a diagnostic test called electrocardiography (ECG), used to measure the electrical activity of the heart over time using external skin electrodes. In particular, ECG can record and evaluate two signals, known as Heart Rate (HR) and Heart Rate Variability (HVR). HR is the speed at which the heart beats, usually expressed in beats per minute (bpm). HVR, instead, consists of changes in the time intervals between consecutive heartbeats. These ECG data can be acquired from electrodes placed on subjects' wrists and ankles, or better on torsos because this allows subjects to move more freely in their environment.

The variation in HR can be measured with different methods, among which the time domain methods represent the simplest ones. Thanks to this approach, HR and the intervals between successive heartbeats are determined at any point of time and later on different statistical measures and geometric patterns can be applied to evaluate the signals. Then, there are also the frequency domain methods to evaluate HVR, which consist in spectral methods such as the Power Spectral Density (PSD) analysis in order to interpret the tachogram and understand how power distributes as a function of frequency (Malik, et al., 1996). However, by taking into consideration the time domain, it's fundamental to define first the ECG cycle. Traditionally, the letters P, Q, R, S, and T label the individual peaks of the whole cycle's signal (Figure 18). Then, the RR interval represents the time interval between two consecutive R peaks, and this identifies exactly the heart rate variability. Thus, the HVR signal is detected from ECG through recognition of the R peaks performed through the Pan-Tompkins' method - a real-time algorithm for detection of the QRS complexes of ECG signals (Pan & Tompkins, 1985). Therefore, the heart rate is defined with the reciprocal of the RR interval (Malik, et al., 1996).

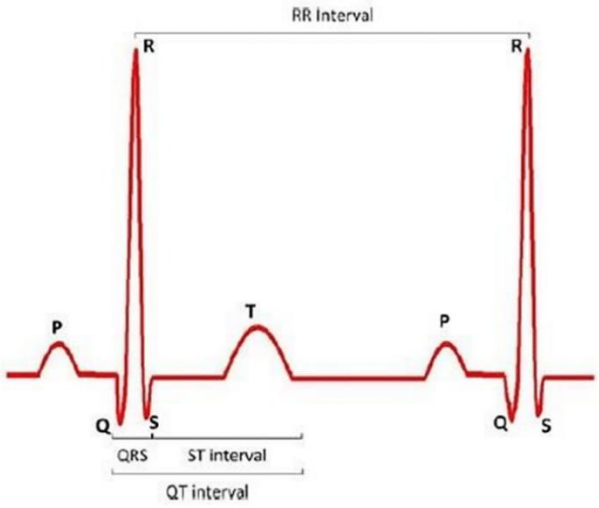


Figure 18: ECG signal

Although there is a delay of few seconds between the brain activity and the physiological responses, the ECG remains a valuable a neuroscientific tool to use in the marketing field. Indeed, it enables at a low cost the recording of neural activity outside the brain, gathering of real-time info about the subjects' emotions when exposed to a specific marketing stimulus, and the collection of physiological responses that are unlikely to be biased (Plassmann, Litt, Shiv, & Rangel, 2011). Thus, these signals can be used in neuromarketing to measure affective and cognitive variables.

In this respect, HR and HRV give a very noteworthy contribution. Remember that emotions are assessed in terms of arousal and valence, with the valence value reflecting the direction of emotion and the arousal value reflecting the scope of emotional changes (Lang, Dhillon, & Dong, 1995). In fact, HR and HRV provide insights on the people's emotional aspects because they are driven by the autonomic nervous system (Malik, et al., 1996). In particular, HR is controlled by the sympathetic nervous system (SNS), which reveals arousal based on a heart rate acceleration following the body's automatic response to a marketing stimulus, and the parasympathetic nervous system (PNS), which reflects a relaxed state characterized by a heart rate deceleration (Lang, Bolls, Potter, & Kawahara, 1999) (Potter & Bolls, 2012) (Wang, Lang, & Busemeyer, 2011). Moreover, Lang et al. (1999) highlighted that increased HR deceleration in response to an ad implies increased ability to focus on that ad and this provides an independent measure of attention. This was also reinforced by the Antonnen and Surakka (2005) who demonstrated that, in general, HR tends to decelerate in response to emotional stimuli and this deceleration is greater in case of unpleasant stimuli exposure than in case of

pleasant stimuli one. In this way, it is possible to assess the valence of these reactions. In particular, Ganglbauer et al. (2009) stated that while HR can be correlated with arousal, HRV instead can be used to assess the valence of an emotion. In addition, by considering the effect of emotions on learning activities, Chaouachi et al. (2010) used HR to assess the valence dimension of the subjects' affective states. Moreover, Vecchiato et al. (2010) first noticed a correlation between HR activity and commercial ads that were remembered and considered pleasant and later on (2015), they found a correlation between HR and the sense of Presence assessed by the subjects in the context of virtual architectural environments.
Thus, ECG is useful to assess the valence and arousal factors of emotions, besides the fact of a possible correlation with attention, memorization processes and sense of presence.

Eye tracking (ET)

Eye tracking (ET) is a neuromarketing method though which eye positions and movements can be measured and recorded by means of optimal cameras. In particular, these eye trackers can be contact lens–based, electrooculogram-based, or video-based, but in any case, they are able to detect the position of the pupils using infrared lights which evoke corneal reflection (Venkatraman, et al., 2015). In this way, real-time coordinates of the users' gaze are generated, and these are useful to understand the possible correlation between what the subjects see and how they react to the information they process in response to the exposure of a specific marketing stimulus. Moreover, they can be also used to indicate higher-level cognitive processes including mental workload and fatigue (Bylinskii, Borkin, Kim, Pfister, & Oliva, 2015). Hence, ET helps neuromarketers in two aspects. First of all, it enables the analysis of people's behavior in front of the screen in terms of where and what they are likely to look at. Second of all, it provides signals, such as pupil dilatation or constriction, to detect cognitive and affective states. Moreover, all these insights are collected with high temporal resolution and at a low cost (Plassmann, Litt, Shiv, & Rangel, 2011) (Venkatraman, et al., 2015).
To observe and analyze the way the person looks at the object, two basic eye movements should be defined first: fixation and saccade. Given coordinates of gaze data, the former (Figure 19.b) is an aggregation of gaze points on a specified stationary area (20 to 50 pixels) and timespan (approximately 200 to 300 milliseconds) (Holmqvist, et al., 2011). However, during the fixation the eye is not completely still and three types of micro-movements can occur, such as tremor (a small movement of about 90 Hz frequency without reason), drift (a slow movement that takes an eye away from the fixation center) and micro saccade (a quick movement to bring the eye back to its original position) (Holmqvist, et al., 2011) (Martinez-Conde, Macknik, & Hubel,

2004) (Rayner, 1998) (Andrychowicz-Trojanowska, 2018). The latter, instead, consists in a rapid eye movement occurring from one fixation to another and lasting, depending on a source, between 40–50 (Lorigo, et al., 2008) or 30–80 milliseconds (Holmqvist, et al., 2011).However, a saccade does not provide any further information because of the high speed of eyes movement (Rayner, 1998). Then, a scan path (Figure 19.d) is defined as the alternating sequence fixation-saccade-fixation and it shows the search activity conducted by the user (Blascheck, et al., 2017). Consequently, more saccades mean more searching (Goldberg & Kotval, 1999). In addition, the screen can be divided in different regions, the so-called areas of interest (AOIs) (Figure 19.a), which can be separately analyzed because, by considering for instance a specific object, they contain all fixations that fall within a certain distance of that object (Orquin, Ashby, & Clarke, 2016). Consecutive fixations on a precise AOI can be further clustered into *gazes* (Figure 19.c) (Bylinskii, Borkin, Kim, Pfister, & Oliva, 2015). This approach is useful to highlight the most interesting parts of the screen and specifically, the most important features of a website/app from the user perspective.

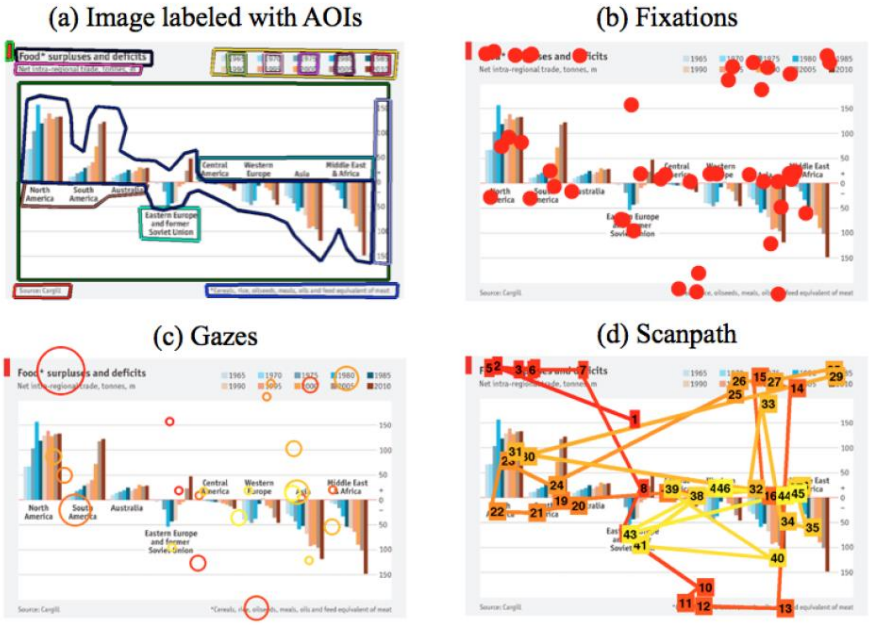


Figure 19: Eye tracking metrics (from Bylinskii et al., 2017)

Although ET is a very effective method to analyze the interaction between users and computers (Human Computer Interaction, HCI), it allows also to make inferences on the subjects' cognitive and affective processes. Significant information can be extracted from the study of contractions and dilations of the pupils that do not only respond to light intensity of the environment, but also to cognitive processing, arousal and increased interest. In fact, pupils' movements are very useful in situations of mental concentration or emotional arousal.

Typically, the grater the level of interest or arousal, the larger the pupil size (Tullis & Albert, 2008). In this regard, there are also previous studies, such as that of Ganglbauer et al. (2009) who talked about the correlation between pupil dilatation and arousal or mental workload. Moreover, Lowenstein and Loewenfeld et al. (1964) already noticed a decrease in the pupil diameter at the increase of fatigue, and Partal, Maria and Surakka (2000) demonstrated that pupil diameter is related with positive and negative affect. Furthermore, by focusing on the functionality of web pages, Bruneau, Sasse and McCarthy (2002) discovered that the number of fixations is positively associated to the task's level of difficulty, while negatively associated to the perceived usability of the website. Then, number and frequency of saccades may reveal changes in arousal and saccade speed, duration and precision may spot fatigue and vigilance. Finally, even attention can be measured through ET, because the number of fixations plus the amount of time eyes are focused on the ad provide an indicator of overall attention or engagement with the ad (distraction) (Venkatraman & Huettel, 2014). More specifically, longer dwell times and fewer fixations represent more detailed processing (Horstmann, Ahlgrimm, & Glöckner, 2009) (Andrychowicz-Trojanowska, 2018).

Once eye tracking data have been recorded, they can be displayed through statistical analysis thanks to graphic representations, such as line charts, bar charts, scatterplots and boxplots. However, in a more comprehensive way, they can be also displayed through attention maps. It is a visualization technique which shows the spatial distribution of the gaze points. In this way, the overview of important areas of interest on a static stimulus provides a qualitative picture of the distribution of attention aggregated over time, even if the temporal component of the data is lost. However, this representation may be difficult in the context of dynamic websites where users change the range of vision by scrolling pages. For this reason, three different approaches can be adopted to tackle this challenge (Menges, et al., 2018). The first method is called virtual screenshot and it consists in showing the whole web page at once; its limitation relies on the representation of the fixed elements that are not affected by scrolling (e.g. research bar). The second approach instead is overlapping the data with a video recorded for each path experienced by the user; its drawback is the fact to be time-consuming as the number of users increases. Finally, these problems are solved by the third option which consists in merging the extracted fixed elements with the representation of the web page without fixed elements, but again it does not exactly reproduce the functioning of the website and the user experience. To conclude, Blascheck et al. (2017) presented other possible visualization techniques, among which the Scanpath visualization, the Space-Time Cube and Relational AOI visualization are remarkable. The first one visualizes fixations on the attention map which are connected through saccade

lines, respecting the temporal order. The second method extends the 2D representation of the spatial dimension into a 3D one, by introducing the time domain. Instead, the last one is a matrix that shows the transitions between different AOIs.

3.2 Conclusion

Now that we have all the tools to understand the behavior of consumers in the web context, Table 11 summarizes all physiological metrics previously cited and how they can detect or are related to cognitive and affective variables.

Table 15: Physiological metrics and related constructs

Metrics	Related cognitive and affective variables
EEG	Attention
	Pleasantness
	Memorization
	Engagement
	Mental Workload
	Presence
	Familiarity
	Comfort
SCR	Arousal
ECG	Arousal
	Valence
	Attention
	Memorization
	Presence
ET	Arousal
	Attention
	Mental Workload
	Fatigue

4. Summary of findings

The purpose of this literature review was to synthetize the findings of published studies on online impulse-buying behaviors and to provide an overview of the current stage of research in this direction.

To summarize, we have analyzed previous research studies by working onto the S-O-R framework in order to classify and understand the interrelationship among impulse-buying.

Going more in depth, the literature analysis put in evidence that researchers mostly focused their attention on external stimuli related to online environment and consumer's characteristics. Indeed, the selected papers have shown that consumers with higher impulsiveness are more responsive to online impulse-buying external stimuli, particularly the website ones and especially without being burdened by any kind of internal evaluation. Thus, there is a list of factors that require more systematic future investigation.

Specifically, one of the main research gaps is related to a very important factor in impulse buying: the mood. The emotional perspective is stressed in many definitions of impulse buying, for example in Rook's one (1987). Mood is vastly analyzed in research, but very often its measurement is based on self-declaration, with questionnaires or interviews, but it is not a proper way. Indeed, mood is related to affective processes: it needs to be measured with instruments that are able to capture the automatic stimulus reaction, the impulsivity and thus the true emotion. That is why mood must be measured with instruments related to System 1 of our brain, without distortions between what one declares to feel and what he actually feels. This possible misalignment is confirmed by a study from Weinberg and Gottwald (1982), that analyzed the role of emotions in impulse buying considering both the self-perception of these emotions (interviews) and the external perception (observations of mimic expressions). They obtained partly contradictory results that can be attributed, to a large extent, to the difficulties in the semantic definition of the various emotions: the same facial expressions were often described by different terms, because of the different interpretations of the semantic content of those terms, but also because each person can have a different perception of what he or she is feeling. For these reasons, consumer neuroscience plays a crucial role.

5. Mood

Mood and, more in general, affect have been identified as a variable that strongly influences a number of actions including impulse purchasing (Rook D. W., 1987) (Rook & Gardner, 1988) (Rook & Gardner, 1993).

Theories of basic emotions posit that a discrete and independent neural system sub serves every emotion, so describe affect as a set of dimensions, such as distress, excitement, depression, and so on, with each dimension varying independently from each other. Consequently, each emotion is independent of the others in its behavioral, psychological, and physiological manifestations, and each arises from activation within unique neural pathways of the central

nervous system (CNS). Basic emotion theorists have investigated emotional processes in humans by exploring facial expressions and peripheral physiological responses to affective stimuli. However, Ekman (1993) noted that not all emotions are accompanied by a characteristic facial expression; moreover, some facial expressions are associated with more than one emotion (e.g., a smile can be associated with happiness and pride). Facial expressions may sometimes communicate information about, among other things, an individual's affective state, but they do not delineate it (Camras, 1992) (Fernandez–Dols & Ruiz–Belda, 1997).

These theories no longer explain adequately all the empirical observations from studies in affective neuroscience, thus a conceptual shift is needed to consider theories that are more consistent with findings from behavioral and cognitive neuroscience. Clinicians and researchers have long noted the difficulty of people in assessing and describing their own emotions (Saarni, 1999). This difficulty suggests that individuals do not experience emotions as isolated, but that they rather recognize emotions as ambiguous and overlapping. These intercorrelations among emotions are well described by two-dimensional (2D) models that regard affective experiences as a continuum of highly interrelated states, so they can be represented by a spatial model in which they fall in a circle. There are many ways in which these two dimensions have been conceptualized, thus many models exist. One of the main models is the one proposed by Russell (1980), called the *circumplex model of affect*. It proposes a cognitive representation of affect, where eight variables fall on a circle in a two-dimensional space; the horizontal dimension is the pleasure – displeasure dimension, and the vertical dimension is arousal – quiet. The remaining four variables do not form independent dimensions but help to define the quadrants of the space.

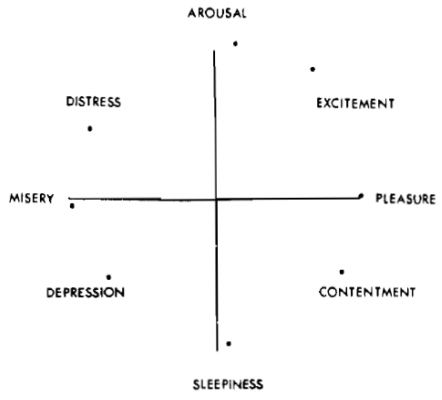


Figure 20: Eight affect concepts in a circular order

Each emotion can be understood as a linear combination of the two dimensions, or as varying degrees of both valence (unpleasant-pleasant) and arousal (deactivation-activation). As emotions are experienced and communicated, cognitive interpretations are employed to identify

the neurophysiological changes in the valence and arousal systems and conceptually organize these physiological changes in relation to the eliciting stimuli, memories of prior experiences, behavioral responses, and semantic knowledge (Russell, 2003). Emotions can therefore be seen as the end product of a complex interaction between cognitions, likely occurring primarily in neocortical structures, and neurophysiological changes related to the valence and arousal systems, which presumably are sub served largely by subcortical structures.

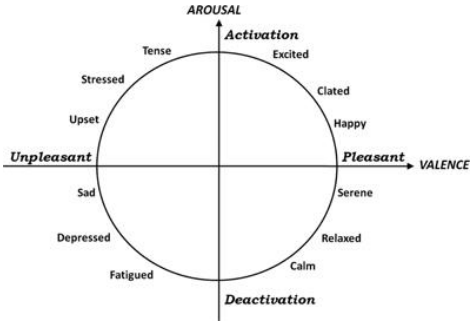


Figure 21: A graphical representation of circumplex model

Research have correlated increases in skin conductance and heart rate accelerations with subjective ratings of arousal (Lang, Greenwald, Bradley, & Hamm, 1993). EEG studies have demonstrated similar increases in cerebral activation in relation to subjective ratings of arousal (Keil, et al., 2001).

Similarly, valence ratings have been correlated with facial electromyographic measurements of the corrugator and zygomatic musculature (Cacioppo, Petty, Losch, & Kim, 1986). Corrugator activity increases incrementally with negative valence ratings regardless of the specific affective state described by the subject. Conversely, zygomatic muscle activity increases incrementally with positive valence ratings.

Mesolimbic and reticular networks support the primitive sensations of valence and arousal. According to the circumplex model of affect, cognitive schemas identify and instantiate these core neurophysiological sensations. The prefrontal cortex integrates, organizes, and structures the primitive sensations of valence and arousal with knowledge of the temporal contingencies that link prior experiences of stimuli within varying life contexts with expectations for the future (Fuster, 1997). The prefrontal cortex, for example, likely integrates the sensations of valence and elevated arousal when winning a lottery ticket with knowledge of the present context, recollection of previous financial hardship, and expectations of future advantage that the windfall will bring, to create the conscious experience of joy. The prefrontal cortex may serve the function of interpreting the sensations of valence and arousal within varying situational

contexts, culminating in the subjective experience of a specific emotion within a particular situational and historical context (Posner, Russell, & Peterson, 2005).

5.1 Mood states and impulse buying

Moods have the potential to influence both mental and overt behaviors. Ryle (1949) discovered that moods function as affective pre-dispositions that encourage, or discourage, specific behaviors. Considerable research has investigated the effects of various mood states on consumption-related behaviors. Specifically, mood states can encourage impulse buying. Consumers are likely to associate particular moods with an evolved set of evaluations and objects that may suggest, or prevent, impulse buying. Rook and Gardner (1993) analyzed also antecedent moods' effect on impulse buying.

5.2 Mood or emotions?

There is frequent confusion between different types of affective phenomena. A frequently encountered source of confusion relates to the tendency, based on popular usage of the terms, to treat emotion and mood as synonyms. At this point in the study, before going deeper in the research, it is necessary to make a clarification.

Emotions are defined as "relatively brief episodes of synchronized responses by all or most organismic subsystems to the evaluation of an external or internal event as being of major significance (e.g., anger, sadness, joy, fear)" and is characterized by high intensity and short duration; they are highly focused on specific events and change rapidly (Borod, 2000).

Moods, instead, are "diffuse affect state, most pronounced as change in subjective feeling, of low intensity but relatively long duration, often without apparent cause (e.g., cheerful, gloomy, irritable, depressed)". They are characterized by lower intensity than emotions and by longer duration; moods change less rapidly than emotions and the relationship with specific events is weaker (Borod, 2000).

Table 11 summarizes and highlights the main differences. Symbols indicate the degree to which the features are present, with 0 indicating the lowest (absence) and + + + indicating the highest.

Table 16: Emotions and Moods. Adapted from "The Neuropsychology of Emotion"

	Intensity	*Duration*	*Event focus*	*Rapidity of change*
Emotions	+++	+	+++	+++
Moods	++	++	+	++

Part II:

EMPIRICAL INVESTIGATION

Part II: EMPIRICAL INVESTIGATION

The model of this research is made by hypotheses that rely on the existing literature. An experiment must be set with the scope to empirically test this model and understand how the mood influences the buying behavior of users: this could validate or disconfirm the results of the previous studies analyzed in the *Literature Review* and will constitute the basis on which the managerial implications of this research will be discussed.

6. Experimental design

In this section, the experimental design is analyzed in depth.

6.1 Hypotheses to test

Positive mood

The psychological literature suggests that when one is in a good mood (i.e. positive affect), one is more likely to engage in approach behavior than avoidance behavior. Laboratory findings suggest that positive moods cause people to reward themselves more generously, to feel as if they have more freedom to act and will produce behaviors aimed at maintaining a positive mood state (Cunningham, 1979) (Isen, 1984) (Isen & F., 1972).

Verplanken and Herabadi (2001) explain that customers engaging in impulse buying tend to show emotions at any point of time during the purchase (i.e., before, during, or after). It has been argued that impulse buying behavior relates strongly to positive emotions such that impulse buyers experience more positive emotions such as delight and consequently spend more (Beatty & Ferrell, 1998). Rook and Gardner (1993) found that when participants were asked which mood states encouraged them to make impulsive purchases, the most common answer was the positive mood; the act of buying on impulse may thus be an expression of feeling good.

Nevertheless, impulse buying may also be the cause of positive emotions. All domains of psychology agree that people are motivated to seek pleasure and avoid pain; these hedonistic motives can be fulfilled by impulse buying. Holbrook and Hirschman (1982) contrasted the information processing account of consumer behavior, which prevailed at that time, with the

view that consumers are often driven by the hedonistic and aesthetic nature of consuming. Pleasant feelings or a good mood may thus be an important goal of impulsive buying. Holbrook and Gardner (2000) presented a dynamic model in which mood is an outcome of a consumer experience, suggesting that an initial mood combines with consumption experiences and produces an "updated" mood. Such a cycle may repeat over time and may induce variations in mood depending on the emotional tone of the consumption experience.

Negative mood

Impulsive purchases are not exclusively associated with positive emotions.

Sometimes they produce effects similar to those produced by positive moods, while at other times they produce opposite effects (Isen & Clarks, 1982). Some people indicate that they would be likely to buy something on impulse when in negative mood hoping that they will feel better through shopping. Rook and Gardner's (1993) also reported that a significant portion of participants mentioned negative moods as causing them to buy on impulse; impulsive purchases may function as attempts to repair or distract from low moods.

But negative moods may also decrease the approach behavior. Freud (1956) suggested that extremely negative moods derive from a decline in self-esteem, so when individuals experience this type of affect, they are unlikely to feel that they deserve the gratification of a spontaneous purchase. Acutely negative moods encourage internal withdrawal and could be so strong that individuals' energies are drained by them and so they would not even consider shopping.

There appears to be both a positive and negative influence of negative affect on approach behavior, which may produce only a minimal overall influence of this variable on urge, which may be negative. It is reasonable to suggest that the major effect of affect will come from its positive dimension in valence rather than its negative.

A preliminary hypothesis is needed in order to be sure that the stimuli chosen for the manipulation check are the right ones.

H0*: During the priming phase, the exposure to a high-valence stimulus will lead to a greater valence experienced, compared to a low-valence one*

H1*: A positive mood has a positive influence on the online impulse buying, compared to a negative mood*

Moreover, several individual traits and self-identity may serve as internal sources of impulse buying. Prior research shows that people who score high on impulsivity trait measures are more likely to engage in impulse buying (Beatty & Ferrell, 1998) (Rook & Fisher, 1995) (Rook & Gardner, 1993).

Thus, we propose to analyze the influence of some personality traits on the impulse buying.

Firstly, we examine the role of an impulse buying tendency, which includes the trait of impulsivity and reflects a disposition to act spontaneously in a specific consumption context. This well-recognized concept captures a relatively enduring consumer trait that produces an urge or motivation for actual impulse buying (Rook & Fisher, 1995).

H2*: Impulse Buying Tendency traits have an influence on the online impulse buying*

Finally, we consider the differences in the two primary dimensions of mood right after the purchase depending on impulsivity. The first one is Positive Affect, reflecting the extent to which a person feels enthusiastic, active, and alert, while the second one is Negative Affect, the extent to which a person feels distress, anger and nervousness. High Positive Affect refers to a state of high energy and pleasurable engagement, whereas low PA is characterized by sadness and lethargy. On the contrary, high Negative Affect corresponds to unpleasurable engagement, while low Negative Affect is related to a state of calm (Watson, Clark, & Tellegen, 1988).

H3a*: The positive affect immediately after the purchase differs according to the online buying behavior (impulsive or not)*

H3b*: The negative affect immediately after the purchase differs according to the online buying behavior (impulsive or not)*

6.2 Mood induction scheme

In many studies, the influence of mood on various cognitive tasks has been investigated by inducing different emotional states. Mood induction procedures (MIPs) can be defined as strategies whose aim is to momentarily change the participant's mood in an artificial and controlled way; the moods then elicited are supposed to be equivalent to naturally occurring moods.

Westermann et al. (1996) provided quantitative results on both effectiveness and validity of a wide range of MIPs, integrated systematically using statistical techniques of modem meta-analysis. Their main aim was to assess and compare the effectiveness of the MIPs and to ask whether the magnitude of the observed effects depends on specific characteristics of the studies, subjects, and procedures. In their analysis, the different mood induction procedures
are grouped into the following classes used in the literature: Imagination MIPs, Velten MIPs, Film/Story MIPS (with and without instruction), Music MIPs (with and without instruction), Feedback MIPs, Social Interaction MIPs, Gift MIPs, Facial Expression MIPs, and Combined MIPs. They are briefly characterized as follows.

Imagination MIP

Moods can be induced by imagining emotion-ridden events. Subjects are asked to imagine situations from their lives that had evoked the desired mood and also to try to re-experience the original perceptions, sensations, and affective reactions (Brewer, Doughtie, & Lubin, 1980).

Velten MIP

The self-referent-statement technique developed by Velten (1968) is the most used MIP (Westermann, Spies, Stahl, & Hesse, 1996). Subjects are asked to try to feel the mood described by statements that are presented to them, describing either positive and negative self-evaluations (e.g. 'I've doubted that I'm a worthwhile person') or somatic states (e.g. 'I feel rather sluggish now').

Film/Story MIP

In this class of mood induction procedures, subjects' imagination is stimulated by some narrative material. The presentation of films is subsumed into one class of MIPs because subjects may identify with certain protagonists. The complexity of the stimulus material differs and can covers elaborate stories, short scenes from a film, descriptions of scenarios, etc. Subjects are explicitly asked to imagine and 'get involved' in the situation described and in the feelings suggested.

Music MIP

Subjects listen to a mood-suggestive piece of classical or modern music after being instructed to try to get into the mood expressed by the music.

Feedback MIP

Mood can be influenced by experiences of success or failure; thus, subjects can be given positive or negative feedback on their performance on a test. In most cases, cognitive abilities such as perceptual motor skills, intelligence or spatial and analytical abilities are tested, and the subject receives false feedback.

Social Interaction MIP

In order to induce a specific mood state, subjects are exposed to social interactions arranged by the experimenter. Usually subjects interact with a confederate trained to behave in a depressed, an elated, or a neutral manner. The assumption in this case is that the behavior of others will affect one's own emotional state.

Gift MIP

This MIP is based on the assumption that most people are delighted when they are offered an unexpected gift. Usually subjects receive a small gift and are told that the gift was a token of appreciation for participating in the experiment (Isen, Daubman, & Gorgoglione, 1987).

Facial Expression MIP

According to the facial feedback hypothesis (Leventhal, 1980), some experimenters manipulate the expression of their subjects' faces in order to induce certain mood states. Subjects are instructed on how to contract and relax different facial muscles to produce specific facial expressions.

Combined MIPs

To increase the effectiveness of the induction, some authors combine different types of MIPs. Very often, MIPs combined are those procedures that are similar to one another, for example the Velten and Imagination MIPs, or that can be applied simultaneously, for example the Velten and Music MIPs.

The **effectiveness** of the MIPs has been discussed in several review articles, both in general and by considering a number of different aspects, such as specificity, group differences, and demand effects. According to Martin (1990), the Imagination, Film, and Music MIPs achieve the highest success rate (more than 75%). These findings are in agreement with those of Clark (1983), who has reported that between one-third and one-half of the subjects show little or no mood change after the Velten MIP, whereas 100% demonstrated a critical level of change after the Music MIP. Goodwin and Williams (1982), instead, conclude that the Velten procedure is a potent manipulator of mood.

According to their results, the Film/Story MIP with explicit instruction is clearly the most potent manipulator of elated mood states and is significantly more effective than all other MIPs. For the induction of depressed mood, the Film/Story MIP with instruction and the Combined MIPs turn out to be the most effective procedures.

In both cases, the Facial Expression MIP showed the smallest effect.

The Mood Induction Procedure chosen has been the *Film/Story MIP*.
According to Schaefer at al. (2009), exposure to emotional film excerpts has several advantages: first, it is one of easiest techniques to implement in a laboratory. Second, it has been widely observed that film excerpts can elicit strong subjective and physiological changes (Frazier, Strauss, & Steinhauer, 2004) (Gross, 1998) (Palomba, Sarlo, Angrilli, Mini, & Stegagno, 2000). Third, the dynamic nature of film scenes provides an optimal artificial model of reality, without the ethical and practical problems of real-life techniques. Fourth, it seems to be the most powerful technique to elicit emotion in a laboratory: Westermann, Spies, Stahl & Hesse (1996) showed in a meta-analysis that among several other techniques, film clips were the most potent inducers of both positive and negative mood states.
Many studies have tested the reliability of film clips to elicit emotions, leading to the development of reliable sets of stimuli (Gross & Levenson, 1995) (Hagemann, et al., 1999) (McHugo, Smith, & Lanzetta, 1982) (Philippot, 1993).

The validation study by Schaefer et al. (2009) aimed to set up a new battery of film stimuli that expands the current choice of film stimuli and allows a more flexible selection of stimuli covering a larger array of potential research questions. This study is particularly important for the aim of our research since it provides a battery of emotional stimuli allowing not only the manipulation of basic emotions, but also the manipulation of the two dimensions of affective states (valence and arousal).

Following the results of their study, the two clips for mood induction were:

Positive Valence. The Dead Poets Society: All the students climb on their desks to manifest their solidarity with Mr. Keating (Robin William), who has just been fired.
Negative Valence. American History X: A neo-Nazi (Edward Norton) kills an Afro-American man smashing his head on the curb.

6.3 Stimulus development

Considering the arousal dimension of the mood, Rook and Gardner (1993) suggest that high arousal moods mobilize consumers' energies to respond positively to the buying impulse and can also help consumers in overcoming the level of reluctance to spend. Instead, moods that are low in arousal may be insufficient to do so. For example, excitement, which is also a pleasurable mood, tends to facilitate the impulse buying, but also anxiety, which is an arousing mood but

with negative valence, appears to encourage impulse buying in order to improve the mood. Instead, moods that are low in arousal do not give enough energy to encourage an impulsive purchase.

Given the findings in previous literature, we suggest focusing the analysis only on the moods characterized by a high level of arousal, both with positive and negative valence.

Prior to the experiment, a pretest was first conducted to be sure of the effectiveness of the two videos.

An online survey was created on SurveyMonkey. Each respondent had to see both videos, in a randomized order. After each video, a short survey had to be filled. The scale used was the Mehrabian and Russell's one (1974) in Italian. They introduced the idea of using the two emotional dimensions, valence and arousal, to describe perceptions of physical environments. The scale is reported in Appendix A.

The survey had 108 total responses. The records for which the respondent did not fill at least the 75% of the questionnaire or whose standard deviation was 0 (meaning that the answers to all the questions were the same) were eliminated. The resulting valid responses were 96.
The analysis of results was made in SPSS with a Friedman test, a non-parametric one.
It emerged that the two stimuli are characterized by a significant difference in valence, as it was expected; it is shown in the following graph.

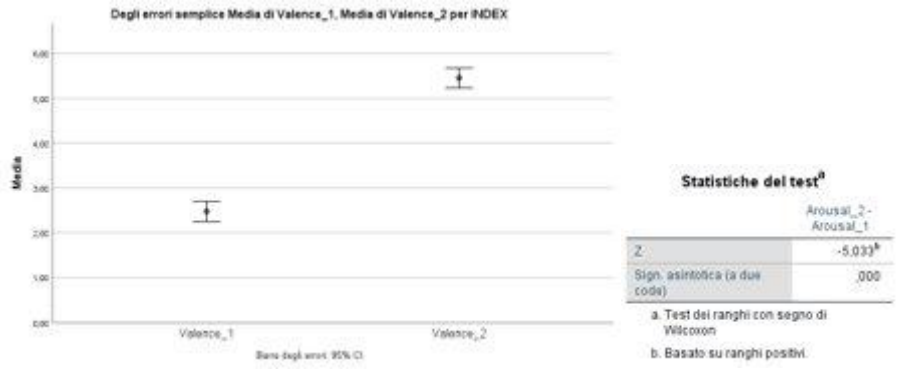
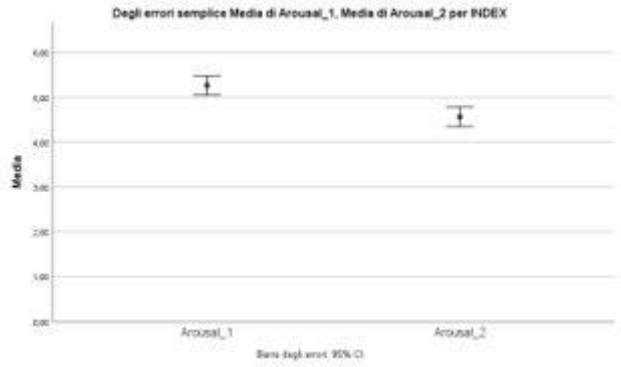


Figure 22: statistics on valence

However, a difference in the level of arousal emerged too, even if smaller. It was unexpected since we though both of these stimuli to be characterized by high arousal.



Statistiche del test[a]

	Valence_2 - Valence_1
Z	-8.259[b]
Sign. asintotica (a due code)	,000

a. Test dei ranghi con segno di Wilcoxon

b. Basato su ranghi negativi.

Figure 23: statistics on arousal

Despite this last finding, this work remains coherent with what said in the previous paragraph, thus focused on the valence dimension.

6.4 The sample

A convenience sample of people between 18 and 30 years old was recruited. Initially, the sample chosen was of 50 people; however, due to the difficulties caused by the global pandemic of Covid-19, we were forced to reduce the sample to 16 people to be able to guarantee the social distancing required.

All participants were young people, and this is a good representative sample of online shoppers, as impulse-buying behavior has been found to be prominent in younger adults (Retail World, 2002).

The sample was balanced in terms of gender, with 8 females and 8 males participating in the experiment. Going into detail, the mean age of the subjects (n = 16) was approximately 24 years, with a range of 21 to 29 years. More than 81% of them were older than 23 years. The majority of the participants were students, while the remaining ones were workers, of which 80% were graduated. Thus, they were well educated and almost 81% had a bachelor's degree; moreover, most of those with a high school degree were already studying (Table 13).

Table 17: Demographics of the participants

		Participants	
Category	*Classification*	*Number*	*Percentage*
Sex	Male	8	50%
	Female	8	50%
Age	21-23	5	31,25%
	24-26	8	50%
	27-29	3	18,75%
Occupation	Student	11	68,75%
	Postdoc	0	0%
	Worker	5	31,25%
	Unemployed	0	0%
Education	High school diploma	3	18,75%
		8	50%
	Bachelor's degree	4	25%
	MSc degree	1	6,25%
	Master		

6.5 Experimental design setting

The study was conceived with a between-subjects design, where two distinct groups of subjects either face a level of the treatment variable or the other one.

The experiment is made up of 7 steps. The difference between the two groups is only present from the third step on.

The first task is a *money granting task*: the subject is required to fill a long questionnaire after which he/she wins a physical Amazon voucher of 9€. This is the reward medium used to induce pre-specified characteristics in the subjects so that their personal characteristics became less relevant.

Then, an *auxiliary experiment* starts. The subject has to navigate an immersive website for a maximum of 15 minutes; after the browsing, he/she has to fill a survey. The scope of this phase of the experiment is to decouple the first task from the purchasing phase that will come

afterward, creating a situation in which the subject does not foresee any correlation between the initial gain and the following steps.
The third phase is the *priming*, in which subjects are differentiated in two groups of equal size, facing the two different treatments. In this phase, one of the two videos is shown to each subject to induce the desired mood.
To let the subject win additional money and to strengthen the mood induction, he/she is asked to participate in a pilot *lottery*. The prize is always of 9€ in the form of a digital amazon voucher. Nevertheless, to avoid altering the induced mood, the subjects with a negative mood thinks they win the minimum possible prize; the ones with a positive mood thinks they win the maximum prize.

The whole setting is able to trigger impulsive urges to buy using actual money that have been earned.

Indeed, the next phase is the purchasing process. The subject is sent on the promotion section of Amazon. This choice was due to the need of having a neutral portfolio of products, not specifically tied to a brand or a category.
Participants should have limited time to perform their action, thus each subject has the possibility to browse the section and to buy one product within 3 minutes. This specific amount of time resulted, from a pre-test, to be the ideal interval for an impulse buying behavior. Indeed, it allows to reach the right compromise between a reasoned purchase and a too rushed one.
To avoid subjects buying something they already intended to buy – thus not an impulse buying behavior but a planned purchase – the use of search bar was forbidden.
The subject had the possibility to spend all the amount of money gained (the two vouchers, both physical and digital, of 9€+9€=18€ in total), or only a part of it. Shipping costs must have been included in that amount.
Specifically, the digital voucher won in the lottery could have only been spent in the moment of the experiment; the physical voucher won after the filling up of the first questionnaire was not lost if not used.

The last phase of the experiment in the lab is the evaluation of the purchasing experience through a self-reported survey.

After 48 hours from the purchase, a short post-purchase questionnaire is sent to participants in order to evaluate the regret.

In figure 24, the experimental procedure is shown.

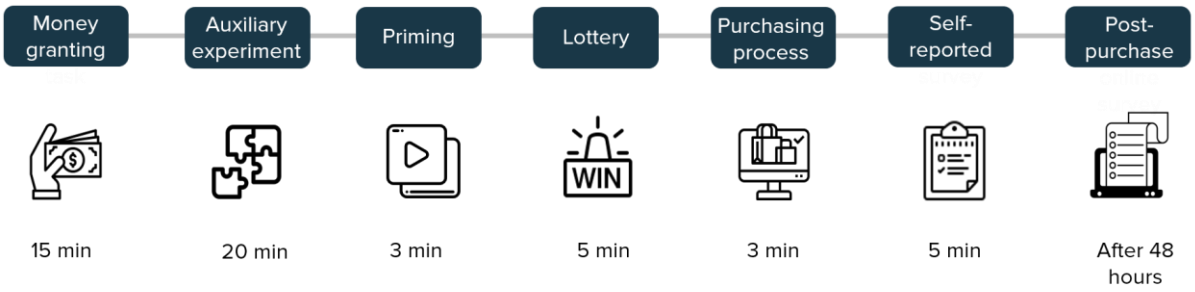


Figure 24: Experimental procedure

From the auxiliary experiment phase to the purchasing process, physiological signals are continuously measured. This experiment joins two approaches to measure the metrics that quantify the variables of the model: Neuromarketing techniques and questionnaires with validated scales.

These two methods have different pros and cons.

Neuromarketing techniques are used to observe the physiological signals of the respondents and see how they correlate with self-reported measures (Lolatto, et al., 2018) and which kind of information they add to the model. This approach helps in quantifying directly the emotional and cognitive states perceived by the users and in bypassing several problems related to traditional questionnaires (included any kind of bias). Moreover, physiological responses can be measured while the user is facing the experiment and therefore, they allow to detect how emotions and cognitions develop during the whole experience. These techniques shed light on insights that otherwise would be invisible. However, Neuromarketing experiments have a practical limitation: they can be very resource consuming. Indeed, a huge effort in terms of time and costs has to be made for each subject that must be tested. The user must come to the laboratory in order to be dressed up with all the instruments that measure his physiological signals and monitored during the development of the experience.

6.6 The procedure

This section includes a detailed description of the procedure followed in the experiment.
Its aim was to validate or confute the hypotheses that have been built on the existing literature; managerial implications and the conclusions of this study will be based on the results coming from this experiment.

The experiment took place at PHEEL (PHysiology Emotion Experience Lab) in Milan between the 7th and the 10th of September 2020, with the support of the team of the biomedical engineers.

The 16 sessions were divided into 4 sessions per day, due to the dispositions required by the government ordinance for Covid-19. It was forecasted an average duration of 1 hour and a half per session, including the time needed to clean the EEG headset and for the sanitization of the workstations.

When the participant arrived at PHEEL lab, he/she was welcomed at the entrance of the facility and, after the measurement of the temperature and the hand sanitation, in a separate room (Office 701), he/she was requested to fill-in an informed consent form, a GDPR form and a self-certification for Covid-19. In the meanwhile, the logic and the scope of the experiment were explained.
Subsequently, an identification code from 01 to 16 was assigned accordingly to the visit order, by which the subject was asked to fill up a preliminary questionnaire after which he/she gained a physical Amazon voucher of 9€. It was the *money granting task*. The questionnaire was aimed at assessing the attitudes of the subject and it includes:

- socio-demographic data,
- the 20-item Italian version of BIS/BAS scale by Carver & White (1994) to better understand how the two general motivational systems (Behavioural Inhibition System and Behavioural Activation System) underlie behavior,
- the Italian translation of Trait Meta-Mood Scale (TMMS) by Salovey, Mayer et al. (1995) to measure individual differences in people's tendency to attend to their moods, emotions, discriminate clearly among them and regulate them.

After this first phase, the volunteer was conducted and seated in the PHEEL lab room. The experimental protocol was conceived to be carried out in a neutral experimental setting devoid of elements of distractions where the environmental conditions such as light, noise and temperature were controlled. Each subject was supposed to be sat in a natural posture at a desk in front of a monitor, at a distance of 60 cm allowing an effective recording of eye movements. Researchers were expected to be monitoring the sessions from the control desk, in a separated position that allowed non-participant observation, and taking retrospective notes.
The subject was dressed up with medical instrumentation to monitor his/her physiological and behavioral activity.
Specifically, the used instrumentation was the following: an EEG pre-cabled cap for the encephalic activity, three ECG biosensors placed on the subject's chest and abdomen that

measure the heart rate (HR), two electrodes on the non-dominant hand fingers to monitor the skin conductance rate (SCR) and a chest band for the respiratory activity.
Additionally, an eye-tracker attached to the computer monitor was used to track the eye gaze and the subject was asked to observe a moving point on the screen in order to calibrate it.

Once the instrumentation was ready, the subject was asked to close his eyes for a minute and then, to focus on a neutral image on the screen in order to acquire the baseline of the physiological measurements. Following this stage, the experimental procedure started and the participant started interacting with the PC. All the instructions were seen on screen.

After the auxiliary experiment, one of the two videos for the priming was shown to the participant. Even identification codes were matched with the video related to positive mood, while odd codes were associated to the negative mood-related video. After this *mood manipulation phase,* he/she was asked to fill a short survey with the scale from Mehrabian and Russell (1974) for the manipulation check.
The subject was then asked to participate to the *lottery* (see Appendix C). The application was created on MATLAB with appdesigner. The participant had the possibility to choose one out of three gifts, each one containing a prize.
After this game, the subject watched again to an extracted part of 30 seconds of the previous priming video. It was done to recall the induced mood.

The *purchasing phase* started afterwards. The promotion section of Amazon was opened and the subject was able to buy, if desired, only one product. He/she was free to navigate the categories of the section and to apply filters.
A timer was displayed on the right corner of the screen and the time for the navigation and the possible purchase was set equal to 3 minutes, after which the website shut down and the final questionnaire was proposed both in case of purchase or not.

Then, a *self-reported survey* was shown. It includes the Italian versions of:

- a 2-item scale to measure the buying intention,
- the 20-item PANAS scale to measure both positive and negative affect,
- an 8-item scale by Zaichkowsky (1985) to measure the product involvement,
- a 9-item scale by Rook and Fisher (1995) to measure the Impulse Buying Tendency,
- a 4-item scale by Beatty and Ferrel (1998) to measure the online shopping enjoyment,

- a 2-item scale by Park et al. (2012) to measure the experience of the hedonic web browsing,
- a 3-item scale by Liu et al. (2013) to measure the instant gratification,
- a 3-item scale by Liu et al. (2013) for the normative evaluation,
- a 4-item scale by Davis (1989) for the perceived easiness.

Once completed, the experiment was definitely concluded and the subject was helped in removing the equipment he was wearing.

After 2 days – 48 hours – from the purchase, a *post-purchase online survey* was sent to all the participants that bought a product, in order to measure cognitive dissonance. It includes 8 items of the Italian version of the scale by Sweeney et al. (2000).

All questionnaires are reported in Appendix A.
Pictures of the appointed experimental spaces at PHEEL and the instrumentation are shown in Appendix B.

6.7 Measures

The focus variable, whose effect we want to understand, is the **mood** and, specifically, the dimension of the *valence*.
For controlling the variable, we decided to vary it between two levels – positive and negative – thus it is a treatment variable.
The treatment variable is assigned to subjects in a random order. Specifically, all the subjects whose code is uneven face the treatment of negative mood; consequently, all the subjects whose code is even face the treatment of positive mood.

Neuromarketing methods, and the relative indexes that result, are able to explain how the user feel and think during the development of the experience. The adopted Neuromarketing methods involves the use of the following instrumentation:

- an electroencephalogram (EEG) by means of a system equipped with a 64-channels pre-cabled cap, with 25 electrodes uniformly distributed on the scalp activated. A standard 10–20 configuration was employed with electrodes prepared with a water based gel to enhance the electrical conductivity between each electrode and the subject's scalp

(Kappenman & Luck, 2010). The cortical activity was collected at a sampling rate of 256 Hz and the impedance level was kept below 5 kΩ.

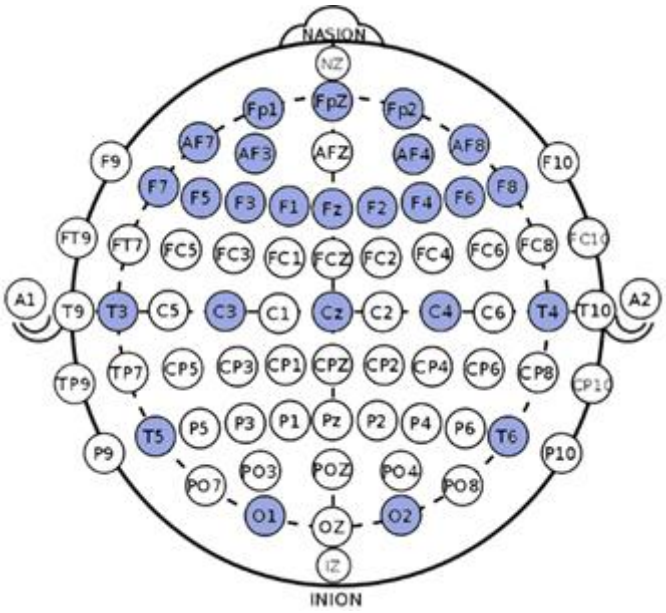


Figure 25: EEG

- a single electrocardiogram (ECG) lead by means of a dedicated software and disposable electrodes to be placed on the participant's chest and abdomen. It was acquired by means of ProComp Infiniti unit from Thought Technologies through three electrodes placed according to Einthoven's triangle. The signal was recorded at a sampling rate of 256 Hz;
- a chest band for the respiratory curve;
- two finger electrodes to gauge the electrodermal activity from the nondominant hand of the subject;
- an eye-tracking bar to be placed attached to the stimulus monitor to track the user ocular responses. Its signal was gathered recording at a sampling rate of 60 Hz. To assure a sound signal recording, subjects were seated at a distance ranging from 60 to 75 centimeters from the eye-tracking bar.

All the signals were continuously recorded during the experimental phases.

Questionnaires, instead, are needed to assess those metrics that cannot be measured otherwise. It is essential to define emotional scales that measure the different constructs: they consist in a series of questions that have been found to properly explain the variance of a determined factor.

They could be, however, characterized by biases. To reduce them, we decided to use only existing validated scales.
The used scales were described in the previous section and the final questionnaires are reported in Appendix A.

In the questionnaires, it was necessary to add scales that measure the covariates, which are all those factors that can potentially have an impact on the dependent variable but that are not included in the model because of their belonging to other domains (i.e.: not emotional or cognitive layers). Hereby, the covariates and the associated scales are described.

- The *motivational systems* that underlie behaviors in each user was measured using the 20-item Italian version of BIS/BAS scale by Carver & White (1994)
- *Personality traits* should be included between the covariates because they can obviously influence the emotional and cognitive processes of each user. For this reason, the 18-items Trait Meta-Mood Scale (TMMS) from Salovey, Mayer et al. (1995) was used.
- The *product involvement* can be significative too; thus, it was assessed through an 8-item scale by Zaichkowsky (1985)
- The *impulse buying tendency* should be considered. Indeed, this factor can influence the way in which people search for the needed information and therefore the time that they spend on the e-commerce. This covariate was measured through the 9-items scale from Rook and Fisher (1995)
- The *online shopping enjoyment* of consumers culminates from pleasure and excitement triggered by the store environment and it can influence our dependent variable; a 4-item scale by Beatty and Ferrel (1998)
- *Hedonic web browsing* can impact the impulse buying behaviour too, as demonstrated in literature (Park et al. 2012). To measure it, a 2-item scale by Park et al. (2012) was used.
- Also, the *normative evaluation* is demonstrated to be a key determinant of urge to buy impulsively (Liu et al. 2013); a 3-item scale by Liu et al. (2013) was used to measure it.

7. Data analysis

The experimental phase described in the previous chapter provided the data necessary to test the hypotheses that have been formulated on the basis of the existing literature. In this chapter, it will be described the phase of analysis of these data in order to validate or confute the hypotheses, and therefore the experimental results will be illustrated.

7.1 Data analysis

Three types of data can be extracted from the experiment, namely physiological, self-reported and behavioral (such as the time spent on the website or the data extracted from the eye-tracker that can be used to qualitatively analyze the navigation). The analysis on this phase will focus in finding correlations between these signals and what has been declared in the questionnaire, with the scope of understanding how the mood (specifically the valence) of the subject can influence its impulse buying behavior.
Moreover, it will be studied how the physiological signals of the different respondents develop during the navigation in order to understand if there is a common trend in how the users live the purchasing experience.

7.1.1 Eye tracking

The analysis of the data of eye-tracking were analyzed on BeGaze 3.7, where the screen record for each participant was saved. Before starting the videos, to avoid unnecessary noise the mouse clicks were faded out and a trailer of 0.5 seconds was set.
Three important instants were of interest and they were reported in an Excel file in which each row was a specific subject:

1. Eye-tracking start: the starting point, the moment in which the Amazon website opens and the timer starts;
2. First fixation: the exact moment in which the subject looks at the object that will then be purchased. Previous researches demonstrated that in the first milliseconds of perception we do not only understand what is the precepted object, but we also decide if we like it or not (Bargh, 1994);
3. Purchase: the instant in which the subject adds the desired object to the cart.

Additionally, two time intervals were computed:

1. Exploration time: the time (in seconds) between the starting point and the first fix. It is the time period in which the subject explores the different alternatives before seeing the product that will then be bought;
2. Consideration time: the time (in seconds) between the first fix and the purchase.

Other columns were added and filled with some dummy variables to highlight some behaviors of interest:

1. Category bar: if the subject navigates the promotion section using filters and categories for the research;
2. Goal-oriented: if the subject was goal oriented or browsing oriented. It was assessed according to how much he/she further explored the products after the first fixation;
3. Info acquisition: if the subject opened the product pages to gather more information on the products before the purchase;
4. Related products: if the subject explored the related products suggested by Amazon. Indeed, it could mean that he/she was really interested in that category of product and searched for the best one. Of course, it indicates a lower level of impulsiveness.

Two more descriptive columns were:

1. Time pressure: descriptive comments were added according to the time pressure shown by the subject. Specifically, it can be high, medium, or low and constant during the whole process or concentrated just at the end. For a rigorous computation, it was based on the number of times the subject looked at the timer present on screen during the 3 minutes of the purchase phase.

Table 18: time pressure

0 – 4 times	Low
4 – 8 times	Medium
> 8 times	High

2. Comments: any additional comment was added in order to gain more insights from the behavior of each subject.

7.1.2 EEG

The severe contamination of EEG activity by eye movements, blinks and muscles is a serious problem for EEG interpretation and analysis. For this reason, the graphic interface EEGLAB, built on top of MATLAB, was used to manipulate and clean EEG data.

The first phase is about manual processing. For each subject, the raw signal was manually cleaned from the evident movement artefacts and signal noise and, in case of noisy channels for a long period of time (noisy signal traces of more than almost 75 sec.), interpolation was done to obtain more aligned channels. However, the peaks present on each channel of the signal at the same time, corresponding to the subject's blink or to the rapid eye movements, were not discarded at this moment.

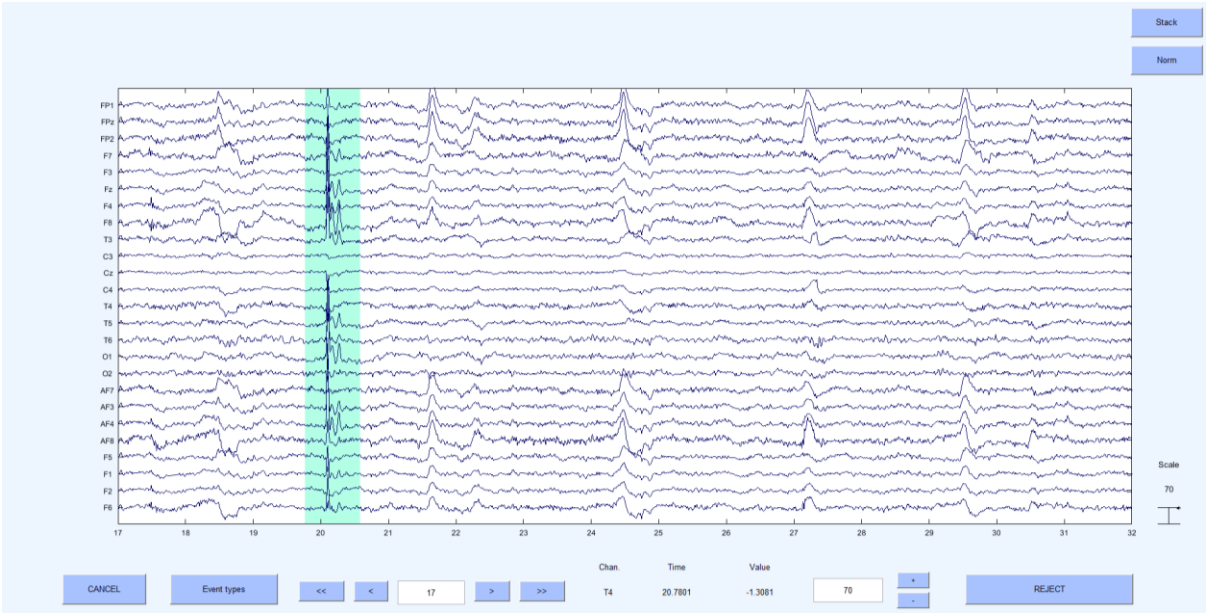


Figure 26: Signal plot in EEGLAB – movement artefacts and signal noise

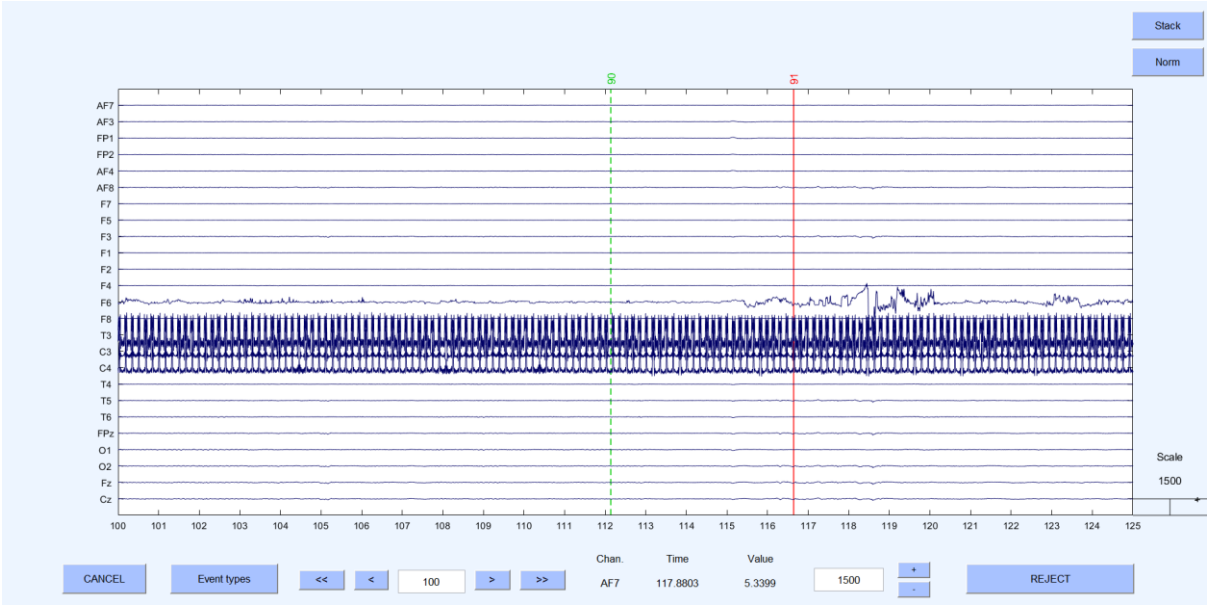


Figure 27: Signal plot in EEGLAB – long noisy signal traces

Secondly, once this pre-processing is done for all the subjects, an independent component analysis (ICA) was conducted in order to remove the two components related to the ocular artefacts. Thus, the scalp maps presenting almost horizontal and vertical lines were removed.

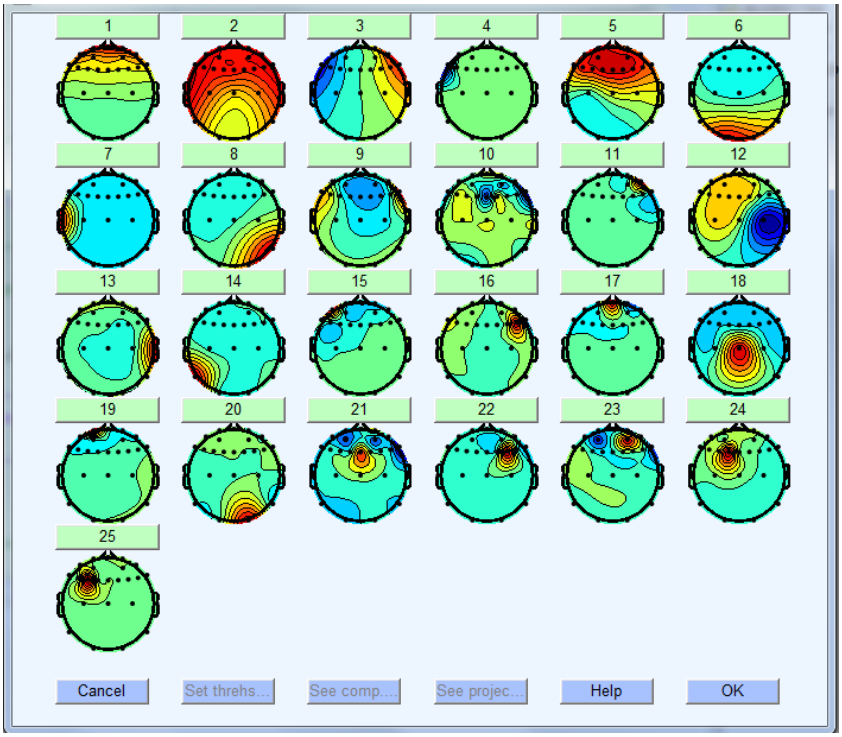


Figure 28: Components by map in EEGLAB

In addition, if after these phases there are again noisy channels, the related components were firstly identified and finally removed.

When the component removal is concluded, the first phase of manual processing was repeated to avoid some dissonance left behind and finally get clean EEG data useful for the computation of different indexes that are the *Attention Index* (AI), measuring the effort the subject makes in making attention in front of a stimulus; the *Memorization Index* (MI), which measures the subject's effort to retain the information in the short-term period; the *Engagement Index* (EI) that is linked to attention and concentration and it is referred to what extent the subject feels engaged in the experience, and finally the *Pleasantness Index* (PI), which is the feeling of pleasantness experienced by the subject during the stimulation, considered in terms of attractiveness.

These indices are estimated by computing the Global Field Power (GFP) between different signals. Indeed, firstly the original EEG signal referred to a specific electrode placed on the pre-cabled cap, between CPz and Pz, has been transformed by means of the Common Average Reference (CAR). Secondly, Individual Alpha Frequency (IAF) for each subject was

calculated and then, EEG traces were band pass filtered to obtain three different signals, each one containing different contributions to the total EEG spectrum. Consequently, the three frequency bands were:

- Theta, ranging between IAF–6Hz and IAF–4Hz;
- Lower alpha, between IAF–4Hz and IAF;
- Upper alpha, between IAF and IAF+2Hz (Reali, et al., 2017)

In particular, the *Attention Index* (AI) considers the lower alpha frequency band for the channels Fpz, AF3, F3, AF4, F4, Fz, while the *Memorization Index* (MI) is calculated by taking into account the theta band pass filtered channels AF3 and F3. The *Engagement Index* (EI) is measured instead as the ratio between spectral power in beta and alpha bands. Finally, the upper alpha band pass filtered channels F3, AF3, F4, AF4 are used to compute the *Pleasantness Index* (PI). Moreover, as far as concern PI, it has been defined by taking into account the frontal EEG asymmetry (Davidson, 2004) (Vecchiato, et al., 2011) (Vecchiato, et al., 2012). Specifically, findings suggest that the left hemisphere activity mediates an "Approach" attitude to stimuli and/or emotions, while the right hemisphere activity instantiates a defensive "Withdrawal" attitude (Davidson, 2004). This kind of phenomenon, i.e. the asymmetry of PFC activity, in the scientific literature is called "Approach/Withdrawal motivation". Hence, PI is defined as the difference between the GFP calculated among right (AF4, F4) and left (AF3, F3) electrodes, respectively, or it can be also seen as this difference divided by the sum of right and left GFP (Davidson, 1988).

EEG traces were automatically segmented to separate EEG activity recorded during different phases of the experiment: the baseline, the full navigation, the exploration, the catch, the consideration and the purchase. Thus, the indexes abovementioned have been computed for all these 6 periods. The baseline taken as reference is the phase occurring at the beginning of the experiment, during which the subject looks at a neutral image for a minute. Then, full navigation considers the time interval between the beginning and the end of the 3 minutes navigation on Amazon. The timeframe passing from the moment in which the subject starts navigating to the moment in which he/she sees the chosen product for the first time (catch) is called exploration. Instead, the phase passing from the first seen (catch) and the decision to buy the product by adding it to the cart (purchase) is named consideration.

The following table sums up the extracted parameters.

Table 19: EEG parameters

Method	Parameters	Units	Description
Manual processing + ICA	AI	Hz	Effort made by the subjects in making attention in front of a stimulus
	MI	Hz	Effort made by the subject to retain the information in the short-term period
	EI	Hz	Attention and concentration of the subjects; measurement of the engagement in the experience
	PI	Hz	Pleasantness experienced by the subjects in term of attractiveness

7.1.3 ECG

The heart rate variability (HRV) signal gathered during the experimental sessions contained information that quantifies the activity of the neural mechanisms of cardiovascular control of the subjects. As mentioned in the previous sections, HRV represents the oscillation of the interval between two consecutive heartbeats.

The signal gathered from the ECG was analyzed using a Heart Rate Variability (HRV) dedicated Matlab GUI. The data were pre-processed by the assistance of the Biomedical Engineers working in the PHEEL laboratory. After the experimental acquisition, which generate a text file (.txt) for each participant including Heart Rate, Breath and time information, an input Matlab file (.mat) has been created. It contained: Numeric Array of ECG signal values (in mV), of Breath signal values and time. Once the ECG signal was filtered and processed, a

first round of maxima detection (R-peak detection) was performed by giving the input files to the algorithm (Pan–Tompkins algorithm) on a Matlab App, a standalone Matlab programs with a GUI that automate the R-peak detection.

The Pan–Tompkins algorithm adopts a series of filters to highlight the frequency content of the rapid heart depolarization and removes the background noise. Then, it squares the signal to amplify the QRS contribute. Finally, it applies adaptive thresholds to detect the peaks of the filtered signal. The output of this process produces a *tachogram*, which is a chart reporting the time on the abscissa and time interval between two consecutive R waves on the ordinate:

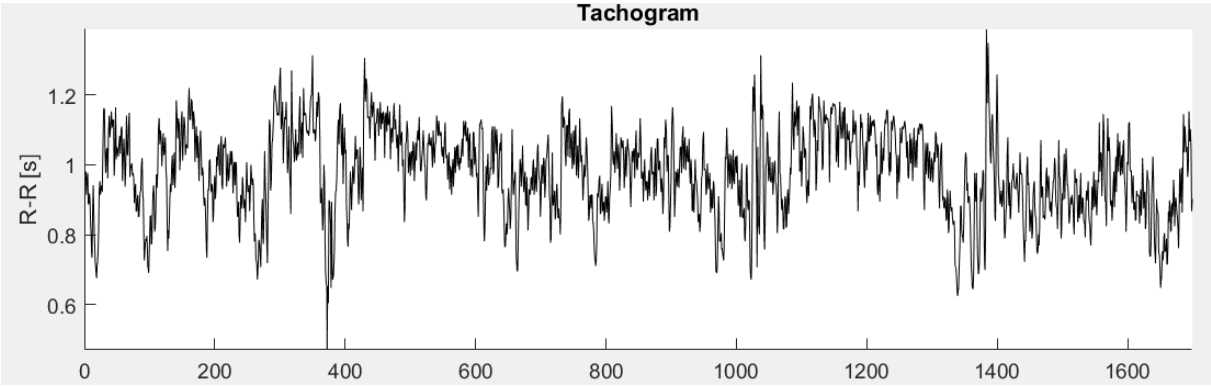


Figure 16: tachogram

The obtained tachograms may present situation of error, noise or corruption: it could happen that a beat was missed and the tachogram presented a large peak with respect to the baseline, or it could also happen a small peak was misled and considered as a maximum, resulting in a peak under the baseline, and the algorithm searched for the following maximum after the previously calculated average R-R interval skipping the real maximum, resulting in a high peak over the baseline. These situations intensified when the signals (or parts of it) were compromised, probably due to strange movements of the subject or a high level of hair that hindered the acquisitions. For this reason it was necessary to manually check and scroll through each signal in its entirety to make sure that the algorithm had positioned the peaks in the correct way, otherwise, using the Matlab application it was possible to erase those peaks in the wrong position and locate the new ones.

The analyzed signals were sufficiently clean or easily interpretable. In fact, if the algorithm had mistakenly selected or missed a peak, it was conceivable to interpret recurrent trends in the signal and easily establish the more likely position of the peak, taking into account the previous time intervals between two consecutive R waves.

In particular, only 2 subjects presented clearly disturbed or problematic signals: S06, S07. They were very noisy signals and therefore the algorithm placed many more peaks than necessary. However, it was possible to detect the R-wave peak followed by derivation of the R-R interval sequence.

With Frequency Domain methods, spectral methods are applied to the tachogram in order to understand how power distributes as a function of frequency. In particular, the parameters extracted are displayed in the following Table.

Table 20: ECG parameters

Method	**Parameters**	**Units**	**Description**
Frequency Domain Method	LF	ms^2	Power in low frequency range (0.04 – 0.15 Hz). This measure reflects both sympathetic and para-sympathetic activity. Typically, it is a strong indicator of sympathetic activity.
	HF	ms^2	Power in high frequency range (0.15 – 0.4 Hz). This measure reflects parasympathetic (vagal) activity. HF is also known as a 'respiratory' band because it corresponds to the R-R variations caused by respiration
	LF/HF		Ratio of LF over HF. This measure indicates overall balance between sympathetic and parasympathetic systems. Higher values reflect domination of the sympathetic system, whereas lower ones domination of the parasympathetic system.
	LF norm	Percentile	The ratio between absolute value of the Low Frequency and Total Power (HF+LF) multiplied by 100. This parameters emphasizes changes in sympathetic regulation.

	HF norm	Percentile	The ratio between absolute value of the High Frequency and Total Power (HF+LF) multiplied by 100. This parameter emphasizes changes in parasympathetic regulation

7.1.4 Data aggregation

The focus of this analysis is on the purchasing phase. Since that different human beings have different standards for each physiological signal, in order to make them comparable and visualize increments or trends, it is necessary to relate the value of each signal during the navigation to the value of that signal recorded during the baseline acquisition.

The aggregated score of the physiological signals for each user is therefore computed in this way:

1. The average value of the signal during the free navigation is calculated;
2. The average value of the signal during the baseline acquisition is calculated;
3. The aggregated score is computed as the ratio between the mean of the signal during the free navigation and the mean of the signal during the baseline acquisition.

Self-reported data must be cleaned and aggregated too.

Eventual missing values and outliers are deleted on Excel; all the constructs are scaled and aligned on the same scale.

A dummy variable was created, called *ImpulseBuying*. It assumes value 0 if the subject spent less than 9€ and value 1 if he/she spent more than 9€.

Then, data are transferred to SPSS. Internal consistency for all variables is checked by computing *Cronbach's alpha* (it must be higher than 0,7). Finally, factors are created as the average mean of single items.

All data are now aggregated. The final dataset included 14 observations and 42 variables: 30 of them are self-reported variables, 12 of them are physiological indexes.

Some data have been lost during the experiment due to noise or other external factors that occurred. More specifically, all the physiological data of S14 and S16 have been lost, while for S11 all EEG data are not available due to signal noise.

The summary of a descriptive analysis containing average, standard deviation, p-value of the Shapiro-test and coefficient of variation for each variable is reported in Table 4.

The variables whose p-value of Shapiro results higher than 0,05 are normally distributed and they are highlighted in green.

Table 21: descriptive analysis of self-reported variables

Related scale	***Factor***	***Variable***	***Mean***	***Standard deviation***	***p-value Shapiro***
	ImpBuy	Impulse Buying	0,47	0,52	0,000
Money granting survey					
BIS/BAS (Carver & White, 1994)	BIS	Behavioral Inhibition System	3,47	0,85	0,432
	BASRR	Behavioral Activation System Reward Responsiveness	4,25	0,38	0,041
	BASD	Behavioral Activation System Drive	3,27	0,70	0,592
	BASF	Behavioral Activation System Fun Seeking	3,56	0,63	0,923
TMMS (Salovey, Mayer et al., 1995)	EmoAtt	Emotional Attention	3,92	0,70	0,126
	Clar	Clarity	3,71	0,34	0,006
	Rep	Repair	3,59	0,67	0,952
Evaluation of the stimulus					
Mehrabian and Russell (1974)	P	Valence	4,32	1,86	T1:0,580
					T2:0,579
Self-reported survey post purchase					

Buying Intention	BuyingInt	Buying Intention	2,77	1,43	0,012
Zaichkowsky, J. L. (1985)	ProdInv	Product Involvement	4,11	1,11	0,237
PANAS (Watson & Tellegen, 1988)	A	Arousal	5,63	0,91	0,450
	PosAff	Positive Affect	3,77	0,52	0,226
	NegAff	Negative Affect	1,73	0,76	0,007
Beatty, S. E., & Ferrell, M. E. (1998)	OnShopEnj	Online Shopping Enjoyment	4,59	0,99	0,804
Park, E. J., Kim, E. Y., Funches, V. M., & Foxx, W. (2012)	HedWebBrow	Hedonic Web Browsing	4,16	1,39	0,132
Rook, D. W., & Fisher, R. J. (1995)	ImpBuT	Impulse Buying Tendency	3,19	1,53	0,623
Liu, Y., Li, H., & Hu, F. (2013)	InstantGrat	Instant Gratification	4,29	1,13	0,772
Liu, Y., Li, H., & Hu, F. (2013)	NormEval	Normative Evaluation	3,69	1,47	0,692
(David, 2011)	PercEas	Perceived easiness	5,17	1,41	0,033
Post-purchase online survey					
Cognitive dissonance (Sweeney, J. C., Hausknecht,	WisdOfPur	Wisdom of Purchase	4,07	2,28	0,947
	PostEmo	Emotional	1,49	1,18	0,001

D., & Soutar, G. N. (2000)					

Table 22: descriptive analysis of physiological variables

Signal		***Variable***	***Mean***	***Standard deviation***	***p-value Shapiro***
ECG	LF	Low Frequency	-0,33	0,52	0,334
	HF	High Frequency	0,33	1,77	< 0,001
	LF/HF	Ratio	-0,07	0,94	0,078
	LF norm	LF normalized	-0,17	0,73	0,051
	HF norm	HF normalized	0,39	1,60	< 0,001
Skin Conductance	Tonic	Slowly varying tonic activity	0,26	0,40	0,312
	ISCR	Integrated Skin Conductance Response	258,65	626,75	< 0,001
EEG	AI	Attention Index	-0,08	0,15	0,682
	MI	Memorization Index	-0,09	0,32	0,722
	PI	Pleasantness Index	-4,09	4,86	0,047
	EI	Engagement Index	0,09	0,18	0,318
	PI_2	Pleasantness Index	-7,58	14,57	< 0,001
Eye-tracking	ET	Exploratory Time	75,36	39,43	0,543
	CT	Consideration Time	73,14	43,86	0,749

The aggregate scores of the physiological signals have been computed as the ratio between the average value of the signal during the purchase and the average value of the signal during the baseline acquisition.

There are two distinct p-values for the variable P (valence). Indeed, the Shapiro test to check the normality of this variable has been conducted by using a binary variable called *Treatment* in order to differentiate between the two groups of subjects, assessing the normality for both. This distinction has been made only for this variable because the other ones are not directly affected by the difference of treatment. This choice is also preferable due to the reduced sample size.

8. Experimental results

8.1 Hypotheses validation

To validate our hypotheses, the Independent-Samples Mann-Whitney U Test and the Independent-Samples Kolmogorov-Smirnov Test were conducted for each, with a level of significance of 0,05.

The table hereby summarizes the results that will then be explored in depth.

Table 23: test of hypotheses

Hypotheses	**Variables**	**Result**
H0: During the priming phase, the exposure to a high-valence stimulus will lead to a greater Valence experienced, compared to a low-valence one	• P_37 • Treatment	yes
H1: A positive mood has a positive influence on the online impulse buying, compared to a negative mood	• P_37 • Impulse Buying (0; 1)	no
H2: A difference in Impulse Buying Tendency traits have influence on the online impulse buying	• ImpBuyTend • Impulse Buying	no

H3a: The positive affect immediately after the purchase differs according to the online buying behavior (impulsive or not)	• PosAff_37 • Impulse Buying (0; 1)	no
H3b: The negative affect immediately after the purchase differs according to the online buying behavior (impulsive or not)	• NegAff_37 • Impulse Buying (0; 1)	no

The first step of the analysis aims at verifying that there is a significative difference of self-reported valence (variable P) between the two groups of subjects that faced the two different treatments (**hypothesis H0**).

Due to the normality of the variables, a *t-test* was conducted. The results (t=-6,735, p<0,001) confirmed the significative difference between the groups as resulted from the pretest (rif. 3.1.3). Mann-Whitney test for two independent samples was performed in the treatment comparisons with significance levels set at α=0.05, with results U=64 and p=0,001.

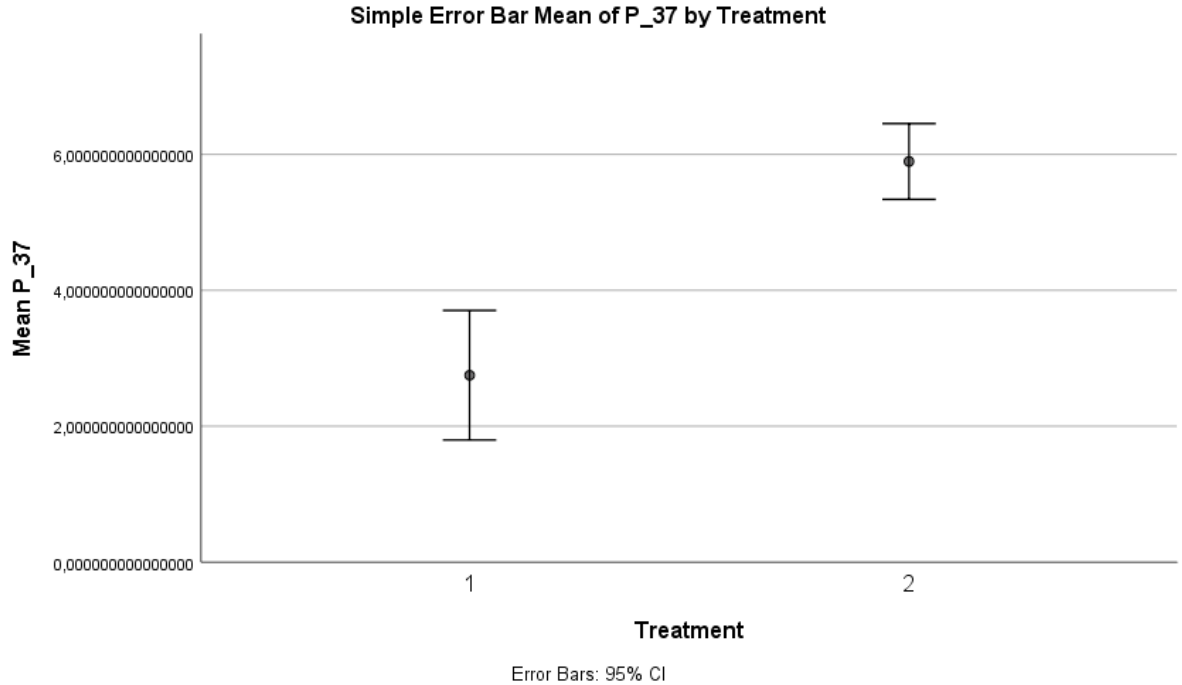


Figure 17: Error bar mean of Valence by Treatment

For **hypothesis H1**, the variables are P_37 for the valence, being the dimension of the mood of interest for our experiment, and ImpulseBuying. The results of the two tests reject the hypothesis. Indeed, the Mann-Whitney U is 29,500 with a p-value of 0,867; the p-value for the Komogorov-Smirnov test is of 0,783. The two high p-values denotes a lack of significance in the test.

Table 24: hypothesis H1 test summary

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of P_37 is the same across categories of ImpBuy.	Independent-Samples Mann-Whitney U Test	,867[a]	Retain the null hypothesis.
2	The distribution of P_37 is the same across categories of ImpBuy.	Independent-Samples Kolmogorov-Smirnov Test	,783	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,050.

a. Exact significance is displayed for this test.

The results of the tests on **hypothesis H2** are the following and they lead to the rejection of the hypothesis.

Table 25: hypothesis H2 test summary

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of ImpBuyTend_37 is the same across categories of ImpBuy.	Independent-Samples Mann-Whitney U Test	,189[a]	Retain the null hypothesis.
2	The distribution of ImpBuyTend_37 is the same across categories of ImpBuy.	Independent-Samples Kolmogorov-Smirnov Test	,499	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,050.

a. Exact significance is displayed for this test.

Finally, for **hypotheses H3a** and **H3b**, results show that there is no significant difference in the two groups of impulse buying in relation both to the positive and negative affect, respectively. Thus, these hypotheses are rejected too.

Table 26: hypothesis H3a test summary

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of PosAff_37 is the same across categories of ImpBuy.	Independent-Samples Mann-Whitney U Test	,121[a]	Retain the null hypothesis.
2	The distribution of PosAff_37 is the same across categories of ImpBuy.	Independent-Samples Kolmogorov-Smirnov Test	,108	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,050.

a. Exact significance is displayed for this test.

Table 27: hypothesis H3b test summary

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of NegAff_37 is the same across categories of ImpBuy.	Independent-Samples Mann-Whitney U Test	,232[a]	Retain the null hypothesis.
2	The distribution of NegAff_37 is the same across categories of ImpBuy.	Independent-Samples Kolmogorov-Smirnov Test	,351	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,050.

a. Exact significance is displayed for this test.

In addition, all the other variables are tested too, in order to check whether they show significant differences across the categories of impulse buying. In this regard, the only variable that is noteworthy to mention is Mood Repair.

Table 28: test summary for mood repair

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Rep_37 is the same across categories of ImpBuy.	Independent-Samples Mann-Whitney U Test	,021[a]	Reject the null hypothesis.
2	The distribution of Rep_37 is the same across categories of ImpBuy.	Independent-Samples Kolmogorov-Smirnov Test	,037	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is ,050.

a. Exact significance is displayed for this test.

8.2 Regression analysis

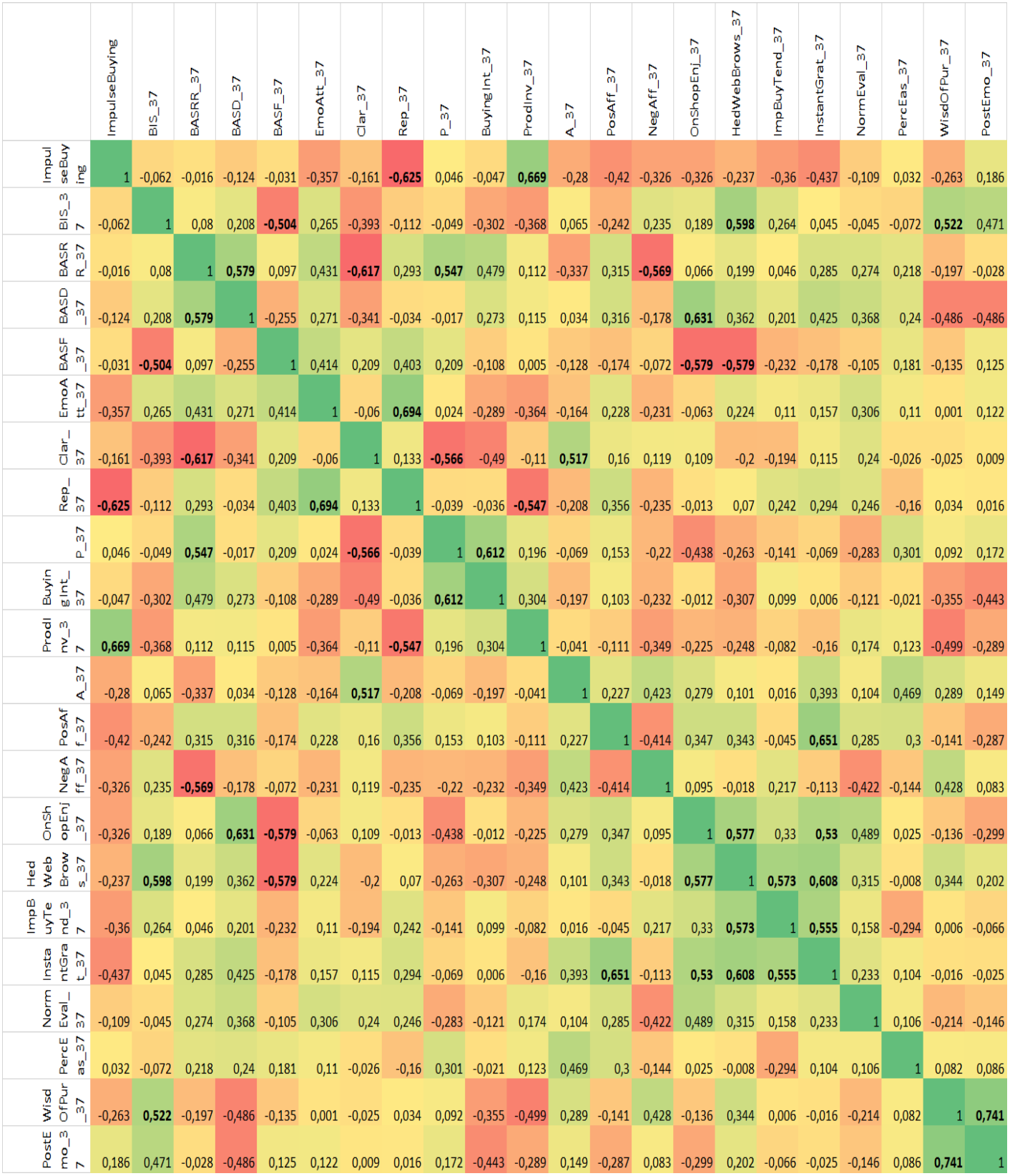
The next step in the analysis was to build regression models in order to test which are the variables that have a greater impact on the impulse buying.

Three logistic regression models have been built; the dependent variable is always the impulse buying, while the independent variables are respectively:

1. Self-declared variables
2. Physiological variables
3. All variables together

Firstly, a correlation analysis is needed to understand which variables show a high correlation and thus must not be included in the model.

The two-correlation matrix are hereby reported; the first is between self-declared variables, the second is between all variables – both self-declared and physiological ones.
The numbers in bold highlight a significance higher than 0,05 in the Spearman correlation.



	ImpulseBuying	BIS_37	BASRR_37	BASD_37	BASF_37	EmoAtt_37	Clar_37	Rep_37	P_37	BuyingInt_37	ProdInv_37	A_37	PosAff_37	NegAff_37	OnShopEnj_37	HedWebBrows_37	ImpBuyTend_37	InstantGrat_37	NormEval_37	PercEas_37	WisdOfPur_37	PostEmo_37
ImpulseBuying	1	-0,062	-0,016	-0,124	-0,031	-0,357	-0,161	**-0,625**	0,046	-0,047	**0,669**	-0,28	-0,42	-0,326	-0,326	-0,237	-0,36	-0,437	-0,109	0,032	-0,263	0,186
BIS_37	-0,062	1	0,08	0,208	**-0,504**	0,265	-0,393	-0,112	-0,049	-0,302	-0,368	0,065	-0,242	0,235	0,189	**0,598**	0,264	0,045	-0,045	-0,072	**0,522**	0,471
BASRR_37	-0,016	0,08	1	**0,579**	0,097	0,431	**-0,617**	0,293	**0,547**	0,479	0,112	-0,337	0,315	**-0,569**	0,066	0,199	0,046	0,285	0,274	0,218	-0,197	-0,028
BASD_37	-0,124	0,208	**0,579**	1	-0,255	0,271	-0,341	-0,034	-0,017	0,273	0,115	0,034	0,316	-0,178	**0,631**	0,362	0,201	0,425	0,368	0,24	-0,486	-0,486
BASF_37	-0,031	**-0,504**	0,097	-0,255	1	0,414	0,209	0,403	0,209	-0,108	0,005	-0,128	-0,174	-0,072	**-0,579**	**-0,579**	-0,232	-0,178	-0,105	0,181	-0,135	0,125
EmoAtt_37	-0,357	0,265	0,431	0,271	0,414	1	-0,06	**0,694**	0,024	-0,289	-0,364	-0,164	0,228	-0,231	-0,063	0,224	0,11	0,157	0,306	0,11	0,001	0,122
Clar_37	-0,161	-0,393	**-0,617**	-0,341	0,209	-0,06	1	0,133	**-0,566**	-0,49	-0,11	**0,517**	0,16	0,119	0,109	-0,2	-0,194	0,115	0,24	-0,026	-0,025	0,009
Rep_37	**-0,625**	-0,112	0,293	-0,034	0,403	**0,694**	0,133	1	-0,039	-0,036	**-0,547**	-0,208	0,356	-0,235	-0,013	0,07	0,242	0,294	0,246	-0,16	0,034	0,016
P_37	0,046	-0,049	**0,547**	-0,017	0,209	0,024	**-0,566**	-0,039	1	**0,612**	0,196	-0,069	0,153	-0,22	-0,438	-0,263	-0,141	-0,069	-0,283	0,301	0,092	0,172
BuyingInt_37	-0,047	-0,302	0,479	0,273	-0,108	-0,289	-0,49	-0,036	**0,612**	1	0,304	-0,197	0,103	-0,232	-0,012	-0,307	0,099	0,006	-0,121	-0,021	-0,355	-0,443
ProdInv_37	**0,669**	-0,368	0,112	0,115	0,005	-0,364	-0,11	**-0,547**	0,196	0,304	1	-0,041	-0,111	-0,349	-0,225	-0,248	-0,082	-0,16	0,174	0,123	-0,499	-0,289
A_37	-0,28	0,065	-0,337	0,034	-0,128	-0,164	**0,517**	-0,208	-0,069	-0,197	-0,041	1	0,227	0,423	0,279	0,101	0,016	0,393	0,104	0,469	0,289	0,149
PosAff_37	-0,42	-0,242	0,315	0,316	-0,174	0,228	0,16	0,356	0,153	0,103	-0,111	0,227	1	-0,414	0,347	0,343	-0,045	**0,651**	0,285	0,3	-0,141	-0,287
NegAff_37	-0,326	0,235	**-0,569**	-0,178	-0,072	-0,231	0,119	-0,235	-0,22	-0,232	-0,349	0,423	-0,414	1	0,095	-0,018	0,217	-0,113	-0,422	-0,144	0,428	0,083
OnShopEnj_37	-0,326	0,189	0,066	**0,631**	**-0,579**	-0,063	0,109	-0,013	-0,438	-0,012	-0,225	0,279	0,347	0,095	1	**0,577**	0,33	**0,53**	0,489	0,025	-0,136	-0,299
HedWebBrows_37	-0,237	**0,598**	0,199	0,362	**-0,579**	0,224	-0,2	0,07	-0,263	-0,307	-0,248	0,101	0,343	-0,018	**0,577**	1	**0,573**	**0,608**	0,315	-0,008	0,344	0,202
ImpBuyTend_37	-0,36	0,264	0,046	0,201	-0,232	0,11	-0,194	0,242	-0,141	0,099	-0,082	0,016	-0,045	0,217	0,33	**0,573**	1	**0,555**	0,158	-0,294	0,006	-0,066
InstantGrat_37	-0,437	0,045	0,285	0,425	-0,178	0,157	0,115	0,294	-0,069	0,006	-0,16	0,393	**0,651**	-0,113	**0,53**	**0,608**	**0,555**	1	0,233	0,104	-0,016	-0,025
NormEval_37	-0,109	-0,045	0,274	0,368	-0,105	0,306	0,24	0,246	-0,283	-0,121	0,174	0,104	0,285	-0,422	0,489	0,315	0,158	0,233	1	0,106	-0,214	-0,146
PercEas_37	0,032	-0,072	0,218	0,24	0,181	0,11	-0,026	-0,16	0,301	-0,021	0,123	0,469	0,3	-0,144	0,025	-0,008	-0,294	0,104	0,106	1	0,082	0,086
WisdOfPur_37	-0,263	**0,522**	-0,197	-0,486	-0,135	0,001	-0,025	0,034	0,092	-0,355	-0,499	0,289	-0,141	0,428	-0,136	0,344	0,006	-0,016	-0,214	0,082	1	**0,741**
PostEmo_37	0,186	0,471	-0,028	-0,486	0,125	0,122	0,009	0,016	0,172	-0,443	-0,289	0,149	-0,287	0,083	-0,299	0,202	-0,066	-0,025	-0,146	0,086	**0,741**	1

Figure 18: Correlation matrix of the dataset containing the self-reported scores

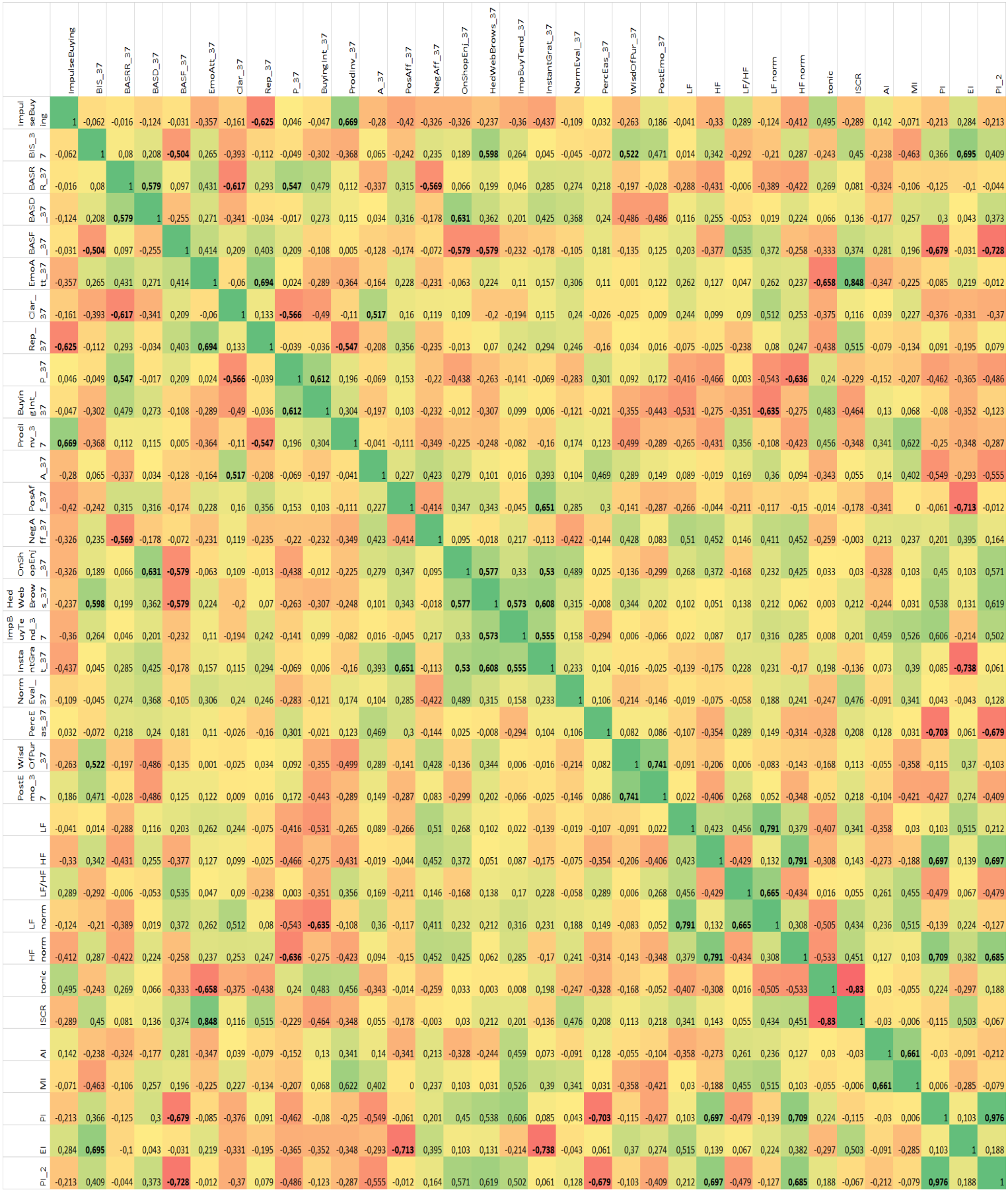


Figure 19: Correlations between self-assessed scores and physiological signals

However, the three models were not able to converge, as none of the variables in the model was significant. It is probably due to the limited sample size. The three regression models are hereby explained in depth.

1. Self-declared variables

This model aims at evaluating the impact of self-declared variables on the online impulse buying. As shown by the correlation matrix, some of them are highly correlated to each other. In this regard, only the variables which do not demonstrate high correlation are considered: *P*, *BuyInt*, *A*, *OnshopEnj*, *IBT*, *NormEval*, *PercEas*. Moreover, due to our hypothesis, the variables *BIS*, *BASRR*, *BASD*, *BASF* are involved in the model too.

Then, a backward stepwise selection has been conducted. The final model reveals five predictors: *BASRR*, *BuyInt*, *A*, *NormEval* and *PercEas*. Its significance is 0,072 with a Nagelkerke R-square equal to 0,656 and a percentage correct of 73,3%.

PerEac, *NormEval* and *BuyInt* have a positive influence on impulse buying. Instead, the remaining two variables show a negative influence on impulse buying with higher coefficients in absolute value. However, none of the variables was significant.

Table 29: variables in the equation of the regression model with self-declared variables

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	BASRR_37	-19,402	14,331	1,833	1	,176	,000
	BuyingInt_37	1,508	1,225	1,515	1	,218	4,519
	A_37	-8,350	6,307	1,753	1	,186	,000
	NormEval_37	2,074	1,756	1,395	1	,238	7,954
	PercEas_37	4,978	3,726	1,785	1	,182	145,252
	Constant	89,869	67,928	1,750	1	,186	1,071E+39

a. Variable(s) entered on step 1: BASRR_37, BuyingInt_37, A_37, NormEval_37, PercEas_37.

2. Physiological variables

This second model explores the influence of the physiological variables on the online impulse buying. A backward procedure has been followed for the implementation of this regression model. The final one includes two variables as predictors: ISCR from the skin conductance and LF/HF from the ECG.

The overall significance of this model is of 0,064 with a Nagelkerke R-square of 0,462 and a percentage correct equal to 61,5%.

The ISCR has a slightly negative influence on the impulse buying, while the variable LF/HF, has a positive impact. In this model, no variable was significant.

Table 30: variables in the equation of the regression model with physiological variables

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	LF/HF	1,267	,969	1,709	1	,191	3,549
	ISCR	-,012	,010	1,313	1	,252	,988
	Constant	,954	,949	1,011	1	,315	2,596

a. Variable(s) entered on step 1: LF/HF, ISCR.

3. Overall model

The last regression model considers all the variables together, both the self-declared and the physiological ones. The backward procedure has been followed.

The final model includes the following variables as predictors: *IBT*, *Positive Affect*, *ISCR*.

The model is robust (p-value = 0,007), with a Nagelkerke R-square equal to 0,808 and a percentage correct of 84,6%.

All the three variables have a negative influence on the online impulse buying, especially the Positive Affect.

Table 31: variables in the equation of the regression model with all the variables

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	IBT_37	-1,198	1,118	1,148	1	,284	,302
	ISCR	-,014	,010	1,988	1	,159	,986
	PosAff_37	-7,695	5,798	1,761	1	,184	,000
	Constant	34,200	23,944	2,040	1	,153	7127720664914 82,800

a. Variable(s) entered on step 1: IBT_37, ISCR, PosAff_37.

This result is coherent with the precedent model, in which ISCR had a negative influence too. None of the variable was significant.

Finally, three models of linear regression were useful to understand what variables influenced the affect (valence) felt by the subject, considering different aspects: personal traits, the type of purchase and also situational factors.

The first model considers the variable of Positive Affect resulting from the PANAS (PosAff) as dependent variable, and the following ones as predictors:

- BIS
- BASF
- Emotional Attention
- Impulse Buying (0;1)

This model was robust, with a p-value of 0,049 and an adjusted R-square of 0,417. The only variables that resulted to be significant are the BIS and the BASF. The coefficients are hereby reported and the results will be explained in depth in the next paragraph (Discussion).

Table 32: coefficients in the linear regression model for the Positive Affect

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	6,456	1,070		6,031	,000
	BIS_37	-,606	,199	-,945	-3,046	,012
	EmoAtt_37	,506	,262	,700	1,932	,082
	BASF_37	-,690	,308	-,841	-2,244	,049
	ImpBuy	-,266	,243	-,265	-1,096	,299

a. Dependent Variable: PosAff_37

The second regression model aims at understanding which are the predictors of the negative affect felt by the subjects after the purchase. The dependent variable is the Negative Affect from the PANAS, while the independent ones are:

- BIS
- BASRR
- BASF
- Emotional Attention
- Clarity
- Mood Repair

- Online Shopping Enjoyment

The model was robust with a p-value of 0,017 and an adjusted R-square of 0,761. The significant predictors are only the BASF, BASRR, Clarity and Online Shopping Enjoyment. The coefficients are reported in the table:

Table 33: coefficients in the linear regression model for the Negative Affect

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	16,207	4,679		3,463	,013
	BIS_37	,247	,258	,262	,958	,375
	EmoAtt_37	-,558	,313	-,524	-1,785	,125
	BASF_37	1,237	,391	1,024	3,164	,019
	BASRR_37	-3,350	,719	-1,737	-4,659	,003
	Clar_37	-2,303	,862	-1,061	-2,670	,037
	Rep_37	,729	,340	,661	2,143	,076
	OnShopEnj_37	,590	,221	,792	2,675	,037
	ImpBuyTend_37	-,050	,090	-,101	-,553	,600

a. Dependent Variable: NegAff_37

Finally, the third model refers to the physiological variable related to the valence: the Pleasantness Index PI. The independent variables are:

- BIS
- BASRR
- BASD
- BASF
- Product Involvement
- Online Shopping Enjoyment
- Impulse Buying Tendency

The model showed a p-value of 0,024, thus being robust, and an adjusted R-square of 0,968. All the variables were significant in the model except for the BIS and the Online Shopping Enjoyment. The results are reported in the following table:

Table 34: coefficients in the linear regression model for the Arousal

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	66,187	14,587		4,537	,045
	BIS_37	-4,692	1,468	-,685	-3,197	,085
	BASRR_37	-8,509	1,769	-,739	-4,811	,041
	BASD_37	9,610	1,746	1,446	5,502	,031
	ProdInv_37	-5,701	1,014	-1,322	-5,624	,030
	BASF_37	-6,246	,976	-,647	-6,401	,024
	OnShopEnj_37	-2,024	,647	-,400	-3,128	,089
	ImpBuyTend_37	1,720	,220	,488	7,810	,016

8.3 Physiological variables in the 4 phases of navigation

This section aims at a qualitative analysis of the differences of the main physiological indexes during the 4 phases of navigation.

As explained in the previous paragraphs, 4 phases were identified within the navigation of the e-commerce:

1. Exploration
2. Catch
3. Consideration
4. Purchase

It was interesting to analyze how the different physiological variables varied between these phases, with the purpose of understanding how the user felt during the whole navigation time of 3 minutes.

A first analysis is done dividing the subjects in two groups according to the treatment they faced (1 for the negative treatment, 2 for the positive treatment).

Starting from the Indexes from the EEG (Attention Index, Memorization Index, Engagement Index, Pleasant Index), the average values of each index have been computed for the two groups of subjects in each phase.

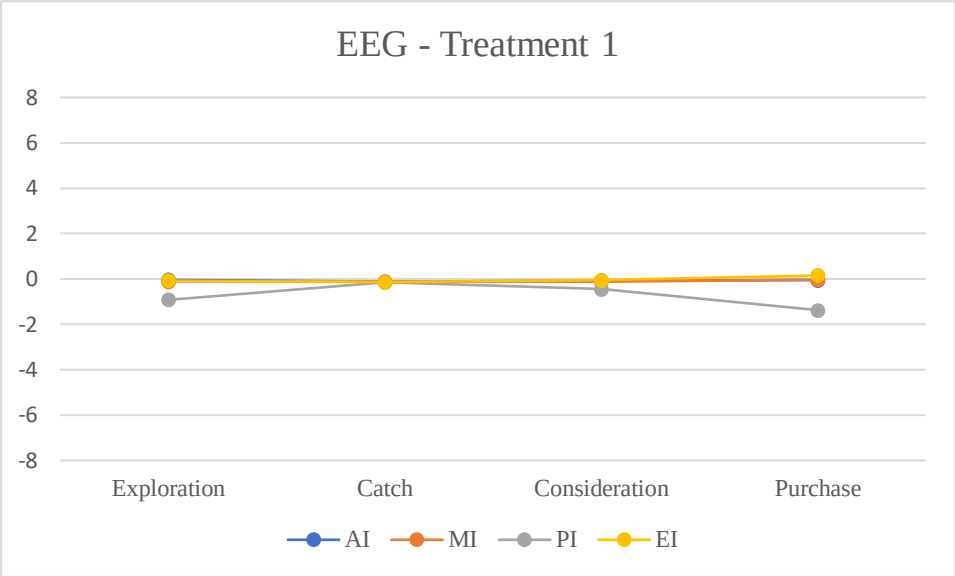


Figure 20: EEG indexes for group 1

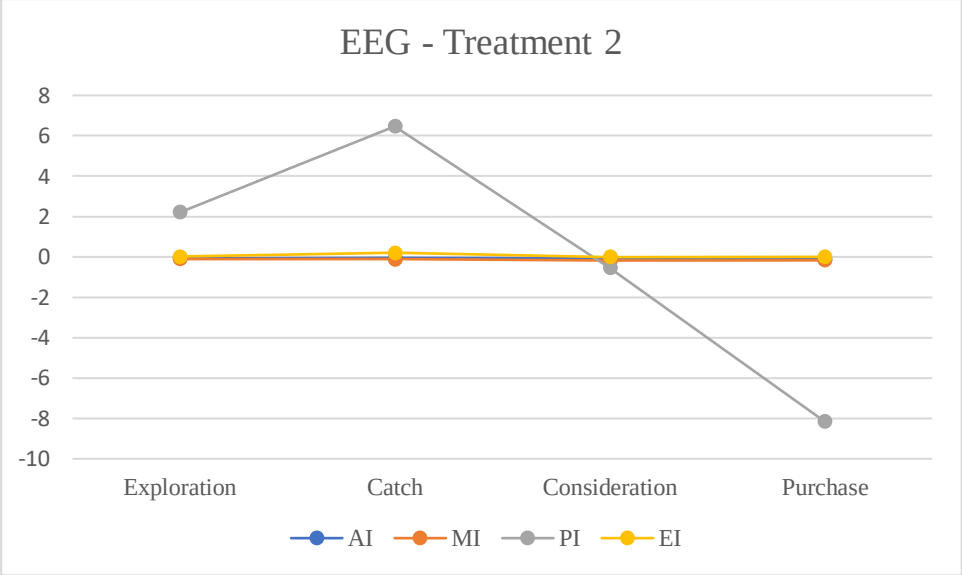


Figure 21: EEG indexes for group 2

- *Attention Index*. It remains around the value of 0, for both groups. Specifically, for treatment 1 it has an average between the phases of -0,0713 and a standard deviation of 0,034; for treatment 2 the average is -0,0798 and the standard deviation is 0,0309.
- *Memorization Index*. In group 1, it shows a slightly higher value in the phase of purchase; the average is -0,095 and the standard deviation is 0,0406. In group 2, it is quite flat and the average is -0,1396 and the standard deviation is 0,0371.
- *Pleasant Index*. This is the only index that shows clear differences between the 4 phases of analysis. The values are significantly different between the two groups – as confirmed by the validation of hypothesis H0. Nevertheless, the pattern is similar. As expected, it

shows a great increase in the catch phase, that represent the first time the subject sees the product that will then be bought; then, it decreases during the consideration phase and keep decreasing also during the purchase phase. For group 1, the average is -0,7226 and the standard deviation is 0,5387; for group 2, the average is -0,0029 and the standard deviation is 6,1519.

A t-test confirms the existence of a valley during the purchase phase: this test just verifies the null hypotheses according to which the mean of that index in that phase is equal to 0, that is like saying that it is different from the mean of the navigation since that the signals are standardized. In other words, a statistically significant difference from 0 would represent a peak or a valley in that point. Performing the t-tests in this way, the results confirm the statistical significance of the valley with an overall p-value of 0,026.

- *Engagement Index*. In group 1, it is higher during the purchase phase, while in group 2 it is maximum at the catch phase. However, in both groups this index remains around the value of 0 with no significant difference between the phases. The average values are, respectively for group 1 and 2, equal to -0,0291 and 0,0559; the standard deviations are 0,1247 and 0,1016.

Moving to the ISCR index, related to the skin conductance, the two following graphs are related to the groups who faced respectively treatment 1 and treatment 2. They show a similar pattern, with an increase in the catch phase and in the purchase phase. Specifically, the ISCR results much higher in the purchase phase for the group who faced a negative treatment (group 1), with an average value of 440,87 against the average value for group 2 of 47,3.

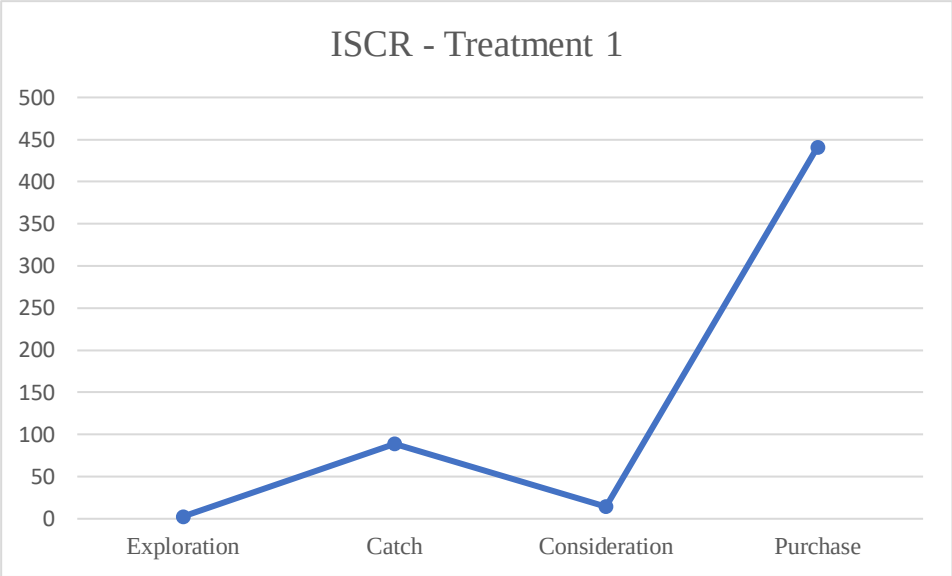


Figure 22: ISCR for treatment 1

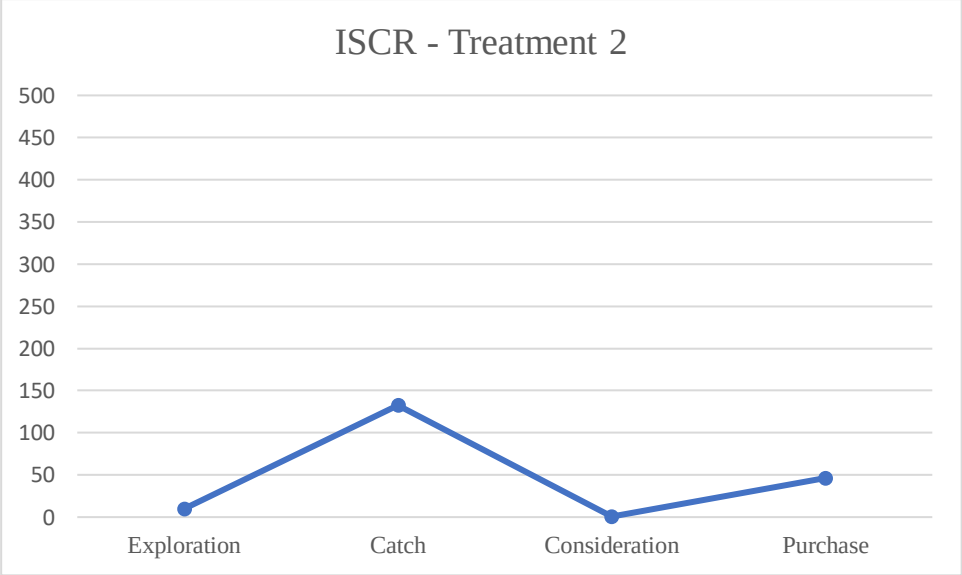


Figure 23: ISCR for treatment 2

Considering the overall trend of ISCR among all the subjects (see figure 26), without making group distinctions since the trend is the same, a t-test confirms the statistical significance of the pick in the catch phase, with a p-value of 0,024.

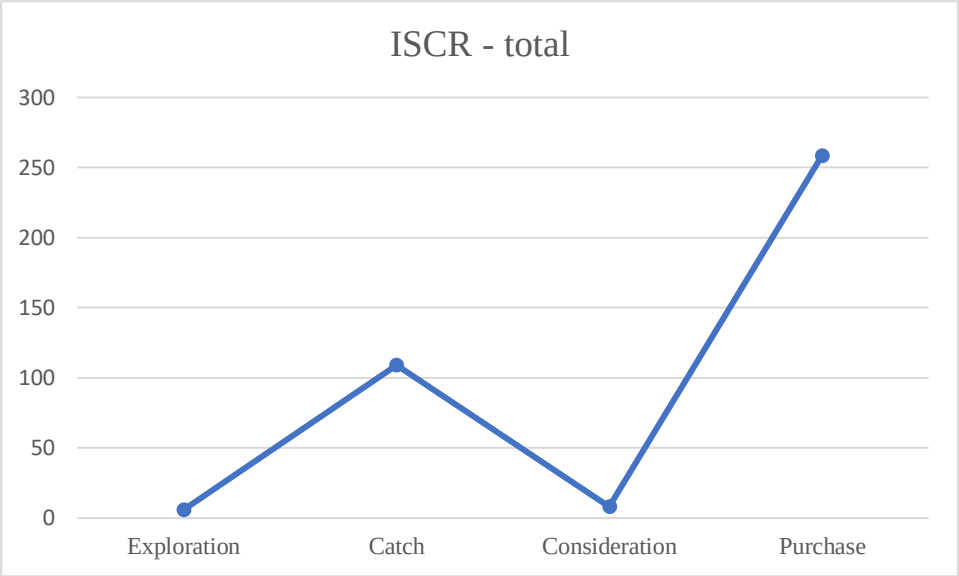


Figure 24: ISCR in different phases

Subsequently, the same analysis is done dividing the subjects in two groups according to their buying behavior (0 for non-impulse buyers, 1 for impulse-buyers).

Starting from the Indexes from the EEG (Attention Index, Memorization Index, Engagement Index, Pleasant Index), the average values of each index have been computed for the two groups of subjects in each phase.

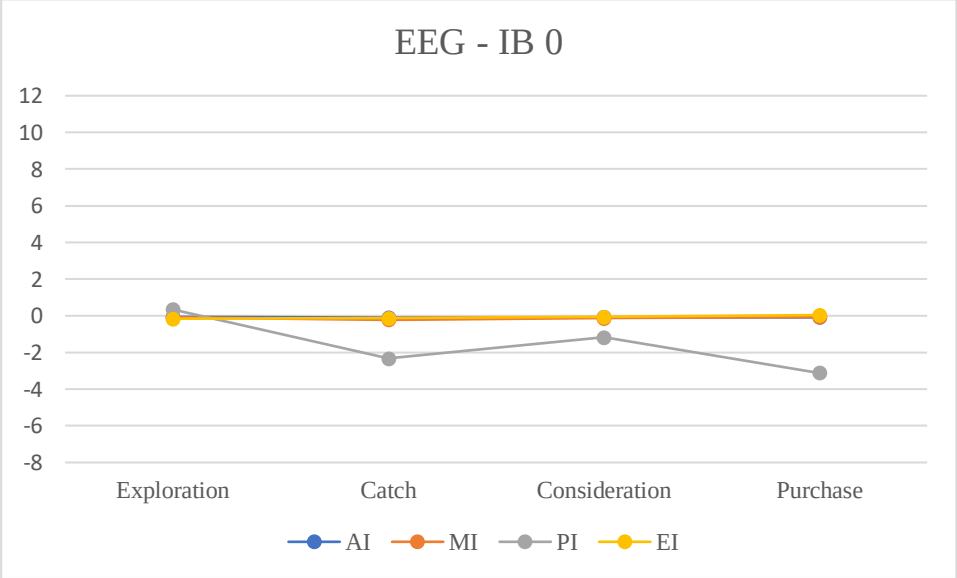


Figure 25: EEG indexes for group 0

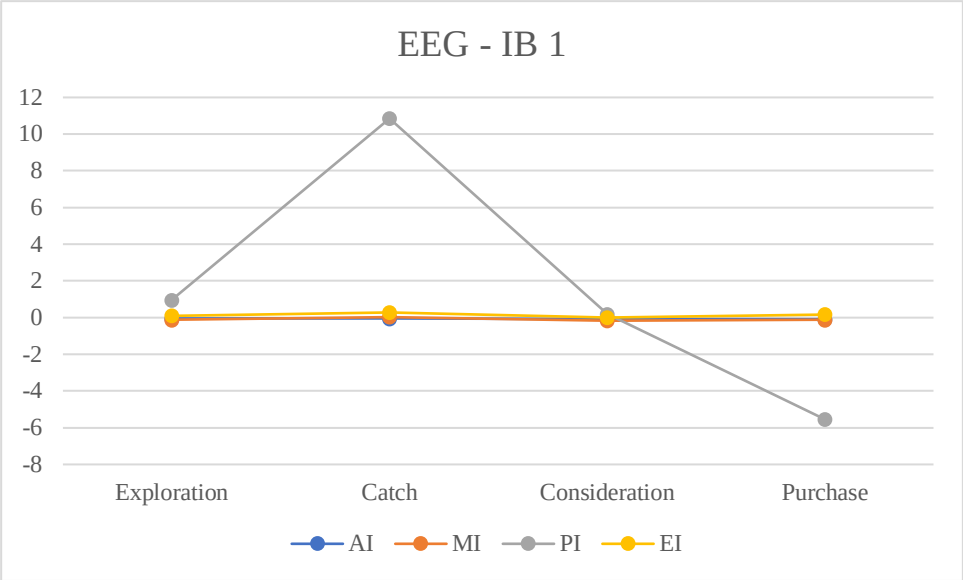


Figure 26: EEG indexes for group 1

- *Attention Index*. It remains around the value of 0, for both groups. Specifically, for group 0 it has an average between the phases of -0,0795 and a standard deviation of 0,0158; for group 1 the average is -0,0658 and the standard deviation is 0,0176.
- *Memorization Index*. In group 0, the average is -0,131 and the standard deviation is 0,0684. In group 1, it is quite flat and the average is -0,093 and the standard deviation is 0,0839.
- *Pleasant Index*. This is the only index that shows clear differences between the 4 phases of analysis. The values are significantly different between the two groups; indeed, it remains negative in all the phases for group 0 while it shows positive values in the first three phases for group 1. Moreover, the pattern is different too. In group 0, it starts from a neutral value and decreases in the catch phase, becoming negative as explained before; then, it only increases a bit in the consideration phase, subsequently decreasing again in the purchase phase to a value of -3,12 and it is the valley. In group 1, the value in the exploration phase is again slightly higher than 0 but it increases significantly in the catch phase, showing a pick with a value of 10,85; then, it starts decreasing and, after a neutral value in the consideration phase, it becomes negative in the purchase phase with a value of -5,53, thus lower than for the group 0.

  For group 0, the average is -1,574 and the standard deviation is 1,506; for group 1, the average is 1,617 and the standard deviation is 6,803.

- *Engagement Index*. In both groups this index remains around the value of 0 with no significant difference between the phases. The average values are, respectively for group 0 and 1, equal to -0,0781 and 0,0881; the standard deviations are 0,14 and 0,116.

Moving to the ISCR index, related to the skin conductance, the two following graphs are related to the groups who had respectively an impulse behavior or not. They show a similar pattern, with an increase in the catch phase and in the purchase phase. Specifically, the ISCR results much higher in the purchase phase for the group of non-impulse buyers (group 0), with a value of 440,45 against the value for group 1 of 46,6.

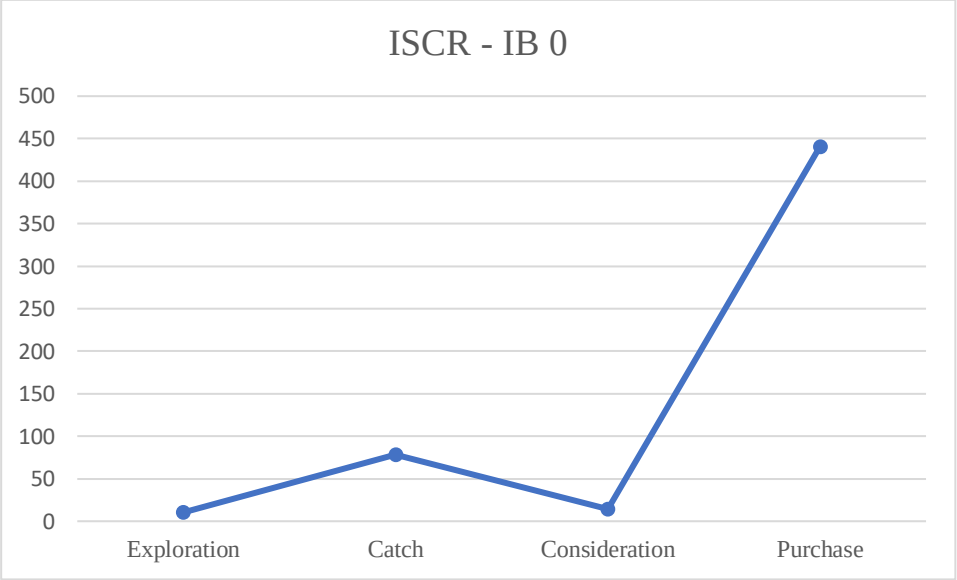


Figure 27: ISCR for group 0

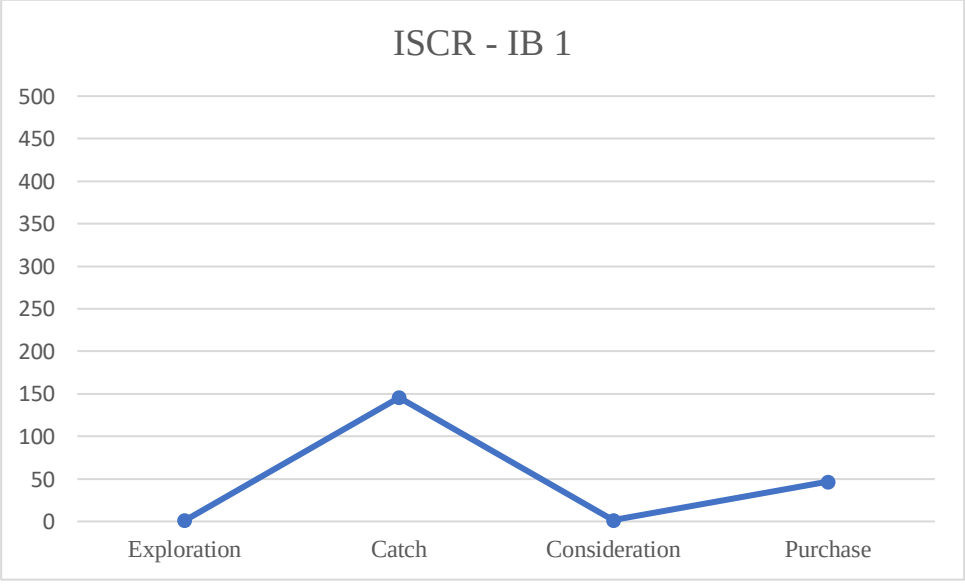


Figure 28: ISCR for group 1

Considering the overall trend of ISCR among all the subjects (see figure 26), without making group distinctions since the trend is the same, a t-test confirms the statistical significance of the pick in the catch phase, with a p-value of 0,024.

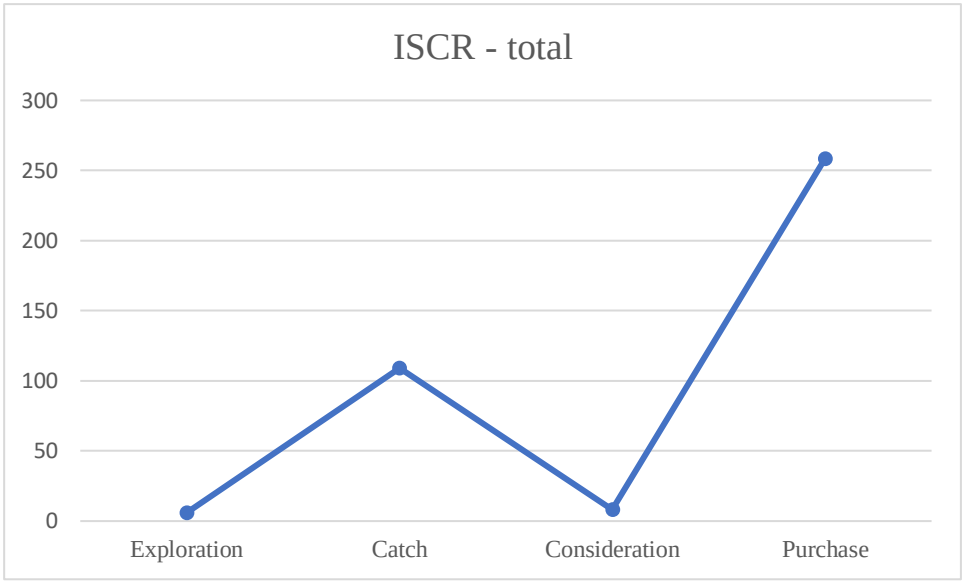


Figure 29: ISCR in different phases

9. Discussion

In this section, results will be discussed and their position with respect to the literature will be illustrated: it will be explained if the result is coherent with other research and eventually how it completes the conclusions illustrated in other studies.

The *insights* generated in this phase will be resumed and further developed in the chapter Managerial Implications, while the next paragraphs will satisfy the previously illustrated scope of this Discussion. Furthermore, the main limitations of this study and potential directions of future works will be illustrated.

9.1 Mood induction

The validation of hypothesis H0 confirms what has been previously found in Literature: the two videos used as visual stimuli are effective in the mood manipulation, specifically in varying the valence. Indeed, the two groups that were subject to the two different stimuli showed a

significant difference in the level of valence; the group of subjects with uneven code, that watched the video for the negative mood induction (the scene from American History X), showed a lower level of self-declared valence, while the group of subjects with even code showed a higher average value of self-declared valence after the watching of the scene from The Dead Poets Society.

9.2 Hypothesis tests

Hypothesis H1 hypothesized that the subjects' emotional responses would be positively related to their impulse buying behavior. Thus, it was expected that the more a subject felt a positive valence, the greater the likelihood of having an impulse buying behavior. Due to the focus of this study on the mood, this hypothesis is of primary importance. Nevertheless, it is not validated and no significant difference in the valence felt by the subjects of the two groups of impulse buying (0;1) was found. Thus, a difference in the level of valence experienced is not significantly related to online impulse buying and moreover, this state is reinforced by the rejection of hypotheses H3a and H3b regarding positive and negative affect immediately after the purchase.

For what concerns instead hypothesis 2, it was expected that the higher was the degree to which an individual is likely to make unintended, immediate, and unreflective purchases, the greatest the likelihood that impulse buying happened. However, this is not surprisingly the case considering that there is no significant difference of IBT between the two categories of impulse buying and thus, that the hypothesis is rejected. This is probably a limitation due to the reduced number of subjects involved in the experiment.

Hence, the logistic regressions were performed in order to assess whether there are other factors in predicting the impulse buying behavior. Nevertheless, even if the models resulted robust, the single variables were not significant. Again, the reason is probably due to the limited sample size, that does not allow the model to converge and to reach a statistical significance. However, these results can provide an interesting direction for future studies to understand predictors of online impulse buying.

These results confirm that the online impulse buying behavior is elicited both by the positive mood and the negative one. This conclusion confirms what was previously found in other studies in the Literature (Adelaar, Chang, Lancendorfer, Lee, & Morimoto, 2003). The only variable that showed a significant difference between the two groups of impulse buying is the one related to the influence of mood repair. Indeed, the variable Rep_37 is distributed

differently between the two categories of impulse buying. Analyzing in depth this difference, it is possible to notice that the average value of mood repair is higher for those subjects that bought an item for less than 9€, as shown in the following graph.

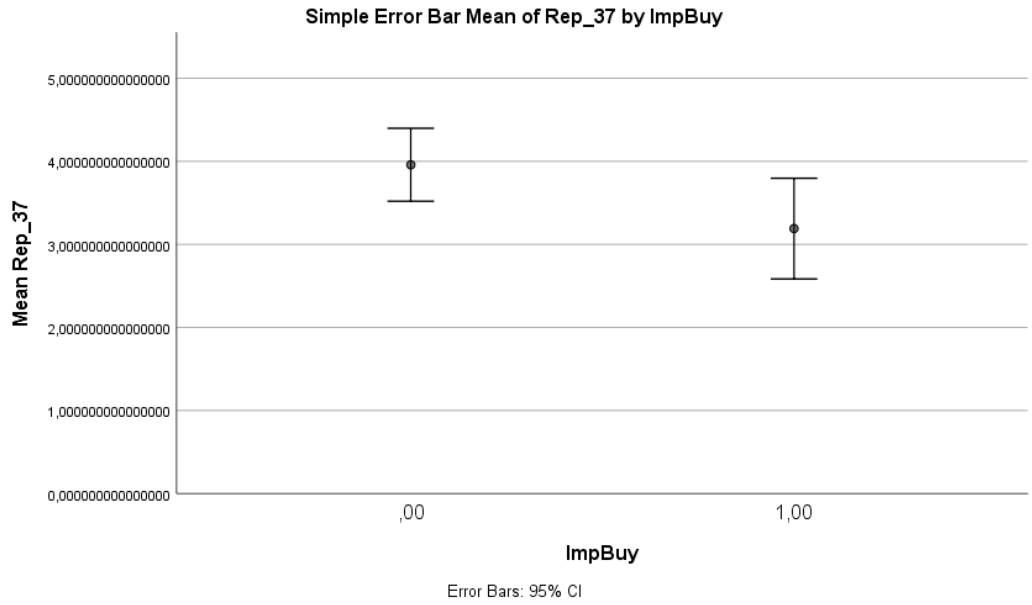


Figure 30: difference of Mood Repair

Mood repair is a form of emotion regulation that measures the consciousness of the subject. It is an attitude by which an individual is prone to curb his emotions and the more he/she is able to suppress his feelings, the more his/her propensity toward impulse buying is lower. Indeed, the attempt to test this proposal experimentally demonstrates that when a consumer makes an impulse purchase, he/she got emotionally overwhelmed. Thus, more conscious people will unlikely engage in an online impulse buying behavior.

Since the high interest toward mood in this study, it must be explored in depth. Indeed, from the correlation matrix in the previous paragraph, it is possible to highlight some interesting reflections. Indeed, some variables show a high correlation coefficient. The most interesting correlations are hereby explained.

Firstly, for what concern self-declared variables only, correlation is:

- Negative between Mood Repair and Product Involvement. Subjects that are more conscientious show a lower involvement toward the product.

- Negative between Clarity of Feelings and self-declared Valence; positive between Clarity and self-declared Arousal. Subjects that are more connected to their emotions declared to feel lower valence, but higher arousal.
- Positive between Positive Affect after the purchase and Instant Gratification. Subjects that declared to have higher positive affect right after the purchase also generally feel more gratified from online purchases.
- Positive between the Online Shopping Enjoyment and Hedonic Web Browsing and Instant Gratification. Subjects that enjoy more online purchasing experiences also usually surf websites just for fun and feel better after an online purchase.
- Positive between Impulse Buying Tendency and Hedonic Web Browsing and Instant Gratification. Subjects with higher impulsive traits also like to explore products on the internet just for fun and feel an immediate sense of gratification after an online purchase.
- Positive between Wisdom of Purchase and Post Emotion. Subjects that recognize after the purchase that they may not have needed that product also felt a psychological discomfort subsequent to the purchase decision.

Instead, in order to check whether personality traits can be expressed at the physiological level, the correlation between self-declared variables and the physiological ones is investigated:

- Positive between Emotional Attention and ISCR. Subjects that show more attention toward their own mood experience a higher arousal after an impulsive trigger.
- Negative between Instant Gratification and Engagement Index. Subjects that feel better after an online purchase also feel less engaged in the experience at the moment of purchase. A possible explanation is that these subjects are more focused on the feeling of subsequent gratification than on the purchase itself
- Positive between BIS and Engagement Index. Subjects with a higher feeling of anxiety feel more engaged in the experience at the moment of purchase
- Negative between BASF and Pleasantness Index. Subjects with a higher desire for novel rewards showed a lower level of valence. It can be explained by the fact that subjects that usually seek for novel rewards feel disappointed by the purchasing experience, not seeing the bought product as a proper reward.

Therefore, mood is still important for impulse buying, as shown by the correlation between physiological variables and personality traits, that resulted to be important predictors for

impulse buying. Although the hypothesis validation tests and the logistic regressions reject the initial hypothesis and confirm that online impulse buying does not deal with a difference into positive or negative moods, these correlations reinforce what already said in literature, namely that mood is an affective pre-disposition that encourages, or discourages, specific behaviors.

Indeed, mood boosts online impulse buying behavior since impulse buyers were found to be more likely to buy on impulse in both negative moods and positive moods than non-impulse buyers.

9.3 Linear Regression models

Finally, the results of the three linear regression models were important to test which variables had a role in influencing the pleasantness experienced by the subjects.

In the first model, which considered as dependent variable the self-declared positive affect, the predictors that resulted to be significant were only:

- the BIS
- the BAS Fun Seeking.

Thus, the only variables that influence the positive affect felt by the subjects are personal traits, specifically the behavioral inhibition system and the behavioral activation system fun seeking. The first one inhibits behavior that may lead to negative or painful outcomes; the second one reflects both a desire for new rewards and a willingness to approach a potentially rewarding event on the spur of the moment.
Specifically, the coefficients can be analyzed in depth to provide a better explanation on how these predictors influence the felt valence. Both the predictors have a negative coefficient. The higher the activation of the BIS and the BASF, the lower the positive affect experienced by the subject after the purchase. Thus, these personal traits negatively influence the positive affect. While the negative influence of the BIS was expected, as it refers to a general state of anxiety, the negative impact of the BASF was surprising. However, it reflects the result of the negative correlation between this variable and the PI, as shown before.

The second regression model aims at understanding the variables influencing the negative affect felt by the subject after the purchase. The significant predictors refer again only to personal traits of the subjects and not to situational factors.
Indeed, they were:

- the BASF, explained above;
- the BASRR, which refers to the focus on positive responses to the occurrence or anticipation of reward;
- the Clarity of Feelings refers to one's ability to identify the type of emotions;
- the Online Shopping Enjoyment, that represents an individual's personality trait, linking the shopping trip with great pleasure and enjoyable aspects (Bellenger & Korgaonkar, 1980) (Odekerken-Schroder, De Wulf, & Schumacher, 2003) (Wong, Osman, Jamaluddin, & Yin-Fah, 2012)

Analyzing the coefficients, the BASF and the Shopping Enjoyment has a positive impact on the negative affect, that is to say the more reactive the BASF and the higher the enjoyment, the higher the negative affect felt; contrarily, the BASRR and Clarity have a negative coefficient, thus the more the subject is reactive to reward responsiveness and the clearer he/she is about his/her emotions, the lower the negative affect felt after the purchase. While the negative coefficients were expected, the positive ones are quite peculiar. However, the positive impact of the BASF on the negative affect is coherent with the result of the previous regression, in which the same BASF negatively influence the positive affect. Thus, the behavioral activation system fun seeking tends to lead to a lower level of affect after the purchase. Instead, an explanation for the positive influence of Online Shopping Enjoyment on the Negative Affect could be related to the constrained time span allowed for the purchase and to the experimental environment, that did not allow the subjects to fully appreciate the purchasing experience.

Moving to the third linear regression model, which considers the physiological variable of the Pleasantness Index at the moment of the purchase, the significant predictors were:

- Behavioral activation system
- Product involvement
- Impulse buying tendency

All of the three sub-categories of BAS were significant. Nevertheless, the BASRR has a negative coefficient together with the BASF, while the BASD has a positive coefficient. This result shows that the more a subject tends to have the willingness to approach a rewarding event on the spur of the moment (BASF) and the more he/she focuses on positive responses in case of reward (BASRR), the less the valence experienced at the moment of the purchase. Since the two predictors are both related to the concept of 'reward', this result could be possibly explained, again, by the fact that the subject did not feel the purchase as a proper reward.

On the contrary, the BASD has a high positive influence on the Pleasantness Index, thus the more the subject is oriented toward the pursuing of his/her goals, the higher the valence experienced during the purchase.
This result is apparently in contrast with the negative influence of the product involvement. Indeed, the negative coefficient shows that the more the involvement in the product (thus the perceived product's relevance), the less the valence felt. Probably, this result is due to the fact that the subject could only choose between a limited set of products, without the possibility to search for the most desired products. As a result, the choice was only a sub-optimal choice, even if he/she declared a high involvement in the product.
Finally, the Impulse Buying Tendency is positively related to the physiological index, meaning that subjects with higher impulsive traits felt a higher level of valence when purchasing the product.
Concluding, the predictors of the valence in terms of Pleasantness Index at the moment of purchase are personal traits (BAS and IBT) and the product involvement.

An important consideration is due after the explanation of these linear regression models. As it can be noticed, the predictors for the valence (both self-declared and physiological) are not situational factors (such as the perceived easiness) but are mainly subjects' personal traits and their attention to the mood. Thus, the influence on the pleasure is not much related to external factors but to internal and personal ones. A significant amount of impulse buying research has linked impulse buying to personality traits (Beatty & Ferrell, 1998) (Rook D. W., 1987) (Rook & Fisher, 1995) (Weun, Jones, & Beatty, 1998). Research contends that these personality traits can help determine the degree of a person's IBT, and that a person's IBT is a reliable indicator of impulse-buying behavior (Beatty & Ferrell, 1998) (Rook & Fisher, Normative Influences on Impulsive Buying Behavior, 1995).

This result strengthens the great importance of the cognitive and affective responses.

Self-declared valence and physiological valence

An interesting results that must be highlighted is the absence of significant correlation between the Pleasantness Index, representing the physiological measurement of the valence, and the two variables of Positive and Negative Affect, resulting from the self-declared questionnaire of the

PANAS. This absence of correlation shows a gap between what the subject declared to feel and what has been measured thanks to the EEG.

A possible explanation is the limited sample size, that does not allow to fill the biases that are naturally involved in questionnaires, as they are self-declaration. These biases are especially frequent in case of emotions, as they are not univocally defined, and different people have different level of awareness.

9.4 Physiological variables in the 4 phases of navigation

This analysis deviate from the previous statistical models – that wanted to understand which are the precursors of impulse buying – and aims at providing an explanation of the trend of the Neuroscience indexes during the four phases of the purchasing process.
The most interesting insights can be gained from the analysis of the indexes in the two groups of impulse buyers and non-impulse buyer. It allows to understand the physiological behavior of impulse buyers during the navigation time and the differences with the behavior of non-impulse buyers.

Starting from the EEG indexes, the AI, EI and MI do not show significant differences neither between the four phases nor between the two groups of subjects. The only variable that is totally different both between the phases and between the behaviors is the *Pleasantness Index*. In the group of interest, that is the impulse-buyers one, this index has a very high value in the catch phase, higher than in the purchase phase – in which, instead, the index is negative. It means that when the subject sees the product for the first time, he/she experiences a high level of valence, probably because of the felt attractiveness toward the desired product; at the moment of purchase, instead, the valence decreases and a possible explanation is the rise of feelings of regret, that could be related to the payment and thus to the realization of consuming part of its own limited resources. In Literature, in 2012 Zimmerman stated that impulsive buying behavior is related to anxiety and unhappiness as consumers are purchasing goods without further monetary reasoning; furthermore, a study from Eren, Eroglu & Hacioglu (2012) highlighted that the consequences of impulsive behaviors might cause sufferings for individuals as they purchase goods without further reasoning and beyond their needs or financial limits.
Comparing this index to the trend in group 0 (non-impulse buyers), the PI is negative during all the purchasing process and the higher values – even if still negative – are in the exploration and in the consideration phase. It reveals a more rational behavior, as the subject prefers the more

thoughtful phases of the process, in which he/she explores the products and makes consideration on the purchase.

Moving to the indicator of arousal, the ISCR, the first interesting thing to notice is the pick, for the group of impulse-buyers (group 1), in the catch phase. It reinforces the previous explanation given for the high value of PI in the same phase, thus related to the attractiveness elicited by the product. Furthermore, the lower value of arousal in the purchase phase provides an additional validation.

For group 0, the arousal is much higher in the phase of purchase and, combined with the negative value of valence, highlights a state of emotional stress. It can be explained by the fact that the purchase was in a laboratory setting, that is a controlled environment, and thus not totally free. This unexpected purchase could elicit negative feelings in a subject that is not used to this kind of behavior.

The insights illustrated in this chapter will be resumed in the Managerial Implications in order to take as reference the common behavioral pattern described and identify critical success factors for the online shopping and the online impulse buying behavior.

Part III:

MANAGERIAL IMPLICATIONS

Part III: MANAGERIAL IMPLICATION AND RESEARCH CONTRIBUTION

The objective of this chapter is to draw, from the results previously discussed, conclusions that can be used for future research but also as guidelines for businesses and policy makers in order to trigger and to regulate the online impulse buying behavior.

10. Business applications

The results of this study provide important guidelines for designers of e-commerce and marketers of brands and companies.

Consumer buying on impulse has long been an area of interest for managers; even a small proportion of impulse purchases on each shopping trip can contribute significant annual incremental sales (Rostoks, 2003).

The textbook representation of homo economicus according to which every consumer in a market tends to behave in a perfectly rational way has been widely overpassed. The mind of the customers is in fact much more complex and many different factors influence their decisions, that cannot be reduced to mere rationality (Zaltman, 2003). In this context, products and services are appreciated not only for their functional value, but especially for the emotional, personal, memorable components that define the dimension of experiences (Pine & Gilmore, 1998). For every marketer, therefore, it becomes fundamental to develop a deep, intimate, knowledge of their customers, starting from their emotions and personality traits.

The results of this research confirm this belief, as the triggers for online impulse buying were not situational factors but internal ones, that had a central and double role. Indeed, personality traits were not only the predictors for the impulse buying behavior, but also the main responsible in eliciting the mood, both positive and negative, that influenced the impulse buying.

The identification of an impulse buying segment of customers would be of great importance to retailers that currently rely solely on marketing stimuli. Hence, marketers could identify a distinct impulse buying segment. Identification of the impulse buying–prone customers is possible and appropriate promotional offers could be devised to attract them. As shown by our results, the likelihood of impulse buying is shaped by traits such as impulsivity and other factors

internal to consumers, not as much by readily observable characteristics. Therefore, primary research is required to identify impulse buying customers.

Given these findings, retailers have the opportunity to encourage shoppers with desirable individual difference scores. Indeed, since it is the individual, not the products, who experience the impulse to consume, marketers should identify the impulse buying–prone customers to harness the full power of impulsivity. The profiles of high impulsive or recreational shoppers may be identified, so that promotions and events can be targeted at these individuals.

It is possible to know customers by surveying them, analyzing the types of products they buy, or reviewing the questions they leave on social media. The more is known about the types of products they are most likely to buy, the easier it is to make suggestions and incorporate the tips above to create positive customer experiences.

These are some possible strategies that can elicit impulse buying in these impulsive segments:

1. Use inexpensive products to ask for an upsell. Indeed, the checkout process online is equivalent to waiting in line in a physical store. But instead of getting customers to wait — this is frustrating to customers and hurts the experience — one can add a page of upsells to the checkout process, for example giving the option to add personalized products to their purchase order. Additionally, a timer can be included with the upsell. It is meant to get customers to act immediately rather than say they will come back another time to buy. This adds a sense of urgency that gives customers a few minutes to think about the upsell. It is like recreating the waiting in line experience, where customers have a few minutes to decide whether they will get that pack of gum or not.
2. Make product suggestions that guide customer purchases, acting as a guide during the shopping process. As customers click on products or add items to their carts, similar products at the bottom of product pages are shown. Just like brick-and-mortar stores do with signs and lighting at checkouts, the same idea is used to attract customers to other products. Amazon calls out this section with a headline that reads “Frequently bought together,” which plays up FOMO (fear of missing out) to get customers to buy more. Amazon even includes discounts on the product combinations to encourage customers to buy.
3. Use impulse buying to offset the cost of free shipping. Having a minimum purchase amount in order for customers to qualify for free shipping and reminding them of the offer when they get to checkout is useful to encourage them to add items to their cart to

access the special offer. It is also possible to suggest low-priced items that will get them to the minimum requirement but are actually impulse buys.

4. Promote special discount offers periodically, promoting them through email newsletter specifically targeted for the more impulsive costumers. An image slider can also be used at the top of the homepage to show the offer or highlight certain products.

From the analysis of physiological indexes in the purchasing process of online impulsive buyers, the main result is that their behavior is characterized by a high level of valence and of arousal in the catch phase, that is the first moment in which he/she sees the product. Consequently, it is important for businesses to work on the attractiveness they have, and thus on the ability to elicit a state of excitement at the sight of the product.

One of the most important things to help people truly want to buy a product, increasing on the valence and arousal felt at the moment of first catch, involves using the highest-quality imagery possible. People want to see what they're getting, so if the image is grainy, tiny, or otherwise questionable, they will probably think twice – and that ruins the impulse. Indeed, the image is the first thing a person sees when browsing online shops. Additionally, even if less immediate, another important aspect online for the attractiveness of the product is the description, that should be attractive too, giving importance to the emotional aspect.

Ultimately, marketers should carefully think to the brand image and to the social impact that triggering an online impulse buying behavior might have, hence he/she must choose between making an immediate sale that might produce consumer dissatisfaction and exhibiting concern for the consumer to encourage future patronage. If a brand shows attention toward the negative impact of triggering impulse buying behavior, the brand image can be improved and have a positive impact in the long term. It is a choice: to trigger impulsive purchase, and thus having a positive effect in the short term, or to show attention toward customers' behavior, having a positive effect in the long term.

11. Research applications

Based on the foregoing, consumer impulse buying has long been an area of interest for marketing researchers. Their studies aim at understanding the interrelationship among impulse-

buying and especially how internal and external stimuli related to customers' characteristics and the online environment surrounding the customers, respectively, may prompt and encourage impulse buying. However, the literature review put in evidence that most of the researchers focused their attention on the external stimuli (website, marketing and situational stimuli, as stated above) and considered individual's internal traits in terms of self-declaration. In this respect, although experimental and survey designs are prevalent in the online impulse-buying literature, some researchers have recognized methodological deficits in the capture of actual online impulse-buying behavior. Indeed, responses coming from experimental settings in a controlled laboratory tend to suffer from demand artifacts, meaning that the experimental designs may cause the subject to perceive, interpret, and act upon what he or she believes the experimenters are looking for (Parboteeah, Valacich, & Wells, 2009). Responses collected from self-reported questionnaires are also exposed to the threat of social desirability bias (Rook & Gardner, 1993). Respondents may reply to the questionnaire in a socially desirable way and underreport the level or frequency of their online impulse buying. As such, experimental and survey research designs are arguably insufficient to fully capture online impulse-buying behavior. For these reasons, neurophysiological measures for method triangulation were used in this study and we hope this opens the path to a new stream of research. A neurophysiological approach allows researchers to assess the degree of impulsivity using neurophysiological methods; by combining these approaches with the experiment and survey, more rigorous and objective measurements of online impulse buying behavior can be obtained. In this way, our study fulfils the resulted research gap and contributes knowledge to e-commerce research on impulse buying by emphasizing its relationship with internal psychological determinants. In particular, there is still little understanding of how mood influences online impulse buying behavior, and this is the reason why this research aims to investigate how emotional components (valence and arousal) occur in response to an e-commerce stimulus. Specifically, given the findings in previous literature, we conduct the analysis only on the moods characterized by a high level of arousal, both with positive and negative valence.

Indeed, Beatty and Ferrell (1998) argued that impulse buying behavior relates strongly to positive emotions such that impulse buyers experiencing more positive feelings such as delight consequently, spend more. Nevertheless, Rook and Gardner (1993) acknowledge that negative mood states such as sadness can also be associated with impulse buying. Moreover, other researchers stated that impulse buying can serve to manage or elevate negative mood states but also suggest that this influence occurs through a self-regulatory function (Rook & Gardner,

1993) (Verplanken B. , Herabadi, Perry, & Silvera, 2005). Thus, emotional states—whether positive or negative—likely affect impulse buying, but there is no consensus about whether negative moods, positive moods, or both determine impulse buying. This is the reason behind the choice of focusing on the impact of both positive and negative mood on online impulse buying. However, despite the high expectations towards the validation of positive mood, the experimental results reject our research question, but on the contrary, they confirm what already said in the literature, namely that online impulse buying is elicited by both positive and negative mood (Adelaar, Chang, Lancendorfer, Lee, & Morimoto, 2003).

Since that, the analysis moves towards understanding the main predictors for valence, which are proven to be internal traits, precisely those that are linked to impulse buying by most of the researchers (Beatty & Ferrell, 1998) (Rook D. W., 1987) (Rook & Fisher, 1995) (Weun, Jones, & Beatty, 1998). Thus, it can be concluded that personality traits elicit positive and negative mood that in turn influences impulse buying.

Among these traits, research concentrates on *Impulse Buying Tendency*, considering it as a reliable indicator of impulse-buying behavior since as consumer impulse buying tendency increases, the frequency of their impulse buying increases (Rook & Fisher, 1995). Conversely, our study shows that IBT does not lead to impulse purchases since results show that there is no difference in IBT between impulse buyers and non-impulse buyers. The focus should be instead on other personality traits and in particular, on those related to the two motivational systems: the behavioral inhibition system (BIS), which corresponds to motivation to avoid aversive outcomes, and the behavioral activation system (BAS), which corresponds to motivation to approach goal-oriented outcomes. Indeed, it was found that BIS/BAS influences mood which in turn influences online impulse buying. Alternatively, further research on individual's tendency toward mood repair can be done, since the result of our study shows that the higher a person's conscientiousness, the lower its willingness to buy impulsively.

Furthermore, the analysis of the physiological indexes provides an additional explanation on the online impulse buying, using a consumer neuroscience approach. The results show that the Pleasantness Index is the only one changing between the impulsive and non-impulsive buyers and also between the four phases identified in the purchasing process. It gives an important indication to future studies and research, that is to focus the attention on the PI and to explore more in depth the contribute it gives to the online impulse buying.

12. Societal applications

It is important to discuss the question whether consumers should be protected against impulsivity. Regulation against misleading practices that play on the vulnerabilities of impulsive buyers could be sharpened and that information provision to consumers and retailers aimed at strengthening consumers' self-regulatory capacities may mitigate adverse consequences of impulse buying. Public policy makers might take heed of self-control, norms, and emotions to devise policies to reduce unhealthy impulse buying.

Without proper self-regulation, people can spend a load amount of money on unnecessary items; thus, self-regulation is needed to control urges for impulsive buying and it must be elicited.

According to Zimmerman (2000) in Shirkhani and Ghaemi (2011), self-regulation can be defined as systematic efforts by which an individual strenuously controls behavior in order to reach important objectives. It is also a process that keeps control of cognition and emotions experienced by an individual which are considered as factors influencing the attainment of goals (Tavakolizadeh, Yadollahi, & Poorshafei, 2012). Thus, self-regulation allows an individual to have control over their personal psychological and physiological state (Berdibayeva, et al.).

In 2012, Zimmerman stated that impulsive buying behavior is related to anxiety and unhappiness as consumers are purchasing goods without further monetary reasoning and controlling this behavior could improve an individual's psychological well-being.

The empirical study from Pradipto, Winata, Murti and Azizah (2015) shows that the higher the person's level of self-regulation, the lower the impulsive buying behavior tendency. Therefore, this study also suggests that if people want to diminish their impulsive buying behavior, they should have a high level of self-regulation.

So far, we have addressed impulsive shopping as a relatively innocent consumer behavior. However, impulsive shopping is less innocent if it takes the form of compulsive shopping (d'Astous, 1990) (Desarbo & Edwards, 1996) (Dittmar, 2005a) (Dittmar, 2005b) (Dittmar & Drury, 2000) (Dittmar, Long, & Bond, 2007) (Faber & O'Guinn, 1992) (Faber & O'Guinn, 2008) (Hanley & Wilhelm, 1992) (Kyrios, Frost, & Steketee, 2004) (Mowen & Spears, 1999) (O'Guinn & Faber, 1989) (Roberts, 1998) (Scherhorn, 1990) (Yurchisin & Johnson, 2004) and it deserves a deeper explanation. We are thus entering the arena of psychopathology, where this form of consumer behavior is known as compulsive buying disorder (Black, 2007). Compulsive buying may lead to extreme suffering in the form of financial debt and the disruption of family

life and personal relationships. In sum, previous Literature (O'Guinn & Faber, 1989) (Sun, Wu, & Youn, 2004) (Valence, d' Astous, & Fortier, 1988) (O'Guinn & Faber, 1992) (Billieux, Rochat, Rebetez, & Van der Linded, 2008) (Williamns & Grisham, 2012)) seems to suggest that both impulsive buying and compulsive buying can be traced to the same cardinal psychological traits.

The link between impulse buying and compulsive buying is still not fully clear. However, these results, together with the result of our study and the important role of inner characteristics, warns us and stresses the importance of guidelines set by policy makers to regulate the impulse buying behavior and to work on the traits that are more responsible for it. The main strategies explained in the paragraph of businesses applications must be regulated, starting from the segmentation of the users, with strict regulation on the privacy and the use of data. Moreover, the customer should be made aware of the existence of the impulsive buying phenomenon and the possibility to trigger it, so he/she can recognize and be conscious of this behavioral pattern. Information provision may be a positive step toward mitigating adverse consequences of this consumer style. Such information may aim at strengthening consumers' self-regulation capacities, such as campaigns focusing on monetary prudence, pre-factual thinking, or anticipated regret. Initiatives may also be taken to promote information search and product comparison.

In conclusion, this discussion is useful for institutions, policy makers and consumers. Institutes can educate and demotivate this sort of abnormal buying behavior by educating resulting outcomes. Public policy officials and consumer welfare societies should develop guidelines for marketers and retailers so that they can align their marketing strategies along with some ethical standards. Additionally, suitable social marketing interventions for example counseling and guidance can be formulated in order to tackle increasing ratio of consumer debts because of compulsive buying behavior. Finally, consumers should have knowledge about this abnormal buying behavior and should access either they are going to lack their impulse control or not.

CONCLUSIONS

Impulsivity adds color to life, just as emotions do.
The present thesis tried to join and find a relation between the two, analyzing how the mood influences online impulse buying behavior. The online impulse buying phenomenon has become a more regular occurrence in today's society and it is indeed interesting because it is not only prompted by external, market-related stimuli, but also influenced by a variety of internal psychological factors. After all, nowadays most of the purchases are made according to the affective and emotional components of the consumer (Filser, 1996) (Lichtlé & Plichon, 2005); economic reason and rationality are gradually being replaced by passion and ludic irrationality (Bessouh & Ferouani, 2016) and a cognitively dominated vision, with information management-based models, is turning into to an emotionally dominated one (Piron, 1993). Hence, taking into account the affect and emotions has helped to better understand the online impulsive buying behavior.

Before going into this direction, the online impulse buying phenomenon was vastly explained in terms of definitions, waves of research, perspective, and a Systematic Literature Review on the experimental studies on this phenomenon was then performed, analyzing the main characteristics and findings in previous research.
Following this introduction, a detailed explanation of the consumer neuroscience approach and techniques was provided, together with a deep description of the Literature on the mood. In this regard, embracing this field was not left to chance. People find difficulties in conveying and expressing their emotions in front of a marketing stimuli thus, there was a growing interest in measuring human emotions through their physiological signals in order to avoid the cognitive biases related to self-reported measures. In this way, the neuroscientific tools support the conventional methods of marketing theory (survey, questionnaires, focus groups) and they constitute a complementing advancement for further investigation of emotional states on online impulse buying behavior.

Grounded on such strong initial analysis and with the willingness to fill the main research gap highlighted – that is the little attention given to internal characteristics of the subject - a laboratory experiment was designed and implemented to understand how the mood, and specifically the dimension of valence, influences the online impulse buying.

To elicit the desired moods in participants, the Film/Story MIP was chosen, showing two videos from two famous film (The Dead Poets' Society and American History X) to induce, respectively, the positive and the negative mood. This choice was driven by results of previous research. An online survey for checking the effectiveness of the mood manipulation was created, using the Mehrabian and Russell's scale (1974) to measure the level of valence and arousal. It counted 108 participants and results confirmed the significative difference of mood elicited after the view of the two videos.

The experimental investigation involved 16 subjects interacting with an e-commerce website after the mood induction. The whole setting was able to trigger impulsive urges to buy using actual money that have been earned. Both self-declared variables and physiological ones were measured. Indeed, questionnaires were provided to subjects and their biological response was collected in the form of heart rate, electroencephalogram activity, and electrodermal activity.

Main findings and contribution

Confirming what already stated in literature, the study highlighted the importance of the mood as a precursor of online impulse buying but showed no difference between positive and negative mood. Furthermore, it highlighted the high importance of personal traits as precursors of the mood, thus stressing the internal characteristics of the consumer that is making the purchase rather than situational, and thus external factors. In this respect, although past research denoted Impulse Buying Tendency as a reliable indicator to define impulse buyers, our work outlined a stronger connection between online impulse buying and individual conscientiousness, showing that the more an individual is prone to curb his emotions, the higher the likelihood of incurring in an impulse buying behavior. In addition, the two motivational systems, the behavioral inhibition system (BIS) and the behavioral activation system (BAS) should be considered too. Indeed, it was found that a high general state of anxiety and a high desire for novel rewards are linked to a lower level of valence.

The consumer neuroscience approach that was followed allowed to gain precious insight on the physiological response of subjects during the purchasing process. The most important phase for impulse buyers was the catch, that is the first ocular fixation of the product; it was characterized by both high valence and high arousal. On the basis of such considerations, the main implication of these findings in terms of Literature, business and societal applications were discussed. In particular, in managerial terms, the importance of customer segmentation was stressed, while

the importance of a self-regulatory framework is strengthened in terms of policy makers implications.

Study limitations

All studies have limitations that can impact the findings, and this research is no exception. Moreover, explanations for the limitations could help explain the results and promote opportunity for future research on the influence of the mood on the online impulse buying behavior.

In particular, some sources of weakness could have affected the measurements.

Firstly, in relation to the sample. The limited sample size, due to the dispositions for the covid-19, surely reduced the generalizability of results. A sample of only 16 participants represents a criticality both for the validation of the questionnaires and for the Neuromarketing techniques, even if for these latter there are no constraints defined by the Literature.
Other limitations are related to the characteristics of the experimental group. The study involved subjects younger than 30 years old; it is possible that a more comprehensive group of participants in terms of age would have displayed different behavior. As online shopping is becoming more popular across different age groups, it is worth examining online impulse-buying behavior in a more diverse sample. This would greatly improve the generalizability of the research findings. Furthermore, the subjects of this research are all Italians. The developed research model and research conclusions should be carefully applied to other cultural contexts. A replication of this study utilizing a different sample base would increase the generalizability of the results.

General criticism related a controlled environment has to be taken into account as well. Indeed, a laboratory experiment recreates a simpler setting, and it considers a limited set of variables with respect to a scenario from the actual real-life behavior.

Therefore, future research is needed to confirm the impact of mood on online impulse buying and in which such highlighted limitations might find an answer.

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Appendix A

COSTRUTTO	QUERY
Mehrabian and Russell, 1974	Ogni riga sottostante contiene una coppia di aggettivi. Per ogni coppia, seleziona la casella più vicina all'aggettivo che pensi possa meglio descrivere la tua reazione all'esperienza provata. (es: 1 = Entusiasta; 7 = Calmo) Felice / Infelice Eccitato / Tranquillo Triste / Contento Agitato / Calmo Soddisfatto / Insoddisfatto Seccato / Disteso Quieto / Acceso Assonnato / Perfettamente sveglio Stimolato / Rilassato Lieto / Irritato Avvilito / Speranzoso Fiacco / Frenetico

Money granting task

COSTRUTTO	QUERY
Socio-demographics	1. Genere (Maschio, Femmina, Altro) 2. Età 3. Grado di istruzione più alto conseguito (Nessuno, Scuola elementare, Scuola Media, Diploma, Laurea triennale, Laurea magistrale/master, Dottorato) 4. Tipo di impiego (full-time, part-time, disoccupato, studente, studente lavoratore, altro)
BIS/BAS *(Carver & White, 1994)*	5. Di solito quando penso che mi succederà qualcosa di spiacevole divento ansioso/a.

	6. Mi preoccupo di commettere errori. 7. Le critiche e i rimproveri mi feriscono. 8. Mi sento piuttosto preoccupato/a e emozionato/a quando penso che qualcuno sia arrabbiato con me. 9. Anche se sta per accadermi qualcosa di spiacevole, raramente ho paura o mi sento nervoso/a. 10. Mi sento preoccupato/a quando penso di aver fatto qualcosa in modo inadeguato. 11. In confronto con i miei amici, ho poche paure. 12. Quanto ottengo qualcosa che voglio mi sento eccitato/a e pieno/a di energia. 13. Quando faccio bene qualcosa mi piace continuare a farla. 14. Quando si verificano cose per me positive, il mio stato d'animo ne è molto influenzato. 15. Mi ecciterebbe vincere una gara. 16. Quando mi si presenta l'opportunità di ottenere qualcosa che mi piace, mi eccito subito. 17. Normalmente quando voglio qualcosa faccio tutto quello che posso per ottenerla. 18. Faccio anche l'impossibile per ottenere le cose che voglio. 19. Quando mi capita l'opportunità di ottenere qualcosa che voglio, agisco subito. 20. Quando sto cercando di ottenere qualcosa, non mi preoccupo troppo della correttezza dei metodi che uso. 21. Spesso, faccio delle cose solo perché potrebbero essere divertenti. 22. Ho sempre voglia di eccitazione e di nuove sensazioni. 23. Se penso che una cosa nuova sia divertente, la provo spesso volentieri. 24. Agisco spesso in base all'impulso del momento.
TMMS *(Salovey, Mayer et al., 1995)*	1. Non presto molta attenzione ai miei sentimenti 2. Non cedo mai alle mie emozioni 3. Non si dovrebbe mai essere guidati dalle emozioni 4. Pensare alle proprie emozioni è solitamente una perdita di tempo 5. Le persone starebbero meglio lasciandosi trasportare meno dai sentimenti e pensando di più 6. Credo nell'agire con il cuore

	7. Ho solitamente molto chiari i miei sentimenti 8. Mi sento a mio agio con le mie emozioni 9. Ho molta energia quando sono triste 10. La varietà dei sentimenti dell'uomo rende la vita più interessante 11. Quando sono depresso, non posso fare a meno di avere pensieri negativi 12. Ciò in cui credo e le mie opinioni sembrano cambiare sempre a seconda di come mi sento 13. Sebbene qualche volta sia triste, ho perlopiù una visione ottimista 14. Non importa quanto mi senta male, cerco di pensare a cose piacevoli 15. Quando sono turbato ricordo a me stesso i piaceri della vita 16. Quando sono arrabbiato, cerco di calmarmi 17. Non ho molta energia quando sono felice 18. Se sono in un mood troppo positivo, penso alla realtà per tornare con i piedi per terra

Self-reported survey

COSTRUTTO	**QUERY**
Buying intention	1. Se non avessi avuto questa occasione, avrei acquistato il prodotto selezionato nei prossimi 7 giorni (Per nulla probabile – Decisamente probabile) 2. Se non avessi avuto questa occasione, avrei acquistato il prodotto selezionato nei prossimi 30 giorni (Per nulla probabile – Decisamente probabile)
PANAS *(Watson & Tellegen, 1988)*	Questa scala contiene una serie di parole che descrivono diverse emozioni. Per ognuna di esse indica in che misura rappresenta come ti senti in questo momento. (es: 1 = per niente; 5 = estremamente) 1. Determinato 2. Attivo 3. Interessato 4. Attento

	5. Entusiasta 6. Concentrato 7. Forte 8. Ispirato 9. Eccitato 10. Orgoglioso 11. Impaurito 12. Turbato 13. Nervoso 14. Agitato 15. Spaventato 16. Angosciato 17. Colpevole 18. Vergogna 19. Irritabile 20. Ostile
Product involvement *(Zaichkowsky, J. L. (1985)*	Ogni riga sottostante contiene una coppia di aggettivi. Per ogni coppia, seleziona la casella più vicina all'aggettivo che pensi possa meglio descrivere la tua percezione del prodotto selezionato (es: 1 = Importante; 7 = Irrilevante) 1. Importante – Irrilevante 2. Essenziale - non essenziale 3. Di valore per me – di poco valore per me 4. Significativo – insignificante 5. Inutile - utile 6. Vitale - superfluo 7. Significa molto per me - non significa niente per me 8. Non necessario – necessario
Impulse Buying Tendency *(Rook, D. W., & Fisher, R. J. (1995).*	Indica il tuo grado di accordo con le seguenti affermazioni: 1. Compro spesso cose spontaneamente 2. "Compralo e basta" descrive il modo in cui faccio acquisti 3. Compro spesso cose senza pensare 4. "Lo vedo, quindi lo compro" mi descrive bene 5. "Acquista ora, pensaci più tardi" mi descrive bene 6. A volte ho voglia di comprare un prodotto di impulso

	7. Compro cose secondo come mi sento al momento 8. Pianifico attentamente la maggior parte dei miei acquisti 9. A volte sono un po' sconsiderato su ciò che compro
Online shopping Enjoyment *(Beatty, S. E., & Ferrell, M. E. (1998). Impulse buying: Modeling its precursors. Journal of retailing, 74(2), 169-191.)*	Indica il tuo grado di accordo con le seguenti affermazioni: 1. Fare shopping online è una perdita di tempo 2. Fare shopping online è un modo in cui mi piace passare il tempo libero 3. Fare shopping online è divertente per me 4. Fare shopping online è una delle mie attività preferite
Hedonic Web Browsing *(Park, E. J., Kim, E. Y., Funches, V. M., & Foxx, W. (2012). Apparel product attributes, web browsing, and e-impulse buying on shopping websites. Journal of Business Research, 65(11), 1583-1589.)*	1. Quando navigo su internet mi dimentico dei miei problemi e mi rilasso 2. Esploro i prodotti su internet giusto per divertimento
Instant gratification *(Liu, Y., Li, H., & Hu, F. (2013). Website attributes in urging online impulse purchase: An empirical investigation on consumer perceptions. Decision Support Systems, 55(3), 829-837.)*	Indica il tuo grado di accordo con le seguenti affermazioni: 1. Acquistare online mi porta divertimento immediato. 2. Acquistare online mi crea una sensazione immediata di piacere 3. Mi sento emozionato quando acquisto qualcosa impulsivamente online
Normative evaluation *(Liu, Y., Li, H., & Hu, F. (2013). Website attributes in urging online impulse purchase: An empirical investigation on consumer perceptions. Decision Support Systems, 55(3), 829-837.)*	Come valuti la seguente situazione? Mario visita un sito web dove ha pianificato di acquistare un coupon per un particolare ristorante, ma alla fine acquista coupon di quattro diversi ristoranti. Penso che il comportamento sopra menzionato sia: 1. Inaccettabile – accettabile 2. Per nulla desiderabile – Desiderabile 3. Pazzo - Razionale

Perceived easiness *(Davis, F.D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technologies. MIS Quarterly, 13 (3), 319-340)*	1. La mia interazione con questo sito web è chiara e comprensibile (oppure: come interagire con questo sito web è chiaro e comprensibile) 2. Interagire con questo sito web non richiede un grande impegno mentale 3. Trovo questo sito web facile da usare 4. Trovo facile localizzare le informazioni che mi servono in questo sito web

Post-purchase online survey

COSTRUTTO	**QUERY**
Cognitive dissonance *(Sweeney, J. C., Hausknecht, D., & Soutar, G. N. (2000))*	Dopo aver comprato questo prodotto… 1. Mi sono sentito risentito (*infastidito*) 2. Mi sono sentito arrabbiato 3. Mi sono sentito frustrato 4. Mi sono sentito furioso con me stesso 5. Mi chiedo se ho davvero bisogno di questo prodotto 6. Mi chiedo se ho fatto la scelta giusta acquistando questo prodotto 7. Personalmente mi sento bene per comprato questo prodotto 8. Mi sento in colpa per l'acquisto fatto

Appendix B

Figure 31: Laboratory entrance – welcoming, temperature testing, and hand sanitation

Figure 32: Office 701 – consent form and preliminary questionnaire

Figure 33: PHEEL lab room – experimental protocol

Figure 34: experimental desk - instrumentation

Appendix C

Figure 35: lottery

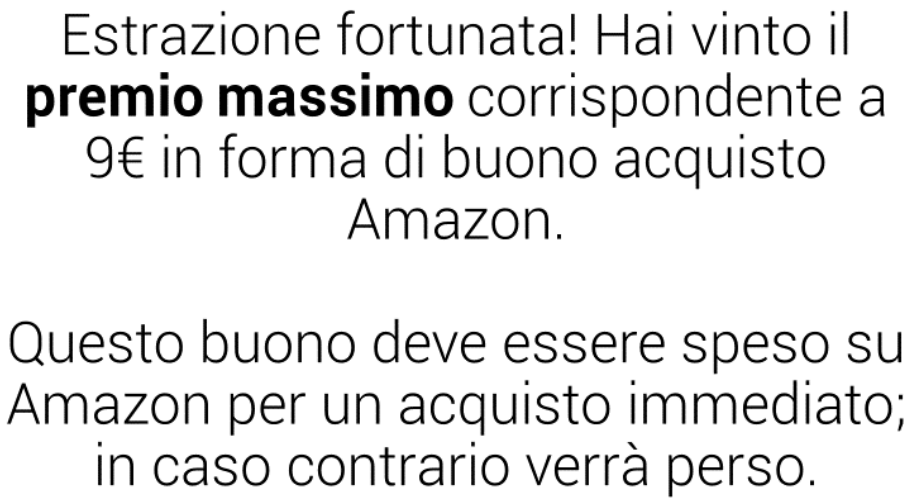

Figure 36: outcome of the lottery for the positive mood

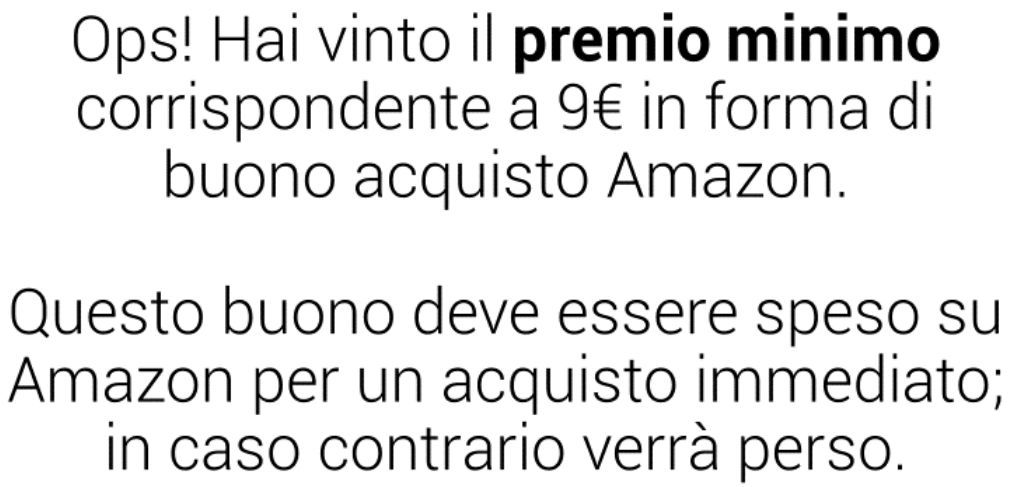

Figure 37: outcome of the lottery for the negative mood