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CONSUMER MOTIVATION FROM A BEHAVIORAL PERSPECTIVE:
INVESTIGATING THE IMPACT OF ANTECEDENT STATES IN
CONSUMPTION SITUATIONS

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Abstract

Marketers and academics have always been interested in studying the proximal controlling factors of consumer behavior. Therefore, a large part of consumer research is focused on studying the consumption situations that influence consumer choice. Motivation is one such antecedent situational factor that is often attributed causality to a host of consumer behaviors. While most cognitive conceptualizations of consumer motivation address the transitory component of motivation, they do not adequately account for the environmental components that encourage/discourage certain behaviors in specific situations. This thesis uses the framework of consumer behavior analysis to provide a functional, behavioral account of consumer motivation to its situational and environmental determinants. The concept of motivating operations provides a behavior-analytic approach to studying the distinct motivating effects of environmental variables. This concept explicitly recognizes the controlling effects of environmental variables in terms of their ability to alter the effectiveness of reinforcers. The main benefit of this approach is that it allows for the direct manipulation of environmental variables that facilitate (or diminish), the likelihood of certain behaviors being performed. More specifically, this thesis focuses on applying the concept of motivating operations to investigate the impact of antecedent states in consumption situations. The broad objectives of this thesis are therefore:

1. To explore whether consumer behavior analysis can be complemented by including a neurophysiological, sub-personal level of analysis of behavior with the super-personal, extensional level. The literature discussed indicates that such an approach can improve the assessment of antecedent situational consumer motivating functions.
2. To provide a process for measuring and analyzing motivating operations of deprivation using a multi-method quantitative approach using eye-tracking and electroencephalography. This is done in a manner consistent with a functional,

approach to consumer behavior. The study empirically verifies the applicability of a multi-method quantitative approach for examining antecedent situational factors like water deprivation.

3. To test the managerial impact of motivating functions and whether donation requests, along with social proof information presented on a self-service kiosk screen, can overcome the attention-narrowing effects experienced during a visceral antecedent state like water deprivation.

The thesis consists of one accepted conceptual study and two published empirical studies. The first study extends the discussion on how extensional consumer behavior analysis can benefit from including a neurophysiological, sub-personal level of analysis. Examples are discussed where companies have successfully used neurophysiological tools in a manner consistent with consumer behavior analysis. The contribution of this interdisciplinary perspective lies in the assessment of covert behaviors to expand contingency knowledge regarding motivating functions and the potential to improve the prediction of future consumer behavior.

In the second study, three experimental sessions are used to propose a multi-method quantitative approach to study antecedent states as motivating functions of consumer behavior. Eye-tracking and electroencephalography are used to assess the motivating functions of water deprivation. The contribution of this study is that it takes these biometric and neurophysiological approaches into the field of consumer behavior analysis and links the resulting responses to the concept of motivating operations for a behavioral interpretation. This approach provides a comprehensive picture of the functional relationship between motivating events, behavior (attention, neural responses, choice, and consumption), and consequences. The study incorporates these tools and the resulting responses into the consumer behavior analysis framework. Such a quantitative multi-method account of

consumer motivating functions has not previously been conducted within consumer behavior analysis.

The third study explores the managerial impact of donation requests on a self-service kiosk screen at the point of purchase. In such situations, consumers are under the influence of a visceral state, such as thirst. Social proof was used as technology-enabled information on a self-service kiosk screen to counter the attention-narrowing effects of visceral states. The results demonstrate that only a high level of social proof related to donation has a positive impact on the likelihood of buying when consumers are in a state of (simulated) thirst. This demonstrates the practical application of consumer behavior analysis principles in terms of manipulating environmental determinants to account for the impact of antecedent situational motivational variables at the point of purchase.

Based on these three studies, this thesis provides a conceptual basis to first combine sub-personal and super-personal levels of analysis within consumer behavior analysis to study motivating functions. Second, it provides a methodological multi-method quantitative approach to measure the impact of motivating functions on attention, neural responses, choice, and consumption. Third, it shows the managerial applicability of consumer behavior analysis in influencing socially relevant behaviors, especially concerning antecedent motivational variables. Taken together, the overall contribution of the thesis is to show how research on antecedent, situational motivational variables can proceed within consumer behavior analysis.

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Chapter 1

Introduction and Overview of Academic Work

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Introduction

Practitioners have regularly manipulated various components of shopping environments to facilitate purchase and consumption behaviors. The impact of such components can be readily assessed in terms of the broader contextual factors. However, studying specific situational variables can greatly enhance the ability to understand, explain, and predict consumer behavior (Belk, 1975b; Stanton & Bonner, 1980). Such situational variables can impact consumers' product preferences, choices, evaluations (Belk, 1974, 1975b); price sensitivity (Wakefield & Inman, 2003); choice of purchase channel (Gehrt & Yan, 2004; Hand et al., 2009; Nicholson et al., 2002); and even the use of in-store technology (Dabholkar & Bagozzi, 2002; Demoulin & Djelassi, 2016; Meuter et al., 2003; Wang et al., 2012). In consumer research, Belk (1974, 1975b) conceptualized situational variables in terms of objective features that characterize a locus in time and space. Such elements include the antecedent internal states that the participant brings into the situation, and the physical elements present there (Belk, 1975a). Some cognitive approaches have tried to incorporate situational factors to enhance the predictive ability of those theories. However, the demands placed on the specificity with which situations need to be described become cumbersome, thereby losing the utility of cognitive approaches (see Foxall, 2002). Since there is no established approach to how situational variables should be examined in consumer research (Belk, 1975a), it is worthwhile to consider alternatives.

Consumer behavior analysis is an interdisciplinary field that investigates consumer choice and the situational factors that influence it (Foxall, 2001). To examine consumption situations from a behavioral perspective, its antecedents are divided into discriminative and motivating variables that influence it (Foxall, 2010). The discriminative stimuli (S^D) set the occasion for reinforcement/punishment contingent on the outcomes of a response, and

motivating operations (MOs) modulate the relationship between the response and reinforcement/punishment (Michael, 1993; Laraway et al., 2003; Catania, 1998). While consumer research has a long tradition of studying antecedents, the functional analysis of motivating operations extends the precision with which behavior contingencies can be included in the explanation of consumer behavior (Fagerstrøm et al., 2010). A behavior-analytic approach to examining motivating variables becomes comprehensive by explicitly recognizing distinct motivating effects, which previously have been underemphasized, and by clarifying the controlling effects of these variables on behavior (Laraway et al., 2003). In addition, conceptual and methodological developments have been made regarding integration with and access to neurophysiological tools and techniques for consumer research and behavior analysis. The tools have enabled the collection of different topographies (forms) of behavior to enable a more detailed analysis of consumer situations. This research investigates how the study of situational motivating factors within consumer behavior analysis can potentially proceed, given the current methodological developments in eye-tracking and electroencephalography.

1.1 Literature Review

1.1.2 Consumer Behavior Analysis for the Study of Situational Factors

An objective approach is favored for the study of situations so as to add to our ability to explain, predict, or alter consumer behavior (Belk, 1975a). This approach is consistent with the interdisciplinary field of consumer behavior analysis, which aims to investigate consumer choice and the situational factors that influence it (Foxall, 2001, 2002). Consumer behavior analysis is based on the functional principles of behavioral research. This differs from the cognitive, structural approach that is dominantly used to study consumer behavior in marketing. Cognitive approaches focus on the mental structures and processes that mediate

the relationship between the stimulus and response (Bray, 2008; Catania, 2013). While cognitive approaches don't deny the role of the environment as the inevitable source of external stimuli, they place more stress on, and devote a greater proportion of their effort to, the investigation of internal stimuli (Foxall, 2005). Many of these cognitive explanatory components (mental constructs) are unobservable (e.g., beliefs, attitudes, and intentions), and are inferred from psychometric measures that serve as behavioral proxies for these intentional variables (Foxall, 2023). The foundational assumption of cognitive approaches is that fundamentally real elements of mental constructs exist that can be accessed and inferred from behavioral measures (Uttal, 1999). From this, it is evident that cognitive approaches, focusing on how abstract mental constructs represent internal mental processes, raise epistemological issues concerning the accessibility of such mental processes and their relationship to the measures of behavioral proxies used. Whereas cognitivists investigate questions of behavioral structure, behavior analysts study the functional relations between behavior and the environment (Catania, 2013). For behavior analysis, the objective is the discovery of laws and principles governing behavior through experimentation (Skinner, 1953). Lawful relationships between behavior and the environment are objective accounts based on observable variables. Behavioral research aims to describe, predict, and control behavior by monitoring the influence of environmental stimuli on behavior and by manipulating these stimuli to maintain or change the behavior (Foxall, 2016). Therefore, for an objective, natural science approach to the study of consumption situations, a behavioral approach, i.e., consumer behavior analysis, is favored over other alternatives and was accordingly chosen as the epistemological basis of this thesis project.

Consumer behavior analysis is based on the principles of behavior analysis. It has demonstrated its utility in both conceptual and empirical research in different areas of marketing, like branding (e.g., Arntzen et al., 2015; Foxall & James, 2003; Foxall, et al.,

2007), price (e.g., Eriksson et al., 2023; Fagerstrøm et al., 2016; Foxall et al., 2007; Sigurdsson et al., 2010), promotion (e.g., Sigurdsson et al., 2010; Sigurdsson et al., 2013), and strategy (e.g., Larsen et al., 2020; Wells et al., 2014). Consumer behavior analysis has also been useful in utilizing behavioral principles to understand and potentially impact socially significant consumption behaviors for social marketing (Foxall et al., 2006). Applied research has demonstrated the utility of consumer behavior analysis for social marketing initiatives and corporate social responsibility (e.g., Eriksson et al., 2023; Fagerstrøm et al., 2015; Fagerstrøm et al., 2019; Ljusic et al., 2022; Ljusic et al., 2023). Therefore, consumer behavior analysis provides marketing with a robust, objective, behavior-environment framework for the examination and interpretation of consumer choice behavior.

Within consumer behavior analysis, the behavioral perspective model has been used as an interpretive device to study consumer behavior. This model enables the behavior analytic interpretation of consumer motivation to its situational determinants using the concept of motivating operations. These will be discussed in detail in the next section.

1.1.3 The Behavioral Perspective Model and Motivating Operations

The behavioral perspective model is an elaboration of the three-term contingency that allows for its application in the consumer domain (Foxall, 1990, 2004). The model serves as an interpretive device designed to capture the essential components of the three-term contingency as it applies to consumer behavior. The setting where consumer choice takes place consists of an assortment of motivating operations and discriminative stimuli that set the scene for consumption. The consumer situation is the confluence of the learning history and the consumer behavior setting, which are the immediate precursors of operant consumer behavior from a behavioral perspective (Foxall, 2016). Consumer behavior settings vary in the degree to which they promote or prevent specific responses. These form a continuum

from relatively open (behavioral options are “open”) to relatively closed (behavioral options are “closed”) (Foxall, 2016). For example, a grocery store offers multiple selection choices and provides no limitation on the time consumers can spend inside. Settings like these, which allow for multiple responses, are considered relatively open settings. On the other hand, a setting like Internet banking that allows for much more restrictive behaviors is considered a relatively closed setting. Another antecedent in the model is the individual consumer’s learned history, or how the individual has performed the discriminating function in the past. Put simply, this consists of what behaviors an individual has performed in the past and the reinforcing and punishing outcomes these have had (Foxall, 2016). The components forming the consumer behavior setting and learning history are thus analyzed in terms of MOs/S^Ds, thus allowing for an objective interpretation of situational factors.

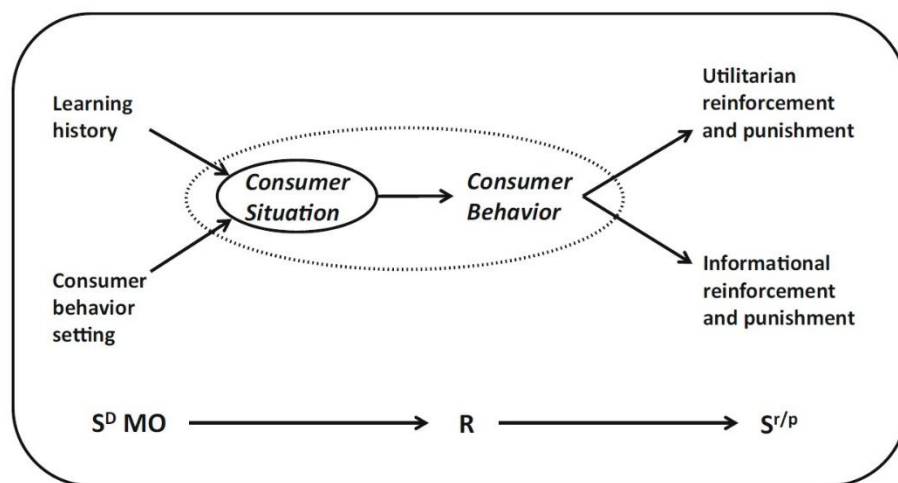


Figure 1: The Behavioral Perspective Model (Foxall, 2016)

The consequent conditions of the behavioral perspective model are defined in terms of utilitarian and informational sources of reinforcement and punishment. Some consequences result in similar responses becoming more frequent and are thus named reinforcers (S^r); other consequences, known as punishers (S^p) decrease the probability of similar responses in the

future (Fagerstrøm & Arntzen, 2013). Utilitarian reinforcement consists of the purely functional benefits derived from the act of consumption. These reinforcers are associated with the technical and operational qualities of the item (Foxall, 2016). Informational reinforcers are socially mediated and consist of performance feedback on the consumer behavior in question or any other behaviors instrumental in making such behavior possible (Foxall, 2016). Utilitarian punishment is related to the costs incurred during consumption, relinquishing money, time-consuming registration before payment when shopping on the Internet, forgoing alternative products, and so on (Fagerstrøm et al., 2010). Informational punishment is socially mediated aversive consequences of consumer choice. These produce negative social attention and disapproval within the social network of the consumer (Fagerstrøm et al., 2010).

Motivating operations (MO) are any environmental event that first establishes (or abolishes) the reinforcing or punishing effect of another event and, second, evokes (or abates) behaviors related with that event (Laraway et al., 2003). Thus, an MO has two main effects; first, it establishes or abolishes the reinforcing (or punishing) effect of another event (the value-altering effect), and second, it evokes (or abates) behaviors related with that event (the behavior-altering effect). The term “establishing operation” refers to motivating operations that increase the reinforcing or punishing effectiveness of other events. The term “abolishing operation” refers to motivating operations which have the reverse effect of establishing operations. In other words, they reduce the effectiveness of other events to function as reinforcers or punishers. For instance, water deprivation should have an establishing effect on the utilitarian reinforcing consequences of drinking water. Drinking water will have an abolishing effect and reduce the effectiveness of water as a utilitarian reinforcer. Table 1.1 below provides examples of the value-altering effects of MOs in different consumer situations.

Value-altering effects of MOs		
Consequences of consumption	Establishing operations	Abolishing operations
Utilitarian reinforcement	Water deprivation has an establishing effect on the reinforcing consequence of buying and drinking bottled water.	Satiation has an abolishing effect on the reinforcing consequence of buying and drinking bottled water.
Utilitarian punishment	Limited time availability may have an establishing effect on the punishing consequences of spending time for first-time user registration for an online shopping situation.	Unlimited time availability may have an abolishing effect on the punishing consequences of spending time on first-time user registration for an online shopping situation.
Informational reinforcement	Social recognition has an establishing effect on the reinforcing consequences of buying and using a luxury car.	When many consumers own a specific luxury car model, it may have an abolishing effect on buying the same luxury car model as everyone else.
Informational punishment	Societal attention towards the adverse health effects of smoking may have an establishing effect on the punishing consequences of buying and smoking cigarettes.	“Cheat days” have an abolishing effect on the punishing health consequences of buying and eating excess junk food.

The MO concept, initially developed by Michael (1982, 1993, 2000), has made important contributions to the analysis of behavior in many different fields and contexts (see Iwata et al., 2000; Langthorne & McGill, 2009; Laraway et al., 2014; McGill, 1999; Tapper, 2005), demonstrating its utility for the functional analysis of behavior. MO has been stated as an empirical and testable concept, useful for (a) describing, predicting, and changing behavior; and (b) being precise, coherent, and parsimonious (Laraway et al., 2014). The pragmatic value of the MO concept lies in its focus on quantifiable environmental changes as primary determinants of the phenomenon of interest (i.e., reinforcer effectiveness), which is consistent with traditional behavior-analytic approaches and suggests strategies for applied

interventions (Poling et al., 2017). The benefit of using the MO concept is that it offers a comprehensive framework for studying consumer choice by investigating antecedent stimuli that alter the values of consequences of responding, and to alter the responses related to those consequences (Fagerstrøm et al., 2010). It provides a functional approach to the objective study of consumer motivation in relation to its situational determinants.

Fagerstrøm, Foxall, and Arntzen (2010) conceptually integrated MO into the BPM, thereby formally introducing the concept into the field of consumer behavior analysis. In a subsequent study, Fagerstrøm (2010) investigated the relative influence of antecedent stimuli on a web shop (i.e., in-stock status, price, customer reviews, order confirmation procedures, and donation of some part of the purchase price to charity) that functioned as MOs in an online setting using conjoint analysis. Self-reported likelihood to purchase was used as a dependent measure in a simulated online shopping task. In another conjoint study, Fagerstrøm and Ghinea (2011) studied the impact of price relative to reviews that might function as MOs at the point of online purchase. Like the previous study, a simulated online shopping task measured self-reported purchase intention. Fagerstrøm, Stratton, and Foxall (2015) used conjoint analysis to examine product attributes (quality and washing temperature), brand, price, and corporate social responsibility activity, which likely functioned as MOs in a purchasing situation for workout clothing. The dependent measure was self-reported purchase intentions. These studies demonstrate that conjoint analysis, a technique employed from marketing research, can be useful in assessing the impact of MOs at the point of purchase using scenario-based descriptions of purchase situations. Using this approach, it is possible to assess which antecedent stimuli are likely to function as MOs given the multiple attributes encountered during a purchase situation.

Sigurdsson, Engilbertsson, and Foxall (2010) examined the influence of an in-store display at the point of purchase on unit sales of dishwashing liquid. The display was intended

to function as an MO by altering the product's image (highlighting the improved durability and quality of the product). The display was tested in two convenience stores and two supermarkets, and the dependent measure was the relative sales of the target brand against the sales of all other detergents. The in-store display did not impact consumer choice; thus, the intervention did not affect the dependent measure used in the study. Sigurdsson, Larsen, and Gunnarsson (2011) utilized an in-store field experiment to promote the consumption of fruits and vegetables. The field experiment consisted of three interventions: placing bananas at the checkout, placing the bananas on the candy shelf, and a mix of the first two interventions in addition to a relevant advertisement. The advertisement highlighted that healthy products were made cheaper by the retailer and was intended to function as an MO for consumers. The dependent measures were a survey and in-store observation. The survey demonstrated that consumers were positive towards consuming fruits and vegetables and intended to buy them. However, observable behavioral measures (noticing, stopping, evaluating, and purchasing) were inconsistent with the results of the survey. Therefore, for interventional field studies, it might be preferable to assess the impact of relevant MOs in controlled settings first. In addition, overt responses might not be present (or might be latent) in the situations that were examined. The research reviewed here has demonstrated the application of motivating operations to consumer behavior analysis. Empirical work has predominantly been conducted using conjoint analysis (e.g., Fagerstrom, 2010; Fagerstrøm & Ghinea, 2011; Fagerstrøm, Stratton, and Foxall, 2015) and field experiments (Sigurdsson, Engilbertsson, and Foxall 2010; Sigurdsson, Larsen, and Gunnarsson 2011).

It has been suggested that examining changes at the physiological level can be used to predict reinforcer effectiveness and might extend the scope and value of the MO concept (Poling et al., 2017). Therefore, this thesis investigates whether the MO concept is suitable to integrate covert responses, at a physiological or neurophysiological level in the functional

analysis of consumer behavior. In addition, the behavioral perspective model has previously been discussed with reference to the inclusion of neurophysiological measures and how they can provide confirmation or disconfirmation of other levels of analysis (see Foxall, 2023). Searching databases of EBSCO (Business Source Premier), ABI/Inform (ProQuest), Web of Science, and Google Scholar, did not yield any study that has tried to link the concept of MO, using multi-method quantitative approaches, with eye-tracking and EEG to study consumer motivating functions.

For this thesis, the terms motivating operations and motivating functions are used and need to be clarified. Motivating operations is the proper conceptual form, used to explain the nature, impact, and direction of the controlling stimulus variables. The term motivating function is used for practical purposes, to specify the existence of a functional relationship between the behavior and the establishing and abolishing operations controlling it. Motivating functions is also the preferred term when introducing the MO concept to an audience unfamiliar with behavioral analysis (e.g., Fagerstrøm et al., 2010). This was the rationale for using these terms in Study I and Study II.

To examine how neurophysiological measurements can be included in consumer behavior analysis, the next section will summarize the broader discussion on the integration of behavioral analysis with neurophysiology to discuss how neurophysiological measures be included in consumer behavior analysis, especially in a manner consistent with a behavioral approach. Recent publications have highlighted possible avenues for interdisciplinary collaboration and have specified how neural responses can be successfully used for the functional analysis of behavior.

1.1.4 Integrating Neuroscientific Measures into Consumer Behavior Analysis

There have been several publications that have dealt with the idea of synthesizing neuroscience with behavior analysis (e.g., Donahoe, 2002, 2017; Ortu & Vaidya, 2016). There is a common notion that behavior analysis and neuroscience are not compatible. This belief rests on opinions regarding the nature of the relationship between behavior analysis and biology. There is no suspicion regarding the status of neuroscience as a sub-discipline of biology. However, opinions are divided in the case of behavioral analysis. In some cases, behavior analysis is considered a branch of psychology and, therefore, unrelated to biology (e.g., Reese, 1996a, 1996b). In other cases, behavior analysis is often considered an independent branch of biological sciences, as it studies behaviors exemplified by living organisms (e.g., Donahoe, 1996; Poling & Byrne, 1996). As a result, these two lines of thought are used by academics depending on their stance, on whether it would be beneficial to include or to ignore physiological processes in the experimental analysis of behavior. Such discussions are helpful for the overall development of the field. For interdisciplinary collaborations, like the one presented in this thesis, there is an inherent assumption that the connections between behavior analysis and another branch of science are complementary. Therefore, this debate is not pursued to a greater depth within this project.

A common concern is that the inclusion of neurophysiology would compromise the *independence* of behavior analysis or that it would take an extreme reductionist perspective on behavior (Donahoe, 1996). For this to be possible, many levels of analysis will need to be omitted or ignored. However, we simply do not have all the information that is needed to reduce behavior to a simple set of neural processes. Instead, there have been (and will continue to be) specific instances when enough is known about neurobiological and behavioral phenomena to integrate levels successfully (Timberlake et al., 2005). Any

knowledge developed experimentally within neuroscience can sometimes add to our understanding of behavior in unexpected ways; however, this does not disapprove or change the core tenets of behavioral theory (Baer, 1996). Moore (1997, 2002) illustrates this point by stating that each science can inform the other in a characteristic way but are not necessary to validate any explanations in the other discipline. There is no doubt that both fields are independent, but together they can contribute to a better explanation of behavior (Moore, 2002; Zilio, 2013). Therefore, the integration of the experimental analysis of behavior and neurophysiology in no way undermines the independence of behavior analysis (Donahoe et al., 1993). The experimental analysis of the neurosciences does not replace, but rather supplements, the experimental analysis of behavior (Donahoe et al., 1993). This is the approach advocated in two of the studies in this thesis. Including data at the physiological level offers an additional data source, providing a supplementary function to the existing, familiar, dependent variables used in behavior analysis. Neurophysiological methods enable the collection of neural-level data to improve the study of antecedent motivational factors in consumer behavior analysis by enabling the collection of an additional data source.

Skinner was never against biology or even neuroscience, but his views on these topics have been greatly misunderstood (Morris et al., 2004; Zilio, 2013, 2016b). Skinner did not criticize neuroscience, but the misuse of pseudo-physiological theories in the explanation of behavior (Zilio, 2016b). Therefore, he pushed toward an independent science of behavior, emphasizing that no functional relation uncovered at the behavioral level can ever be undermined by findings at the neural level (Donahoe, 1996). As a result, he argued that behavior is not to be treated merely as evidence for inferences about entities from neural, mental, or conceptual dimensions and that such entities are not to be given special causal status (Moore, 1997). An important point here is that Skinner's stance was based on strategic and pragmatic considerations and not on principled reservations about the potential relevance

of physiology to behavior, or, of behavior to physiology (Donahoe et al., 1993). While it is not necessary for behavior scientists to include physiological processes in their analysis, there is no evidence to justify the strong resistance to physiology relevant to the study of behavior (Moore, 1997; Poling & Byrne, 1996). In some cases, it might prove to be fruitful as the field of neuroscience has progressed greatly since the days when B. F. Skinner developed his ideas (Zilio, 2016a). As neurophysiological tools have improved and become more accessible, many fields of research (e.g., consumer research, economics, etc.) have adopted neurophysiological tools for practical reasons. For consumer behavior analysis, there is no substantial justification for resisting the inclusion of neurophysiological level data if it helps improve the analyses of functional relationships. This argument is discussed in greater detail in the following paragraph.

At the very broad level, attempts at interdependence between behavior analysis and other sciences can exist at two levels: theoretical (interpretive) and experimental (Donahoe, 1996). Currently, neuroscience cannot provide adequate explanations of behavior by itself, simply due to incomplete knowledge about functional brain-behavior relationships. While some functions might be known, other and more complex interactions between different neurobiological components are still unclear. Additionally, the field of neuroscience deals with the functioning of neurobiological systems in organisms, where explanation and interpretation rely heavily on (observable) structural connections between brain regions. Experimental evidence constantly changes (structural, cognitive) theories about the brain's workings. Thus, neuroscience cannot provide acceptable explanations or interpretations about behavior without resorting to structural and/or reductionist descriptions of behavior. In behavior analysis, explanation is the same as description, or more precisely, explaining a phenomenon means describing a functional analysis of the phenomena (Reese, 1996a). Therefore, behavior-analytic *explanations* remain at the level of behavior (Moore, 1997).

Behavior analytic *interpretations* traditionally account for behavioral events in terms such as discriminative stimuli, responses, and reinforcers, but without necessarily identifying those elements through controlled, formal experimental analysis (Moore, 1997). Behavior analytic interpretations assign logic and give meaning to the concepts under consideration. This implies that any experimentally derived insights only act as evidence (either for or against), but do not change the core proposition of a theory. Thus, the basic theoretical proposition of behavior analysis is that a response is controlled by its consequence and will remain true in the organism's future and has been true in the organism's past (Baer, 1996). Therefore, due to such underlying differences, it has proven difficult to integrate behavior analysis and neuroscience at a purely theoretical level. While this discussion falls outside the scope of this thesis, integration at an empirical level is a much more feasible endeavor. This will be discussed in the next paragraph.

Behavioral analysis examines the functional relationships between observable behavior and the environment. Whether these relationships exist within the skin and/or outside it, biological techniques act as an enabling factor to investigate previously inaccessible behaviors and relationships to environments (Baer, 1996). The most favored approach is incorporating neural responses within a behavioral framework, not as underlying or explanatory mechanisms but as behavioral events (Barnes-Holmes, 2003; Ortu & Vaidya, 2016). These neural responses must be consistent with the orderly functional relations identified at the behavioral level, otherwise analyses at the neural level are either incorrect or incomplete (Donahoe, 1996). Neural responses are treated as any other form of response as measured by behavior analysts, as long as they show sensitivity toward antecedent and consequential manipulations (Ortu & Vaidya, 2016). Thus, neural responses are not being analyzed at the biological or chemical level, but at the behavioral level (Barnes-Holmes, 2003). This strategy stresses the purely pragmatic benefits of including neural responses. The

explanation of behavior is still centered in the theories of behavioral science, and therefore, neural responses do not logically validate the explanation of behavior (Moore, 2002).

Neuroscientific tools just allow for better predictions based on the measurement of neural responses that are functionally related to behavior (Moore, 1997). Neuroscientific tools simply enable the measurement of these behavioral events. This forms the basis of argumentation to include neural activity in consumer behavior analysis in Study I and forms the basis of the empirical approach taken in Study II, enabling a measure of integration among neural and extensional levels without compromising explanatory independence (see Foxall 2024).

This thesis attempts to form a bridge between these two different subfields while placing emphasis on the concept of motivating operations within consumer research. More specifically, it aims to show how research on antecedent motivational variables can potentially proceed within consumer behavior analysis. It especially focuses on using a quantitative multi-method approach, which includes eye-tracking and electroencephalography (EEG) with other behavioral measures, to study the effects of motivating factors like deprivation. The choice of research methods can be divided into mono-method or multiple methods. Mono-method refers to the use of a single data collection technique and corresponding analysis, and multiple methods (or multi-method) refers to the use of more than one data collection technique and corresponding analysis (Saunders et al., 2009). These are restricted within either a quantitative or qualitative worldview (Tashakkori & Teddlie, 2003). Thus, a multi-method quantitative approach refers to the use of more than one quantitative data collection technique and corresponding quantitative analysis procedure or procedures (Saunders et al., 2009). Multi-method approaches provide opportunities for triangulated measurement by means of cross-method comparisons, thereby improving internal validity (Brewer & Hunter, 2006). In this thesis, deductive, quantitative multi-

method (Study II), and mono-method (Study III) positivist approaches are used, with the benefits previously discussed as being objective and pragmatic. The empirical focus has been on motivating functions of deprivation because deprivation of water (or food) is a common situational factor in consumption contexts (Study III) and is one of the most well-discussed motivating operations in behavior analysis (see Study II).

1.2 Aims and Objectives of the Thesis

The overall aim of this thesis is to advance research on antecedent situational factors in consumer research (Studies II and III), especially using a consumer behavior analysis approach (Studies I-III). The focus is on consumer motivating functions and how to study them using a quantitative multi-method approach that is increasingly being favored by marketing academics and practitioners (Studies I and II). In addition, it investigates the impact of deprivation on consumer behavior using a controlled experimental approach (Study II) and a retail-inspired situation (Study III). The specific objectives of the individual studies are as follows.

Study I

1. Discuss the benefits of including neurophysiological measures in consumer behavior analysis to examine the covert, sub-personal level responses.
2. Introduce neurophysiological tools currently used within consumer research.
3. Discuss and suggest how neurophysiological, sub-personal level responses can be included in a behavioral framework.
4. Introduce and connect the neurophysiological measure of frontal EEG asymmetry with the motivating operations concept.

Study II

1. Review literature on water deprivation as an antecedent motivating operation.
Examine behavior analysis strategies on how to experimentally manipulate water deprivation in controlled settings.
2. Provide a quantitative multi-method experimental procedure to measure the impact of water deprivation on different topographies of behavior (attention, neural responses, choice, and consumption) with regard to consumer behavior in a manner consistent with consumer behavior analysis.
3. Test the applicability of a quantitative multi-method approach for empirically examining antecedent motivational situational factors like deprivation.
4. Empirically test the impact of water deprivation as motivating operation on fixation count, average fixation duration, frontal EEG asymmetry, clicking behavior, and actual water consumption.

Study III

1. Explore the managerial impact of motivating functions of deprivation in terms of how the influence of motivating functions (deprivation) can be mitigated using in-store kiosks.
2. Explore literature on how antecedent, situational, visceral states (simulated thirst) can influence the relationship between donation behavior and social proof indicators.
3. Empirically test using conjoint analysis, how social proof indicators (presented on a self-service kiosk screen) impact the likelihood to buy a product that includes a small donation amount in the final price at checkout, when consumers are in a state of simulated thirst.

1.3 Overview of Studies

This section presents an overview of the three studies included in the thesis (see Table 1.2 below). The table provides an overview of the type of study, the intended audience, and the status.

Table 1.2: Overview of studies in the thesis

Study	Type	Intended audience	Status
I	Conceptual Advocacy Study: This study argues for integrating extensional consumer behavior analysis with sub-personal, neurophysiological levels of analysis.	This study's intended audience is marketing firms interested in using neurophysiological tools to improve the prediction of consumer behaviors using a behavioral approach.	Accepted chapter. Pawar, S., Sigurdsson, V. & Fagerstrøm, A., (2025). The Marketing Firm and the Consumerate: Predicting Motivating Functions Using Neurophysiology. <i>The Marketing Firm, Volume II - Consumer Behaviour Analysis</i> , Palgrave MacMillan
II	Experimental Laboratory Study: This study utilizes a quantitative multi-method experimental approach to examine whether the motivating functions of deprivation can be measured using eye-tracking and electroencephalography.	The intended audience for this study is academics and practitioners working in consumer behavior analysis who are interested in experimental research to study consumer motivating functions in retail using a quantitative multi-method approach that includes eye-tracking and EEG.	Published article. Pawar, S., Fagerstrøm, A., Sigurdsson, V., & Arntzen, E. (2023). "Analyzing motivating functions of consumer behavior: Evidence from attention and neural responses to choices and consumption." <i>Frontiers in Psychology</i> , 14, 1053528.
III	Managerial Conjoint Study: This study utilizes conjoint analysis to examine how the undesirable impact of visceral states, like deprivation, on checkout donation requests can be mitigated using social proof on self-service kiosk screens.	This study's intended audience is industry managers using self-service kiosks to deliver their cause-related marketing initiatives.	Published article. Pawar, S., Fagerstrøm, A., & Sigurdsson, V. (2020). "An Explorative Study of How Visceral States Influence the Relationship between Social Proof Heuristics and Donation Behavior When Consumers Are Using Self-Service Kiosks." <i>Sustainability</i> , 12(22), 9477.

1.4 Summary and Contribution of the Studies

This section provides a summary and brief presentation of the studies' contributions. Due to the nature of published research, each is necessarily bound by its context and the

space constraints given by the publication outlet. These contributions will be brought up again in the last section and later discussed within the broader context of the thesis topic.

1.5.1 Study I - Conceptual Advocacy Study

The first study, “The Marketing Firm and the Consumerate: Predicting Motivating Functions Using Neurophysiology,” co-authored with Valdimar Sigurdsson and Asle Fagerstrøm, has been accepted as a chapter for the book: *The Marketing Firm, Volume II - Consumer Behaviour Analysis*, published by Palgrave MacMillan. This chapter describes how the study of motivating operations within the field of consumer behavior analysis can benefit from the inclusion of neurophysiological data in accessing covert responses to improve the predictability of behavior. The chapter begins by discussing the different levels of explanation used in consumer research with a greater emphasis on the sub-personal, neurophysiological level. The chapter introduces neurophysiological tools like functional magnetic resonance imaging and electroencephalography. This is followed by an approach to include neurophysiological responses in a behavioral framework as operant behavioral events. Building on this, the neurophysiological measure, frontal EEG asymmetry, is presented and linked to the concept of motivating operations (Laraway et al., 2003), and its usefulness to predict covert consumer responses in terms of approach-avoidance motivation is briefly discussed. The chapter concludes with a case study showing how a firm used neurophysiological tools to understand the intra-personal bilateral contingencies (Foxall, 2021) of consumers to create marketing intelligence.

Neurophysiological tools can supplement behavior analytic stances by making covert behaviors more accessible and improving predictability, enabling us to fill some of the temporal gaps in assessments of behavior. Motivating functions integration with frontal EEG asymmetry was demonstrated. Overall, the sub-personal level of analyses shows promise

when combined with consumer behavior analysis, either for the identification of proximal controlling functions or for the prediction of the targeted behavioral responses.

Study I primarily contributes by conceptually bridging the concepts of motivating operations from consumer behavior analysis and the neurophysiological measure of frontal EEG asymmetry to predict covert responses for marketing intelligence. This is a novel approach since motivating operations and frontal EEG asymmetry have been used in consumer research independently, but not discussed in conjunction. The main benefit of this combination is that the motivating operations concept can bring more precision in terms of a systematic framework for consumer research, using frontal EEG asymmetry, focusing on the consumption environment. The contribution of this perspective lies in the assessment of covert behaviors to expand contingency knowledge regarding motivating functions and the potential to improve the prediction of future consumer behavior.

1.4.2 Study II – Experimental Laboratory Study

The second study, “Analyzing Motivating Functions of Consumer Behavior: Evidence from Attention and Neural Responses to Choices and Consumption,” co-authored with Asle Fagerstrøm, Valdimar Sigurdsson, and Erik Arntzen, was published in *Frontiers in Psychology* in 2023. The purpose of this paper was to empirically test and provide a procedure to test the impact of water deprivation as a motivating operation on fixation count, average fixation duration, frontal EEG asymmetry, clicking behavior, and actual consumption of water. The concept of motivating operations (Laraway et al., 2003) was used to conceptualize and empirically assess the relationship between situational antecedent events and motivating functions of consumer behaviors. The paper utilizes three laboratory experimental sessions and discusses a deprivation manipulation protocol based on previous literature. This aligns with Belk’s (1975b) suggestion for situational research, where the

recommendation is to manipulate the situational factors under study. A multi-method quantitative approach was used with eye-tracking and EEG tools. This should not be confused with a mixed methods approach where qualitative and quantitative data collection and analysis techniques are used (Tashakkori & Teddlie, 2021). The results provide a glimpse into the potential application of a multi-method quantitative approach using neurophysiological tools in consumer research. The procedure provides a detailed picture of the functional relationship between motivating events, behavior (attention, neural responses, choice, consumption), and consequences.

Study II provides a methodological contribution in terms of a quantitative multi-method, interdisciplinary approach to combine motivating operations from consumer behavior analysis and frontal EEG asymmetry measure from neuroscience. The study takes eye-tracking and frontal EEG asymmetry into consumer behavior analysis and links the resulting responses to the concept of motivating operations for a behavioral interpretation. This approach provided a comprehensive picture of the functional relationship between motivating events, behavior (attention, neural responses, choice, and consumption), and consequences, by using a quantitative multi-method experimental approach. Another contribution is the account presented in the study to streamline consumer research on motivating functions that utilize multiple methods. In doing so, this study provides a starting point for future studies on consumer motivating functions using multiple methods. A minor contribution was that the study was able to demonstrate the MO effects on actual human participants (and not animals) with regard to water deprivation, especially from a consumer behavior analysis perspective. The methodological approach in this study should prove attractive for researchers and practitioners studying consumer motivating functions in retail settings or other relevant consumer settings.

1.4.3 Study III – Managerial Conjoint Study

The third study, “An explorative study of how visceral states influence the relationship between social proof heuristics and donation behavior when consumers are using self-service kiosks,” co-authored with Asle Fagerstrøm and Valdimar Sigurdsson, was published in *Sustainability* in 2020. The purpose of the paper was to explore the impact of situational visceral states on social proof and donation behavior in the context of consumers using a self-service kiosk. The paper utilizes a conjoint analysis conducted to explore this relationship. Conjoint analysis has been cited as a robust method to study the impact of situational variables (Green & Srinivasan, 1978). Relevant attributes were social proof heuristic, price format, and cause proximity. The dependent variable was the likelihood to buy a product that included a small donation amount in the final price at checkout on a self-service kiosk screen. The participants were presented with a scenario to simulate the visceral state of thirst. The results (n=83) indicate that, in a visceral state situation, only a high level of social proof related to donation has a positive impact on the likelihood to buy. Any other level of social proof (medium, low, and not mentioned) decreases the likelihood to buy in such situations. Marketers already engage in cause-related marketing to pair up with beneficial causes. However, antecedent situational variables like visceral states should be considered when employing cause-related marketing activities on self-service technologies.

The aim was to demonstrate the practical application of applied consumer behavior analysis principles in manipulating environmental determinants to account for the impact of antecedent motivational variables at the point of purchase. The study contributes to the knowledge of visceral states and how their attention-narrowing effects can be mitigated using high-level social proof heuristics on self-service kiosk screens. Since this is an exploratory study, the main contribution is in terms of testing the feasibility of the use of technology-

enabled information regarding the promotion of donation behavior. Another contribution is that the study demonstrated that conjoint analysis is a suitable method to test the impact of point-of-purchase interventions using self-service kiosks, laying the groundwork for future research to progress and build on this exploratory study.

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Chapter 2

The Marketing Firm and the Consumerate:

Predicting Motivating Functions Using Neurophysiology

Accepted for Case Histories of the Marketing Firm, Palgrave Macmillan

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Abstract

The marketing firm places a strong focus on understanding and satisfying its consumerate. The primary aim of the current chapter is to examine how neurophysiological methods can work with behavior analytical techniques to enable a more comprehensive analysis of complex *consumer-situation* precursors of consumer behavior. This chapter discusses how the neurophysiological stance can supplement behavior analytical stances in consumer behavior analysis. We discuss how, and to what extent, it is possible to integrate the extensional, super-personal approach, with the sub-personal, given the current developments in neurophysiological technology. The contributions lie in the potential of neurophysiological analyses to expand contingency knowledge in complex environments, by measuring covert responses and improving the predictability of future behavior. Such a synthesis needs to be explored to understand the motivating functions of the consumer behavior setting. The chapter concludes with an examination of the case of Frito-Lay where neurophysiological tools were used in conjunction with traditional marketing research techniques to understand the bilateral contingency of women's intra-personal conflicts regarding snacking behavior.

2.1 Introduction

The theory of the marketing firm seeks to understand the implications for the view of the firm as a response to the imperatives of consumer-orientation (Foxall, 2021). It highlights that an understanding of consumer behavior is central to marketing-oriented management. This theory of the firm enables such a consumer-aligned approach because it is based on the Behavioural Perspective Model (BPM: Foxall, 2004, 2007) of consumer choice, which proceeds in similar terms. The current chapter focuses on exploring the effects of consumer-situations in the context of the marketing firm: the immediate precursor of consumer behavior, by using a combination of neurophysiological and consumer behavior analysis approaches. The focus on the consumer-situation enables an explanation of consumer

behavior contextually. Such contextual focus helps marketers to better operationalize and manage the antecedent stimuli in consumer behavior settings. For contextual explanations, the extensional consumer-situation is given precedence over other levels of analysis. The extensional consumer-situation is the outcome of the interaction between the consumer's learning history, particularly their consumption history, and the stimulus field presented by the consumer behavior setting they currently face (Foxall, 2021). The consumer behavior setting comprises of discriminative stimuli (SD) and motivating operations (MOs) that set the occasion for utilitarian and informational reinforcement and punishment. The marketing firm has a vested interest in examining these antecedent SDs and MOs to improve marketing operations relating to market research and intelligence undertaken by the firm. Market research and intelligence play a vital role in management of the marketing mixes offered to specific consumer segments (or micro-consumers).

To better serve different consumer segments, the firm needs to understand the impact of different motivating operations on consumers. Many consumers experience friction between short- and long-range interests regarding food and exercise. These conflicts can profoundly impact consumers in terms of the products and brands they include in their consideration set for eventual purchase and consumption. Such intra-personal conflicts experienced by the consumer can be thought of in terms of a bilateral contingency linking two diametrically opposed kinds of self-interest (Foxall, 2021). Each of these interests can be envisaged as an agent whose behavior is shaped by a three-term contingency that is enmeshed with that which shapes the behavior of the converse agent (Foxall, 2021). The marketing firm theory is founded on functional analysis that describes the bilateral contingencies using the three-term contingency (SD/MO $\rightarrow$ R $\rightarrow$ SR). Within the three-term relationship, MO is motivating operations that have a motivating function, SD is a discriminative stimulus or cue that signals the consequences resulting from the performance of a specific response, R is a

response, and SR is a reinforcing stimulus. The reinforcing consequences (SR) are likely to increase the possibility of similar responses in the future (Fagerstrøm et al., 2020).

Examining different levels of consumer behavior can help firms gain a better understanding of these intra-personal bilateral contingencies. Some companies are applying neurophysiological tools to gain insights into consumers' intra-personal conflicts to better service the micro-consumer segments and improve the sale of products and services offered by the firm. This chapter concludes with a case study of Frito-Lay, which has been examining the application of neurophysiological tools to gain insights into women's intra-personal conflicts regarding snacking behavior. This approach allowed Frito-Lay to tweak elements of its promotional material to target this segment more effectively.

2.2 Explanation of consumer behavior

For the explanation of individual behavior, three levels of exposition have been previously outlined. These are the sub-personal, personal, and super-personal levels (Foxall, 2021). The sub-personal level describes the operations of the brain and neurons and is concerned with neurophysiological events; the personal level concerns intentional/personal accounts; and the super-personal level, focused on how behavior is shaped and maintained by environmental events, reinforcers, and punishers (Foxall, 2021).

The super-personal level of consumer research is dedicated to how operant behavior is shaped and maintained by environmental events (Foxall, 2021). The sub-discipline of consumer behavior analysis is based on the examining how consumer behavior can be understood using super-personal, extensional accounts. Approaches to consumer behavior using consumer behavior analysis as the underlying framework have been summarized extensively in previous publications, (e.g., Foxall, 2017; Foxall, 2021). The reader is referred to those sources for examples of how extensional, super-personal levels of analyses have been

used in consumer research. Therefore, this chapter will place exclusive focus on the sub-personal level of analysis and its integration with the super-personal level.

Examination of the sub-personal level of analysis offers several pragmatic benefits. Neuroscientific tools and techniques allow the firm to expand knowledge about consumer behavior. The proposed benefits of using neurophysiological tools are that such measures are more objective, being less susceptible to biases and other influences. For example, humans want to be accepted by peer groups, causing issues like social desirability or conformity biases (Lieberman, 2013). Such long-standing problems have been difficult to correct by using traditional marketing research techniques like surveys and interviews (Baumgartl et al., 2020). For marketing researchers, excluding subjective measures in favor of more objective methods of recording consumer responses is nothing new (Bagozzi, 1991; Nevid, 2010). Thus the growing appreciation of neurophysiological tools is linked to the continued search for more objective and reliable insights into consumer behavior (Shaw & Bagozzi, 2018). Neurophysiological techniques provide researchers and practitioners with objective physiological data, which is potentially less susceptible to experimenter bias or demand effects and can be more reliable than self-report data (Camerer et al., 2005; Dimoka et al., 2010). However, the true value of such measures may lie in enhancing more traditional measures of consumer response, rather than replacing them.

The proper study of the sub-personal system provides information about variables necessary for the production of behavior (Zilio, 2016). Sub-personal levels of analyses allow for a more detailed examination of behavior because neurophysiological tools can measure private covert responses that often precede overt behavioral responses. In other cases, there might not even be any overt responses present, or the responses might be latent. Covert and overt responses are subject to the same laws of behavior and differ only in terms of accessibility (Skinner, 1945). The functional-equivalence hypothesis states that covert motor behavior can

be considered equivalent to overt motor behavior because brain activity measured during covert motor behavior resembles the activity present during the overt performance (Ortu & Vaidya, 2016). From a qualitative perspective, covert and overt responses are comparable and the difference between these responses mainly depends on the sensitivity of the measurement tools, i.e., in a quantitative manner (Ortu, 2012). While there are some debates regarding the use of covert responses in behavior analysis (e.g., Baum, 2011). It cannot be denied that neurophysiological measures of covert responses can help improve the predictability of consumer behavior for marketing firms.

The inclusion of neurophysiological measurements helps to fill in the temporal gaps between behavior and the maintaining contingencies. Neurophysiological tools allow the non-invasive recording of real-time activity of neurons in the brain. Such real-time information can help fill in the temporal gap between the times an organism is changed by being exposed to contingencies of reinforcement and when the organism behaves differently at a much later time (Skinner, 1974). A combination of neuro-behavioral research can help understand how the behavioral repertoire of an organism can develop over time, as these changes are accompanied by changes at a neurophysiological level (Ortu & Bugg, 2021). For example, several studies have shown that sub-personal events can be used to predict the influence of tobacco control measures on smoking behaviors (change, reduction, quitting, and relapse) (e.g., Chua et al., 2011; Falk et al., 2011; Owens et al., 2017; Riddle Jr et al., 2016; Wang et al., 2013). Similarly, for consumer research, changes measured using neurophysiological tools at the sub-personal level can help predict changes in future behaviors of consumers.

2.3 Neurophysiological tools in sub-personal consumer research

Functional magnetic resonance imaging (fMRI)

There are a host of techniques that can be used to study sub-personal responses from the central nervous system. The most powerful neurophysiological, brain-imaging method is

functional magnetic resonance imaging (fMRI). An fMRI scanner calculates and measures the variances in blood oxygenation and blood flow throughout the brain (Cerf & Garcia-Garcia, 2017). More active parts of the brain require more oxygen, and an fMRI can show this difference in blood flow density. Basically, fMRI scanners track blood oxygenation in the brain and exploit the different magnetic properties of oxygenated and deoxygenated blood, i.e., the blood–oxygen–level–dependent (BOLD) contrast (Kwong et al., 1992). Changes between the two states of oxygenation in hemoglobin are measured to correlate regions and brain function to a particular stimulus or behavior (Kenning & Linzmayer, 2011). In a study using fMRI, Schaefer and Rotte (2007) examined if the presence of socioeconomic information conveyed by certain classes of brands (prestigious versus pragmatic classes) differentially evoked brain responses. They presented brand logos and recorded the individual's brain activity. In addition, they asked subjects to assess the brands according to different characteristics after the fMRI session. They found that sports and luxury brands of the category activated different regions (medial prefrontal cortex and precuneus), compared to value products (left superior frontal gyrus and anterior cingulate cortex). In a similar vein, (Erk et al., 2002) used event-related fMRI to investigate the rewarding properties of cars signaling wealth and social dominance. Twelve male subjects were studied with fMRI while viewing photographs of different car classes followed by an attractiveness rating. The participants rated sports cars as being significantly more attractive than limousines and small cars. The fMRI results revealed showed activation in reward-related brain areas (ventral striatum, orbitofrontal cortex, anterior cingulate, and occipital regions) for sports cars in contrast to other categories of cars. These two examples show that informational reinforcers can be distinguished from utilitarian reinforcement at a sub-personal level using fMRI.

Electroencephalography (EEG)

Another popular neurophysiological method that is used extensively in sub-personal research is electroencephalography (EEG). An EEG records the electrical activity or voltage fluctuations in the brain from the scalp via electrodes (Kenning & Linzmajer, 2011). These electrodes measure the synchronized electrical activity of vertically aligned pyramidal cells in the neocortex (Teplan, 2002). These electrodes trace the signals that are made by the brain, typically searching for increased activity in a certain (cortical) region (Cerf & Garcia-Garcia, 2017). The resulting electrical signal is a mixture of several base frequencies captured by an electrode. These frequency ranges (or bands) are classified as delta (1-4 Hz), theta (4-8 Hz), alpha (8-12 Hz), and beta (12-25 Hz) (Khushaba et al., 2013). An EEG case study by Daugherty et al. (2016), had participants view six direct-response television ads (that were selected by the direct marketing firm). They found significant activation differences between successful and unsuccessful direct response ads with these differences localized to specialized areas of the brain. Their approach was to determine the basis for success or non-success by gaining insight into why something worked (or failed to work) to develop subsequent strategies. They found that components of successful ads require less neural effort to understand and evaluate than components of unsuccessful ads. This becomes useful as typically there are no immediate overt responses when consumers are exposed to most promotional material. Using the same logic, an EEG can be used as a diagnostic tool to examine existing reinforcers or compare competing reinforcers that consumers face during a purchase decision. Especially regarding the impact of certain elements of the marketing mix. EEG tools are becoming more accessible and are increasingly being used for marketing research and intelligence. Thus, it becomes important to examine neural responses to marketing effects, especially when an overt response has not been shown or might be latent.

2.4 Connecting sub- and super-personal: Neurophysiological responses as operant behavioral events

Modern advances in neurophysiological tools have allowed for a more detailed analysis of consumer behavior. Neuroscientific research utilizes technologies that allow the measurement of responses undetected by tools that have traditionally been used by behavior analysts (Ortu, 2012). This is because neurophysiological tools can measure responses that often precede overt behavioral responses (Palmer, 2010). Many behavior analysts have begun to examine how some neuroscientific approaches can be integrated with the experimental analysis of behavior (e.g., da Silva, 2004; Ortu, 2012; Ortu & Vaidya, 2016). One approach is to incorporate neural responses within a behavioral framework, not as underlying or explanatory mechanisms but as behavioral events (Barnes-Holmes, 2003; Ortu & Vaidya, 2016; Pawar et al., 2023). These neural responses are treated as any other form of response as measured by behavior analysts, as long as they show sensitivity towards antecedent and consequential manipulations (Ortu & Vaidya, 2016). This is especially useful for instances where controlled observation is difficult and unsystematic data hinder behavioral analysis (Palmer, 2009). This strategy stresses the purely pragmatic benefits of including neural responses within a behavioral framework. The same behavioral principles apply if such events were public. Neuroscientific tools allow for better prediction based on the measurement of neural responses that are functionally related to behavior (Moore, 1997). Such techniques act as an enabling factor to investigate previously inaccessible behaviors and relationships to environments (Baer, 1996; Skinner, 1953). Using this approach, we will discuss how frontal EEG asymmetry can be included in a super-personal account of consumer behavior by relating them to motivating operations and how they help predict overt behavioral responses.

The electrical neuronal activity in the frontal areas of the brain has been associated with motivation in neurophysiological studies (Harmon-Jones et al., 2010; Harmon-Jones & Gable,

2018). This measure of the frequency-based electrical differences in the frontal brain regions between the left and right hemispheres is termed *frontal EEG asymmetry*. This asymmetry is the relative difference in activity in the alpha band frequency between the right and left frontal cortical regions of the brain (Allen & Reznik, 2015). Frontal EEG asymmetry differences are calculated as an index: $\log(\text{alpha EEG power right F4}) - \log(\text{alpha EEG power left F3})$ (Allen et al., 2004). Empirical evidence on frontal EEG asymmetry supports the concept that frontal asymmetry is related to two proposed *neural-behavioral systems* associated with an approach system and a withdrawal system (Davidson, 1998, 2004). According to this concept, frontal EEG asymmetry corresponds to motivational or behavioral tendencies to approach versus withdraw. Specifically, approach-related tendencies are reflected by the relatively greater activity in the left frontal cortex and the converse is true for withdrawal-related tendencies (Davidson, 1992, 1998, 2003; Demaree et al., 2005; Harmon-Jones et al., 2010; Tomarken et al., 1990). Further research suggests that in humans these asymmetric activations are often specific to the frontal cortex, and activity in one hemisphere inhibits the other (Harmon-Jones et al., 2010). Frontal asymmetry covers the same dimension as the ‘directional’ aspect of motivation (Harmon-Jones et al., 2004). Motivational direction here is related to an action or behavioral tendency or a likelihood of certain behaviors being performed.

Based on this perspective, neural responses can be viewed as a class of responses contingent on specific consequences. Skinner himself stated that a single motivational variable can impact a large class of behaviors (Sundberg, 2004). It makes sense that sub-personal responses are a part of the more general class of approach and avoidance responses that are impacted by a certain MO. Measuring such neural responses should help in predicting different forms of consumer approach or avoidance behaviors. More specifically, frontal EEG asymmetry can be used to predict the overt approach or avoidance responses that are associated with a specific reinforcer or punisher. Thus, frontal EEG asymmetry can be used to measure a

covert, sub-personal, neurophysiological behavior that can predict eventual overt behaviors within the general classes of approach or avoidance responses.

Frontal EEG asymmetry has often been cited as a useful measure to explain and predict behavior (Goodman et al., 2013; Jackson et al., 2003; Rosenkranz et al., 2003) and has been used to predict a variety of behavioral responses. Relatively greater left frontal activation in the alpha band during the pre-choice period has been evidenced to predict purchases (e.g., Garczarek-Bąk, 2018; Ravaja et al., 2013). Ravaja et al. (2013) used frontal asymmetry to predict choice for fast-moving consumer goods. Their results demonstrated that relatively greater left frontal activation during the pre-choice period measured a few seconds before the actual choice, predicted the purchase of a given grocery product (accounting for the price, brand, and perceived quality). The frontal EEG asymmetry was positively related to an affirmative purchase decision. Similarly, Garczarek-Bąk (2018) found that relatively greater left frontal activation (i.e., higher approach motivation) during the pre-decision period predicted an affirmative purchase decision (depending on the retailer). Frontal EEG asymmetry has been shown to improve the prediction of purchase choices (Garczarek-Bąk & Disterheft, 2018). Pawar et al. (2023) used water deprivation as a motivating operation to measure the effects on frontal EEG asymmetry. In addition, behaviors like eye fixations, choice, and consumption were used to assess the behavioral effects of motivating operations. Their results demonstrated that a combination of methods can help predict the effects of motivating operations on various topographies of behavior. Specifically, deprivation indicated an establishing effect on attention, neural responses, choices, and consumption of the relevant reinforcer. Therefore, combining sub-personal and super-personal levels of responses can help predict consumer choice regarding motivating operations, measured by frontal EEG asymmetry. This is one of the major reasons for interest in neurophysiological tools for

marketing researchers, who ultimately want to influence consumers' actual choices and consumption.

2.5 The case of Frito-Lay and its consumerate

The chapter concludes with a case study on Frito-Lay, which examined intra-personal conflicts of women's short- and long-range interests. Frito-Lay performed marketing research on such intra-personal bilateral contingencies of women using a mix of neurophysiological and traditional tools. This marketing research resulted in the formulation of a new marketing strategy towards the micro-consumerate of women and the creation of marketing intelligence which ultimately impacted the management of Frito-Lay's marketing mix.

Companies have been using neurophysiological techniques to examine the impact on sub-personal responses from the promotion element of the marketing mix. Frito-Lay has explored the application of neurophysiological tools to gain insights into women's intra-personal conflicts for the benefit of their businesses. More specifically, they used neurophysiological tools to respond to the changes in the market for lower-calorie and healthier snack options. Frito-Lay was in the process of revamping its baked and lower-calorie snacks. They wanted to replicate their earlier success with their whole-grain chip line of the "Sun Chips" brand, by revamping all their calorie-conscious snacks to make them appeal to women, especially the baked versions and 100-calorie packages of their snacks (Clifford, 2009). They found that women were more likely to consume snacks than men but were not eating as many Frito-Lay snacks. According to Frito-Lay research, women snack 14 percent of the time on salty foods, 25 percent of the time on sweet foods and the other 61 percent of snacking includes drinks, fruits, and vegetables (Clifford, 2009). Frito-Lay partnered with consultancy firm Juniper Park which specialized in the use of neurophysiological tools, to focus on women as a target segment and examine why their

snacks were overlooked by female consumers (Welsch, 2022).



Figure 1. Minimal marketing integration approach taken by Frito-Lay

They examined structural changes in women's brains regarding brain areas associated with communication, decision-making, memory, and emotion. Based on this, they generated assumptions that (a) women could process ads with more complexity and more pieces of information, and (b) women would look for characters they could empathize with. Regarding emotion, they focused on feelings of guilt. They asked about 100 women to keep journals about their lives for about two weeks and found that the women felt guilt more often, and snacking (amongst other things) was one of the sources of this guilt.

The intra-personal conflicts experienced by the women consumer can be thought of in terms of a bilateral contingency linking two diametrically opposed kinds of self-interest (Foxall, 2021). One interest can be envisioned as long-term health goals (usually high informational, and relatively low utilitarian reinforcement) and short-term (usually low informational, and relatively high utilitarian reinforcement) consumption of snacks. Guilt acted as an informational punisher that impacted women's consumption of Frito-Lay snacks. Although Frito-Lay had often tried advertising snacks as guilt-free and highlighted calorie information, this promotion strategy might have unintentionally acted as a reminder of the punishing effects of snacking. Frito-Lay changed its promotion strategy by toning down the packaging and showing off healthy ingredients in the snacks (Clifford, 2009). They arranged women-friendly snacks together at the end of the aisle where possible, and repackage snacks geared towards women. These were not the typical pink package or something highlighting

calories, but in a matte beige bag that displays pictures of the ingredients and highlighted characteristics like high fiber content and calcium (Clifford, 2009). These promotional messages better aligned with women's long-term interests and likely acted as utilitarian reinforcers highlighting the healthy features of the chips.

There is no doubt that covert neural responses are connected to overt responding. Using a mixed method approach, Frito-Lay was able to uncover the contingencies maintaining women's snacking behavior. Using personal accounts (through the journals that the women kept) they found that guilt was one of the sources that were maintaining choices of snacks. Using neurophysiological tools, they highlighted the greater impact of emotion (guilt) on women compared to men. Based on differences in women's brain areas associated with communication, decision-making, memory, and emotion, Frito-Lay changed its advertising approach towards women. They developed the campaign "Only in a Woman's World" where stories submitted by consumers were converted into animated webisodes (Frito-Lay, 2009). Using an evidence-based marketing approach to create relatively complex advertisements, with more pieces of information, and empathetic characters based on input from their target segment (Clifford, 2009; Frito-Lay, 2009). In the span of six months, over 195 million positive impressions were made, more women visited snack aisles, and the company saw record-breaking sales (Welsch, 2022).

In this case, Frito-Lay obtained neurophysiological research data from Juniper Park, a specialist market research agency. This was an instance of minimal marketing integration (Foxall, 2021), where some marketing functions relating to marketing intelligence were commercially delegated, while those relating to the external marketing of its output are undertaken by Frito-Lay (Figure 1). The behaviors of women acted as a discriminative stimulus for Frito-Lay. The corresponding behavior of Frito-Lay acted as a discriminative stimulus for the micro-consumerate of women. This bilateral interaction resulted in the

metacontingency that caused a change in the creation of the marketing intelligence by Frito-Lay and the final marketing mix (targeted campaign and change in packaging). Frito-Lay found how the choice behavior of women was distributed for different snack options. They used sub-personal level data as a complementary source. Thus, they had to change the advertisement materials that likely had a motivating function since they altered the effectiveness of reinforcers (Foxall, 2021).

2.6 Conclusion

The chapter extended the discussion and focused on examining different levels of individual behavior. More specifically, by analyzing how the effects of environmental contingencies can be better understood by combining data from the sub-personal and the super-personal levels. Neurophysiological tools can supplement some of the limitations of behavior analytic stances in terms of making covert behaviors more accessible. Practically, such integration allows to fill the temporal gaps in assessments of behavior and enables better prediction of overt behaviors. A few examples highlighting the pragmatic approach to using neurophysiological approaches were discussed with a specific focus on motivating functions using frontal EEG asymmetry. The examples discussed demonstrated the utility of the neurophysiological approach for the examination of utilitarian and informational reinforcers and for the prediction of consumer behavior. Overall, the sub-personal level of analyses shows promise when combined with consumer behavior analysis, either for the identification of proximal controlling functions or for the prediction of the targeted behavioral responses.

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Chapter 3

Analyzing Motivating Functions of Consumer Behavior: Evidence From Attention and Neural Responses to Choices and Consumption

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Abstract

Academia and business have shown an increased interest in using neurophysiological methods, such as eye-tracking and electroencephalography (EEG), to assess consumer motivation. The current research contributes to this literature by verifying whether these methods can predict the effects of antecedent events as motivating functions of attention, neural responses, choice, and consumption. Antecedent motivational factors are discussed, with a specific focus on deprivation as such a situational factor. Thirty-two participants were randomly assigned to the experimental and control conditions. Water deprivation of 11–12 hours was used as an establishing operation to increase the reinforcing effectiveness of water. We designed three experimental sessions to capture the complexity of the relationship between antecedents and consumer behavior. Experimental manipulations in session 1 established the effectiveness of water for the experimental group and abolished it for the control group. Results from session 2 show that participants in the experimental group had significantly higher average fixation duration for the image of water. Their frontal asymmetry did not provide significant evidence of greater left frontal activation toward the water image. Session 3 demonstrated that choice and consumption behavior of the relevant reinforcer was significantly higher for participants in the experimental group. These early findings highlight the potential application of a multi-method approach using neurophysiological tools in consumer research, which provides a comprehensive picture of the functional relationship between motivating events, behavior (attention, neural responses, choice, and consumption), and consequences.

3.1 Introduction

Neurophysiological methods encompass a specific category of tools that can measure psychophysiological responses (e.g., using eye-tracking or galvanic skin response) and neural responses (e.g., using functional magnetic resonance imaging or electroencephalography)

(see Dimoka et al., 2012 for a more detailed description of neurophysiological tools). A host of large companies, like Microsoft, Disney, Philips, and Daimler-Chrysler, have examined the application of neurophysiological tools to gain insight into consumer behavior for the benefit of their businesses (Riedl et al., 2010; Singer, 2010). Other companies, like Frito-Lay, Yahoo, and PayPal, have used neurophysiological methods to test their advertisements (Burkitt, 2009). Major broadcasting companies, like Warner Bros, CBS, Time Warner, MTV, ESPN, Fox Sports, and CNN, have employed neurophysiological research to optimize TV shows, promotional campaigns, advertising spaces, social TV, and multi-screening viewing experiences (Crespo-Pereira et al., 2019). Based on these trends, we expect to see increased usage of neurophysiological methods for consumer research in the future. Thus, main objective of this study is to provide a methodological procedure that can provide an experimental framework for future neurophysiological consumer motivation research.

The proposed benefits of research using neurophysiological tools are that such research is less susceptible to biases and other influences (e.g., social desirability, limitations of introspection, etc.) that arise when using methods that rely on a subjective valuation (Baumgartl et al., 2020; Fehse et al., 2017; Meyerding & Merz, 2018). Thus, the growing appreciation of neurophysiological tools is linked to the search for more objective and reliable insights into consumer behavior (Nevid, 2010; Shaw & Bagozzi, 2018). An increasing number of papers have theoretically discussed the application of neurophysiological tools in related fields, such consumer research (e.g., Karmarkar & Plassmann, 2017; Kenning & Plassmann, 2008; Plassmann et al., 2007; Plassmann et al., 2015; Smidts et al., 2014; Verhulst et al., 2019). However, empirical research has not been able to keep pace with the number of conceptual publications. This paper aims to address that gap by providing a detailed procedure that can be used to apply neurophysiological methods in conjunction with conventional experimental methods to study motivating functions of

consumer behavior. Such methodological approaches that use multiple methods are more promising regarding the measurement of the influence of the transient, dynamic nature of situational determinants. Thus, the major goal of this paper is to contribute to a fuller picture of the functional relationship between antecedent events that have a motivating function on consumer behaviors, and how to study them by capturing their complexity using multiple methods. The concept of motivating operations (Laraway et al., 2003) is used to conceptualize and empirically assess the relationship between situational antecedent events and motivating functions of consumer behaviors. The aim of this paper is to capture the complexity of antecedent events that have motivating functions of consumer behaviors by studying the functional relationship between (a) motivational antecedent events (b) consumer behavior (attention, neural responses, choice, and consumption), and (c) resulting consequences

3.2 Literature Review

3.2.1 The Impact of Antecedent Motivational Event on Consumer Behavior

The motivating influence of situational factors can be studied using the concept of *motivating operations*, typically used to refer to events that have motivating functions. Motivating operations are defined as an environmental event that (a) establishes (or abolishes) the reinforcing or punishing effect of another event (the value-altering effect) and (b) evokes (or abates) behaviors related to that event (the behavior-altering effect) (Laraway et al., 2003). In simple terms, a motivating operation changes how much a consumer “wants” something in a purchasing situation and how hard they will “work” to get it (Fagerstrøm et al., 2010). Motivating operations encompass two types of value-altering effects: establishing operations (EOs) and abolishing operations (AOs). EOs make consequences more effective, whereas AOs make them less effective (Laraway et al., 2014). Thus, deprivation tends to be an EO for food and water consumption, and satiation functions as an AO (Tapper, 2005). For

example, water is established as an effective reinforcer after a period of water deprivation. In this situation, an organism is more likely to exhibit choice and consumption behaviors that have previously been associated with drinking. When a large quantity of water has been consumed, the effectiveness of water as a reinforcer is abolished, and simultaneously, the likelihood of previously mentioned behaviors being emitted is abated. In a choice situation where a consumer orders food and/or drinks, it is highly likely that this person is in a state of food/water deprivation. In such situations, deprivation has a motivating function (EO), and most probably influences the choice of product category and/or quantity.

The concept of motivating operations has made important contributions to both conceptual and applied research (e.g., Iwata et al., 2000; Langthorne et al., 2007; Laraway et al., 2014; Maraccini et al., 2016; Rispoli et al., 2011; Simó-Pinatella et al., 2013). The concept has also been shown to be a comprehensive framework for consumer behavior analysis in general (Fagerstrøm, Foxall, & Arntzen, 2010), and in particular for studying consumer online purchasing behavior (Fagerstrøm & Arntzen, 2013; Fagerstrøm et al., 2010; Fagerstrøm & Ghinea, 2011), the impact of corporate social responsibility (Fagerstrøm et al., 2015), and online hotel booking (Eriksson & Fagerstrøm, 2017). However, to the best of our knowledge, no study has tried to capture the complexity of antecedent events that have motivating functions of consumer behaviors by studying the functional relationship between antecedent events (e.g., deprivation), and different types of consumer behaviors (attention, neural responses, choice, and consumption).

3.2.2 Deprivation as a Motivating Antecedent Event

The value-altering effect of motivating operations modifies the ability of consequences (reinforcers and punishers) to change consumer behavior. This ability is usually influenced by manipulating the associated EOs and AOs. Sundberg (1993) highlights that, in general, the reinforcing effectiveness of an EO is transient, and to be used as an

independent variable, researchers can either (1) take advantage of an EO as it occurs naturally in the environment or (2) manipulate some event that alters the value of another event as a form of reinforcement. Most laboratory studies that take advantage of EOs usually involve a history of deprivation of some event that functions as primary reinforcement (Pierce & Cheney, 2013).

Deprivation is an EO that occurs naturally as a function of time. Accordingly, such studies alter the effectiveness of reinforcers by manipulating the EO of deprivation. Researchers studying the effects of deprivation typically use the first strategy (taking advantage of an EO as it occurs naturally in the environment) and manipulate the length of time since consumption of the unconditioned reinforcer. For example, Coate (1964) manipulated various lengths of water deprivation on 32 rats. Overall, the result of this study demonstrated that the strength of responding (behavior-altering effect) was directly related to the level of deprivation at the time of testing. For human participants, ad libitum feeding and drinking rarely allow for individuals to go for more than 24 hours of food or water deprivation. Some previous research has used 16 hours of water deprivation with human participants (Hallschmid et al., 2001). However, such periods of deprivation do not mimic natural settings. Forzano et al. (2010) used a procedure in which participants were scheduled to start experimentation approximately four hours (plus or minus an hour) after their normal awakening time (without consuming any foods or liquids), resulting in a deprivation period of roughly 11–12 hours. This period of deprivation mimics instances where the individual skips or delays the consumption of food or drinks in the morning. The use of such a manipulation strategy is more ecologically sound and allows for a relatively strong EO without causing discomfort to the participant.

The second strategy, that is, to manipulate some event that alters the value of another event as a form of reinforcement (the value-altering effect), is related to EOs (other than

deprivation) that have established the effectiveness of a reinforcer in a similar fashion. For example, an event like ingestion of salt rich food, is not the same as a period of water deprivation but will have similar effects because it functions as an EO for water. This strategy aims to induce effects similar to water deprivation by using events that function as EOs for water. Michael (1982) clearly distinguishes between deprivation as an EO and other events that have the same effect. For example, events like ingestion of salty food, a dry climate, high temperatures, perspiration, or strenuous physical exercise may function as EOs for water and simultaneously evoke behaviors that have provided access to water in the past. These events have much the same effect as deprivation: water becomes more effective as a form of reinforcement, and behavior that has been reinforced with water becomes momentarily more frequent (Michael, 1993). In research, a consumption of a variety of salty food items have been used as a strategy to increase the value of liquids (e.g., Aarts et al., 2001; Ferguson & Bargh, 2004; Shalev, 2014). Physiologically, the addition (through ingestion) or loss (through excretion, salivary loss, respiration, perspiration, etc.) of either water or sodium to/from the body alters the net fluid balance within the body, but also the concentration of salt molecules that draw water in and out of the cell compartments (Johnson & Thunhorst, 1997). In simple terms, the concentrations of sodium and water help regulate the amount of water in the cell compartments, causing water to either leave the cell (the cell shrinks) or enter the cell (the cell expands). The balance of salt and water in the body are heavily interconnected. This is one of the main reasons why the ingestion of salt has a similar EO as water deprivation. Therefore, a mouthful of salty food can have the same effect as a period of water deprivation (Catania, 1998).

The behavior-altering effect subsumes two effects: the evocative effect and the abative effect (Laraway et al., 2003). As their names imply, these effects refer to the respective increases and decreases in the current strength of behavior influenced by

motivating operations (Laraway et al., 2014). It is highly likely that many consumer behaviors are affected by a given motivating operation (Laraway et al., 2003). Deprivation, as a motivating operation, has been shown to cause changes in attention (Castellanos et al., 2009), neural responses (Nijs et al., 2010), and behavioral tendencies (Hoefling & Strack, 2008). By focusing on deprivation states and their motivating functions, we can improve our understanding of how such antecedent events in their entirety influence consumer behavior. These will be discussed in more detail in the sections that follow.

3.2.3 Attention

Research provides evidence that motivationally relevant stimuli significantly impact visual behavior (West et al., 2009). Most of the reported events in eye-tracking data relate to fixations, which are defined as the state when the eye remains relatively still over some time (Holmqvist et al., 2011). During a fixation, a small area of the visual field is projected onto the fovea (an area of the eye with superior visual acuity) for detailed visual processing (Chandon et al., 2009; Wedel & Pieters, 2008). Eye fixations, used as a measurement of attention, forms the basis of many measures and metrics used in consumer research. These measures relate to the number of fixations (e.g., fixation count) and the length of fixations (e.g., first/last/average/total fixation duration) (see Holmqvist et al., 2011 for a more detailed overview of fixation metrics). Fixation count indicates how many times the participant looks at the area of interest (AOI) (Behe et al., 2015). Metrics that measure eye fixation duration reflect the amount of attention given to an area of interest and vary based on the type of stimuli (e.g., texts or graphics) and/or types of tasks (e.g., reading or problem-solving) (Tsai et al., 2012). Most of the measures of visual attention used in eye-tracking research are adept at predicting product choices (Chandon et al., 2006; Pieters & Warlop, 1999; Russo & Leclerc, 1994; Wedel & Pieters, 2007). For example, consumer research on brands has shown that longer average fixation durations are positively correlated with choice (Pieters &

Warlop, 1999). In food research fixation count has shown to be positively correlated with food choice (Jantathai et al., 2013). Taken together, these findings demonstrate the importance of visual attention for choice behavior, and can thus be used to predict eventual choice behavior in-store. By examining both metrics, we can discern which measure of attention, related to consumer choice, can be linked to motivating operations.

3.2.4 Neural Responses

Modern advances in neurophysiological tools have allowed for a more detailed analysis of consumer behavior. Neuroscientific research utilizes technologies that allow measurement of responses undetected by tools that have traditionally been used by behavior analysts (Ortu, 2012). This is because neurophysiological tools can measure responses that often precede overt behavioral responses (Palmer, 2010). One such tool is an EEG, which measures the changes in the brain's electrical activity through external electrodes placed on the scalp. These electrodes measure the synchronized electrical activity of vertically aligned pyramidal cells in the neocortex (Teplan, 2002). The resulting electrical signal is a mixture of several base frequencies captured by an electrode. These frequency ranges (or bands) are classified as delta (1–4 Hz), theta (4–8 Hz), alpha (8–12 Hz), and beta (12–25 Hz) (Khushaba et al., 2013).

A substantial amount of research has suggested that electrical neural activity in the frontal regions of the brain is linked to motivation (Harmon-Jones et al., 2010; Harmon-Jones & Gable, 2018). This measure of the frequency-based electrical differences between the left and right hemispheres in the frontal brain regions is termed *frontal EEG asymmetry*. More specifically, the relative difference in alpha power (activity of the alpha band frequency) between the right and left frontal cortical regions is measured (Allen & Reznik, 2015). Frontal EEG asymmetry differences are calculated as an index: $\log(\text{alpha EEG power right F4}) - \log(\text{alpha EEG power left F3})$ (Allen et al., 2004). Frontal EEG asymmetry has

often been cited as a useful measure to explain and predict behavior (Goodman et al., 2013; Jackson et al., 2003; Rosenkranz et al., 2003).

Substantial research supports the concept that frontal asymmetry is correlated to two proposed *neural-behavioral systems* associated with an approach system and a withdrawal system (Davidson, 1998, 2004). According to this concept, frontal EEG asymmetry corresponds to motivational or behavioral tendencies to approach versus withdraw. Specifically, approach-related tendencies are reflected by the relatively greater activity in the left frontal cortex and the converse is true for withdrawal-related tendencies (Davidson, 1992, 1998, 2003; Demaree et al., 2005; Harmon-Jones et al., 2010; Tomarken et al., 1990). Further research suggests that in humans these asymmetric activations are often specific to the frontal cortex, and activity in one hemisphere inhibits the other (Harmon-Jones et al., 2010).

Unconditioned biological processes have an EO effect (i.e., appetitive/approach motivation) and evoke approach-related behaviors that have led to access to those reinforcers in the past. These unconditioned motivating operations mainly include deprivation and satiation of unconditioned reinforcers like food and water (Laraway et al., 2014). Frontal EEG asymmetry can be used to measure the effects of deprivation. For example, in a study by Zinser et al. (1999), the authors used frontal EEG asymmetry to examine smoking motivation in relation to tobacco deprivation and exposure to smoking cues. They found that cigarette cues elicited increased asymmetry, while actual smoking did not. This result is highly similar to the effects of motivating operations discussed previously. The period of deprivation and presentation of smoking cues changed the reinforcing value of tobacco. When the reinforcer was obtained, the effectiveness of smoking was abolished. Another study where food deprivation was manipulated, demonstrated that time since eating and self-reported liking for dessert were associated with greater relative left frontal EEG activation (approach motivation) during the viewing of dessert pictures, but not during the viewing of neutral

pictures (Gable & Harmon-Jones, 2008; Harmon-Jones & Gable, 2009). Similarly, exposure to alcohol cues by individuals who reported liking alcohol has shown greater relative left frontal EEG activation when compared to neutral images (Gable et al., 2016). Taken together, these results suggest that frontal EEG asymmetry can be used to verify motivating functions of deprivation at a neural level.

3.2.5 Choice and Water Consumption

Consumer choice and consumption are relatively complex behaviors that include many responses. Each choice the consumer makes is influenced by an antecedent event which also has motivating functions related to the final choice. A state of water deprivation, which is highly relevant in a foodservice, convenience, or grocery store when buying something to drink, will most probably have an EO effect on beverages and simultaneously evoke choices of products within that category.

3.2.6 Aims of the Current Study

In general, studies have shown that food deprivation leads to increased attention and reactivity toward food cues (Lavy & van den Hout, 1993; Mogg et al., 1998; Stockburger et al., 2009). Similarly, deprivation has been shown to cause changes in eye movement behavior. Research by Castellanos et al. (2009) has demonstrated that eye-movement behavior among food-deprived participants is significantly inclined toward food images (when compared to non-food images), in terms of gaze duration and direction. Recent reviews suggest that such influences on attention are unrelated to individual differences in body weight (Hardman et al., 2021). Given the evidence, in a situation where a consumer is water-deprived, it is reasonable to assume eye-tracking can be used in verifying motivating functions in relation to attention towards beverages. Deprivation of water has an EO effect on beverages (the value-altering effect), and secondly, it evokes eye movement behaviors related to beverages (the behavior-altering effect).

As mentioned previously, evidence suggests that frontal EEG asymmetry holds potential for measuring unconditioned motivating operation effects like deprivation. Hence, frontal EEG asymmetry can be used in verifying motivating functions when a consumer is water deprived.

It is rare in studies related to consumer behavior to investigate actual consumption. The behavior-altering effect of motivating operations encompasses all responses, from search, choice, and final consumption. Thus, to capture the complexity of consumer behavior, we decided to include consumption. A state of water deprivation will most probably have an EO effect on beverages and simultaneously evoke choices of products within that category.

We asked four related research questions, namely, will deprivation have an EO effect on beverages and evoke: (1) a higher fixation count and longer average fixation duration toward the relevant reinforcer?; (2) relatively greater left frontal activity (approach motivation) toward the relevant reinforcer?; (3) choices of the relevant reinforcer?; and (4) greater consumption of the reinforcer? Furthermore, the prediction is that satiation (having an AO effect) will not be shown to have the same impact as that asked in the four research questions.

3.3 Method

Participants

Initially, 39 students and faculty members agreed to participate in the study which comprised of three sessions. Four participants failed to comply with the deprivation procedure and were removed. Two participants were removed due to invalid cases. The sample was restricted to right-handed participants. The use of homogeneous samples related to handedness affects the validity of EEG experiments because hemispheric asymmetry is strongly connected to hand dominance (Davidson et al., 1990). Consequently, hemispheric specialization is strengthened by the consistent use of the dominant/preferred hand.

Handedness was assessed by the Chapman Handedness Inventory (Chapman & Chapman, 1987). One participant was categorized as ambidextrous (scored 28 on the handedness inventory) and was removed from the analysis. Any personal identifiable information was not collected.

The final sample comprised of a total of 32 (18 male, 14 female) right-handed (scored ≤ 17 on the Chapman and Chapman (1987) handedness inventory), normal-weight adults ranging in age between 19 to 37 years ($M = 24.2$; $SD = 3.54$). All participants received 200 NOK (approximately 20 USD) compensation in exchange for participation. The participants were recruited using flyers and class presentations. The recruitment was done under the pretense that the researcher was measuring the influence of taste using neurophysiology. The main reason for doing so was to introduce the relatively unfamiliar EEG and eye-tracking data collection methods. Additionally, the cover story allowed masking of the water deprivation manipulation (influence of hydrated state versus dehydrated state on taste), minimizing any possible demand effects. Participants were informed that the experimental procedure would take anywhere between forty-five minutes to an hour and were randomly assigned to the experimental (water deprivation) group and control group. Written consent was obtained from all participants using an onscreen consent form. The participants were randomly allocated to each group and were given instructions accordingly. The experimental group consisted of 10 males and six females. The control group consisted of eight males and eight females. Participants in both groups took part in all experimental sessions. Upon arrival, the participants were given a brief overview of the three experimental sessions. Procedural instructions for all sessions were provided in written format onscreen. The use of smaller sessions allowed the participants to take small breaks (if needed) between the experimental proceedings. They were informed that they could quit any time if they wanted to. At the end

of the experimental sessions, participants were asked what they thought the purpose of the study was. None of the participants were able to guess the main purpose of the study.

Overview of Experimental Sessions

We conducted three experimental sessions. In session 1, we wanted to further establish the effectiveness of a reinforcer for the experimental group and abolish it for the control group. The participants in the experimental group had to consume salty biscuits and participants in the control group had to consume flavored water. The session demonstrated that there were differences in the motivating function of water deprivation and satiation for the two groups in terms of thirst. In session 2, we wanted to collect eye-tracking metrics and frontal asymmetry index values for participants in the two groups. The participant viewed a series of neutral images (required for baseline corrections in EEG data) and images of salty snacks and liquid beverages. The images of interest were the image of the salty biscuits and glass of water. This session demonstrated some differences for eye-tracking metrics within-group and some indication of changes in frontal EEG alpha asymmetry index values. In session 3, we stimulate choice through paired choice trials using images of salty snacks against liquid beverages. Another aim of this session was to get a measure of actual consumption, thus participants were offered a 500ml water bottle to drink at the end of the study. This session demonstrated differences in choice and consumption behaviors for the experimental group compared to the control group. The data was exported from the research platform software as a CSV file. All data was analyzed using IBM SPSS Statistics version 28.

Session 1: Baseline Data Collection and Additional Manipulation

Research procedures that manipulate deprivation in human subjects show various deprivation lengths of anywhere between 3–15 hours (Hoeftling & Strack, 2010; Raynor & Epstein, 2003; Strahan et al., 2002). This study employed a procedure similar to Forzano et al. (2010). Participants in the experimental group were asked to show up for data collection 3

hours after their normal waking up time, resulting in a deprivation duration of 11–12 hours (8 hours + 3–4 hours). Thus, for standardization, participants in the experimental group were instructed to refrain from drinking any liquids for three hours (plus or minus an hour) in the morning before any data collection began. Such a situation will mimic instances where the individual postpones the consumption of the first food/drink item to a later time.

Additionally, this deprivation period will effectively replicate the deprivation state that most individuals will experience in consumer settings. Since we were manipulating only the deprivation of water and not food, participants in the experimental group could eat dry solid foods during this time period. Participants in the control group could show up at any time for data collection and had no restrictions on food or water intake.

Design

The survey questions involved thirst, handedness, mood, and tasting items. For the manipulation check, all participants were asked to report the extent to which they currently felt thirsty on a 7-point Likert scale onscreen (1 = not thirsty at all; 7 = very, very thirsty). Handedness was measured using the Chapman and Chapman (1987) inventory consisting of 13 questions about handedness. In some cases, mood can show sensitivity to changes in water deprivation/consumption (see Masento et al., 2014). Thus, we measured mood in case we needed to control for its effects. A priori mood differences were examined by asking the participants the following: “On a scale of 1–7, what is your current mood state?” ranging from 1 (very negative) to 7 (very positive). In addition, three questions consisting of the tasting items were introduced to lend credibility to the cover story. These questions were: (1) “What was the flavor of the biscuit?” (open-ended); (2) “How would you rate the flavor of the biscuit?” (scale: 0 = horrible to 6 = excellent); and (3) “How likely are you to recommend this to others?” (scale: 0 = not at all to 6 = certainly).

Apparatus

For Session 1, participants in the experimental group had to taste at least four salty biscuits and the control group tasted flavored water, after which both groups answered survey questions. For the experimental group, the four flavors of salty biscuits were presented individually on disposable white paper plates, covered with a napkin and correspondingly marked 1 to 4. Each plate had three individual units (three biscuits) of the specific flavor (three flavors and one plain salted variety). For the control group, the four water samples were similarly presented in four clear disposable plastic cups covered with a napkin and correspondingly marked 1 to 4. Each cup contained 100 ml of the specific water flavor (three flavors and one neutral variety). A dual-screen setup was used, where the screens were divided by a partition. Two 24-inch widescreen monitors with a resolution of 1920 x 1080 were used. The primary screen was placed in front of the experimenter and the secondary screen was placed in front of the participants (used to display the slideshow). The experiment was conducted using iMotions® research platform software (<https://imotions.com/>). In this session, the participants progressed through the slideshow by clicking a centrally placed button marked “next” at the bottom of the screen using a standard mouse and keyboard.

Procedure

This session began with the general introduction to the experiment sessions and the consent form. This was followed by the mood scale and the Handedness Inventory (Chapman & Chapman, 1987). Thereafter, the cover story was presented, which stated that the main purpose of the experiment was to examine the relationship between taste and neurophysiology. Participants in the experimental group were told that the manufacturer, Mondelez International, has introduced new varieties of salty biscuits to the market. These are rectangular salty biscuits (product name: TUC) that are widely available in Norway, and have a sodium content between 1.8–2.9 grams per 100 grams. Participants were instructed to taste the four different flavors of salty biscuits (original salty, and three other random

flavors). The onscreen instructions were to taste the biscuits from the plates (in numerical order) and to click in order to proceed to the tasting questions. The participants were verbally informed that they could take their time while tasting and should completely eat at least one biscuit from each of the plates. This was repeated four times for each of the flavors. The last flavor was always the original salted version; the order of the other three flavors was randomized. The participants in the control group followed a similar procedure where they had to taste four different flavors of water (three random flavors with the last one always being regular water) and answer tasting questions. After tasting, the participants responded to the thirst scale item, followed by an information slide stating that the session was completed.

Analysis and results

Mood ratings. Subjective reports of mood were examined for both groups. A Mann-Whitney U test revealed no a priori differences in mood between participants in the experimental group ($Mdn = 5.00, n = 16$) and participants in the control group ($Mdn = 5.50, n = 16$), $U = 127.00, z = -0.04, p = 0.967, r < 0.01$.

Manipulation check. Results from a Mann-Whitney U demonstrated that the experimental group ($Mdn = 5.50, n = 16$) reported stronger feelings of thirst than the control group ($Mdn = 4.00, n = 16$), $U = 24.50, z = -3.98, p < 0.001$, with a large effect size $r = 0.7$. Therefore, the manipulations successfully established a stronger motivating operation for the experimental group than for the control group.

Session 2: Attention and neural responses

This session was designed specifically to study attention and neural responses by collecting eye-tracking and EEG data, respectively. The main aim of the second session was to measure the effects of water deprivation/satiation on attention and neural responses (the behavior-altering effect), linked to research questions one and two. Having a separate session for the collection of eye-tracking and EEG data allows for the minimization of any noise

artifacts that might be generated from extreme physical movement. Therefore, this session was comprised entirely of viewing stimulus images as they changed onscreen.

Design

The session consisted of a viewing condition task where both groups viewed exactly the same slideshow. The slideshow started with a series of 12 randomized neutral images (presented in succession) from the Geneva affective picture database (GAPED) (Dan-Glauser & Scherer, 2011). Each image remained onscreen for 15 seconds. This was done to get a relatively similar starting baseline for all the participants before the collection of eye-tracking and EEG data of interest to the study. This was followed by a second series of randomized images that consisted of five liquid item images in a clear glass (still water, sparkling water, milk, cola, and juice) and salty snacks in a clear bowl (pretzel sticks, peanuts, chips, crackers, and salty biscuits). All images were separated by a black inter-slide which remained onscreen for 20 seconds to minimize carry-over effects of the previous image. The rating for thirst was recorded again at the end of this session.

Apparatus

Eye-tracking data was collected using a Tobii X2-30 screen-based eye-tracker with a sampling rate of 30 Hz. The eye-tracker was attached to the bottom of the 24-inch secondary screen used to display the slideshow. A standard mouse and keyboard were used by the participants to start and end the slideshow using iMotions research software. The EEG model used for the collection of neurophysiological data was the Advanced Brain Monitoring (ABM) B-Alert X10 headset with nine electrode channels according to the International 10/20 system (F3, Fz, F4, C3, Cz, C4, P3, POz, and P4), with a sampling rate of 256 Hz. The EEG headset was fitted to the back of the participant's head. The participant's head was cleaned using an alcohol-based cleaning wipe. Conductive cream was applied to all

electrodes. The linked reference electrodes were placed behind each ear on the mastoid bone. Electrode impedances were kept below 20 kilohms.

Procedure

At the beginning of this session, an impedance check was performed for the EEG. Upon reaching the acceptable level (20 kilohms), the participants performed a calibration for the eye-tracker. The participant was instructed to look at nine points on the screen (fixation locations) to calibrate the eye-tracker to his or her eyes. After calibration, the participant clicked the onscreen button to start the first neutral images slideshow and then to start the test image slideshow. The second slideshow was followed by a thirst scale for the manipulation check. The final slide informed the participants that the session was completed.

Analysis and results

Thirst manipulation check. Thirst was measured again to check whether the deprivation/satiation effect was still active for the respective groups. A Mann-Whitney U demonstrated that the experimental group ($Mdn = 6.00, n = 16$) reported stronger feelings of thirst than the control group ($Mdn = 4.00, n = 16$), $U = 26.00, z = -3.96, p < 0.001$, with a large effect size $r = 0.7$. Therefore, water was still active as a reinforcer for the experimental group during Session 2. For the control group, the effectiveness of water was abolished during eye-tracking and EEG data collection.

Eye-tracking

The stimulus images were displayed centrally with black borders around each image to allow for comfortable viewing on the 24-inch widescreen monitor. For the analysis of eye-tracking data, the AOIs were manually defined around both stimulus images (salty biscuits and water) using the built-in functionalities in the iMotions software. Eye-tracking data quality, reported by the iMotions software, provided quality assurance metrics that show the % of time the respondent looked at the screen. For the experimental group, this was at 91%

for the water stimulus image and 92% for the salty biscuit stimulus image. Reported data quality for the control group was 94% for both the water and salty biscuit stimulus images. For each participant, we calculated the fixation count and the average duration of fixations within the AOIs. We compared the values within the groups because, for the experimental group, the water deprivation and salty biscuit tasting manipulation (eating something salty, increasing the effect of water deprivation) corresponded to an EO. Thus, the water would have an AO effect (on water deprivation). This means that for the experimental group, the water image will correspond to an AO and the salty biscuit image will correspond to an EO. For the control group, only the water image would have an effect, since the manipulation to drink flavored water would have an AO effect on thirst. This means that for the control group only the water image will correspond an AO while the biscuit image will correspond neither an EO nor an AO. Therefore, the eye-tracking metrics relating to the salty biscuit image and water image were compared within-group.

For each group, comparisons between the fixation count values for the salty biscuit stimulus image and water stimulus image were conducted. Shapiro-Wilk tests did not show evidence of non-normality for the experimental group fixation count datasets for the salty biscuit image $W(16) = 0.973, p = 0.881$ and water stimulus image $W(16) = 0.918, p = 0.157$. Based on this outcome, a dependent samples t-test was utilized. Results show significant differences in fixation count values within the experimental group for the salty biscuit image ($M = 31.94, SD = 6.72$) and water image ($M = 26.81, SD = 6.97$), $t(15) = 3.58, p = 0.003$, (two-tailed), Hedges' $g = 0.85$; 95% CI = 0.29 to 1.39.

For the control group fixation count dataset, the Shapiro-Wilk tests provided evidence of departure from normality for the salty biscuit image $W(16) = 0.881, p = 0.041$ and water stimulus image $W(16) = 0.619, p < 0.001$. Therefore a non-parametric, Wilcoxon signed rank test for non-parametric dependent small samples was used. The test revealed no significant

differences in fixation count for the salty biscuit image ($Mdn = 32.50$, $n = 16$), and water image ($Mdn = 29$, $n = 16$), $z = -1.35$, $p = 0.176$, $r = -0.24$.

The average fixation duration were compared to ascertain differences between the water and salty biscuit images within the two groups. Shapiro-Wilk tests did not show evidence of non-normality for the experimental group average fixation duration datasets for the salty biscuit image $W(16) = 0.97$, $p = 0.837$ and water stimulus image $W(16) = 0.959$, $p = 0.649$. Based on this outcome, a dependent samples t-test was utilized. A statistically significant difference was evident in the average fixation duration (in milliseconds), in the experimental group for the salty biscuit image ($M = 305.5$, $SD = 71.62$) and water stimulus image ($M = 351.81$, $SD = 118.37$), $t(15) = -2.29$, $p = 0.037$ (two-tailed), Hedges' $g = -0.54$; 95% CI = -1.04 to -0.03.

Shapiro-Wilk tests did not show evidence of non-normality for the control group average fixation duration datasets for the salty biscuit image $W(16) = 0.941$, $p = 0.362$ and water stimulus image $W(16) = 0.984$, $p = 0.987$. Therefore, a dependent samples t-test was utilized. No significant differences were found for the average fixation duration values (in milliseconds) for the control group for the salty biscuit image ($M = 285.88$, $SD = 62.37$) and the water image ($M = 288.25$, $SD = 82.51$), $t(15) = -0.172$, $p = 0.866$ (two-tailed), Hedges' $g = -0.04$; 95% CI = -0.51 to 0.43.

Frontal asymmetry

Neural activity was recorded from F3 and F4 electrodes on the frontal cortex. The relatively higher activation of the left hemisphere compared to the right hemisphere was used as a neural index of approach motivation (Davidson, 2004; Davidson et al., 1990; Garczarek-Bąk & Disterheft, 2018; Ravaja et al., 2013; Tomarken et al., 1990; Zinser et al., 1999).

The EEG signals for each stimulus were extracted using the stimulus on- and offset timing provided by the data collection software. The raw EEG signals from the F3 and F4

electrodes were z-scored to obtain relative amplitudes of the frequencies of interest. For the stimulus images (neutral GAPED images, water and salty biscuit) power spectral densities in the alpha frequency range (8–12 Hz) were computed for both electrodes using the NeuroSpec toolbox package v2.0 (neurospec.org) for MATLAB (2020). The Power Spectral Density (PSD) estimates were carried out using methodologies set out in Halliday et al. (1995) using 1-second segments with zero overlap. The PSD estimates were then used to calculate the mean frontal alpha asymmetry (FAA) which measures the difference between distributions of frontal alpha activity across the two hemispheres. First the log transformed difference of the PSD estimates at each frequency (8-12Hz) was calculated:

$$FAA_{8-12Hz} = \text{Log}(F4) - \text{Log}(F3) \text{ (Calculated for each frequency)}$$

This provided a difference for each of the frequencies between 8-12Hz. As a last step the mean of differences across the range of frequencies was calculated to obtain the measure of frontal asymmetry. In neurophysiological research it is known that neural activation patterns are highly reliable within-subjects but not necessarily between-subjects (see Corsi-Cabrera et al., 2007). Within-subjects experimental designs can overcome issues with cortical differences by using a proper baseline for meaningful comparisons (Dimoka et al., 2012). Such designs can help reduce error variance by using each subject as her/his own control, as individuals provide their own optimal baseline for measuring activation differences (Daugherty et al., 2016; Dimoka et al., 2012). Therefore, the index scores of the 12 neutral GAPED images were averaged for each participant and the resulting score was used as the baseline for the participant. This baseline score was then subtracted from the index score of the participant for the salty biscuit image and water image. Therefore, the frontal asymmetry scores were compared within-group.

Shapiro-Wilk tests did not show evidence of non-normality for the experimental group frontal asymmetry index value datasets for the salty biscuit image $W(16) = 0.977, p = 0.932$ and water stimulus image $W(16) = 0.987, p = 0.996$. Based on this outcome, a dependent samples t-test was utilized. Results show no significant differences in within the experimental group for the salty biscuit image ($M = -0.009, SD = 0.59$) and water image ($M = 0.033, SD = 0.59$), $t(15) = 2.07, p = 0.056$ (two-tailed), Hedges' $g = -0.49$; 95% CI = -0.98 to 0.01.

For the control group frontal asymmetry index values dataset, the Shapiro-Wilk tests did not show evidence of non-normality for the salty biscuit image $W(16) = 0.909, p = 0.112$. However, the frontal asymmetry index values for the water image provided evidence of departure from normality $W(16) = 0.882, p = 0.041$. Therefore a non-parametric, Wilcoxon signed rank test for non-parametric dependent small samples was used. The test revealed no significant differences in frontal asymmetry index values for the salty biscuit image ($Mdn = -0.007, n = 16$), and water image ($Mdn = 0.003, n = 16$), $z = -0.83, p = 0.41, r = -0.15$.

Session 3: Choice and Water Consumption

The purpose of this session was to measure the behavior-altering effects of water deprivation/satiation on choice and actual consumption, linked to research questions three and four.

Design

The third session consisted of paired choice comparisons. To simulate choice (clicking behavior) the last session consisted of 25 paired choice trials (5 liquids x 5 food items). The liquid beverage and salty snack images from the second session were used again. In each trial, participants were instructed to choose between two options consisting of a liquid beverage and a salty snack. The position of each option on the screen (right versus left side)

was counterbalanced between the pairings. The order of the trials was randomized. Finally, post-experimental questionnaires recorded demographic information and a question on hypothesis guessing. The participants were then informed that they were “free to drink water” and were given a 500 ml bottle of water and a plastic cup. The remaining water left in the 500 ml bottle was used to measure the actual consumption of water for participants in both groups.

Apparatus

In this session, participants in both groups had to choose between the two options presented onscreen, consume water, and answer demographic information. Using a standard mouse and keyboard, all participants completed two-alternative forced-choice questions and demographic information. A 500 ml bottle of water and a disposable plastic cup were given to the participant at the end of the session for consumption. A standard digital food scale was used to measure the remaining water in the bottle (after consumption).

Procedure

The participants started the slideshow and answered the 25 paired choice trials (5 liquids x 5 food items). In each trial, participants were instructed to choose between two options. One of these options always corresponded to a liquid beverage (still water, sparkling water, milk, cola, and juice); the other option always corresponded to a salty snack (pretzel sticks, peanuts, chips, crackers, and salty biscuits). Thereafter, the participants answered the demographic questions onscreen. At the end of the session, participants consumed water from the bottle provided using the plastic glass.

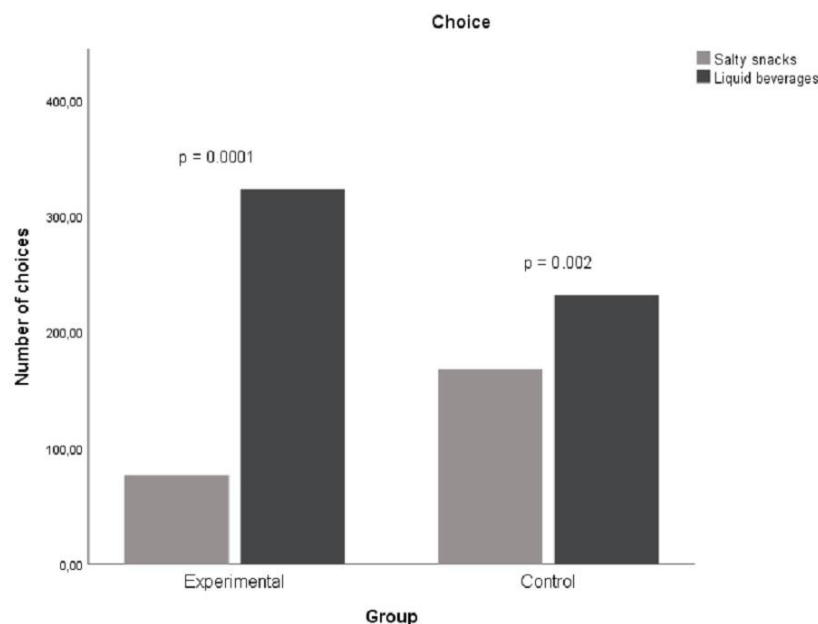
Analysis and results

Paired choice comparisons. Figure 1 below shows choice differences between groups. We tested whether choice proportions differed between the groups when choosing either a salty snack or a cold beverage for the paired choice comparisons. Liquid beverages were chosen

more often by participants in the experimental group (81%; 323/400) compared to the control group (58%; 232/400). A chi-square test of independence was performed to evaluate the relationship between group and choice of liquid beverage. The results of Chi-square test of independence (with Yates Continuity Correction) revealed that relationship between these variables was significant $X^2(1, N = 800) = 47.66, p < 0.001, \phi = 0.28$. Participants in the experimental group were more likely to select liquid beverages than participants in the control group.

Figure 1

Differences in choice of reinforcers in session 3



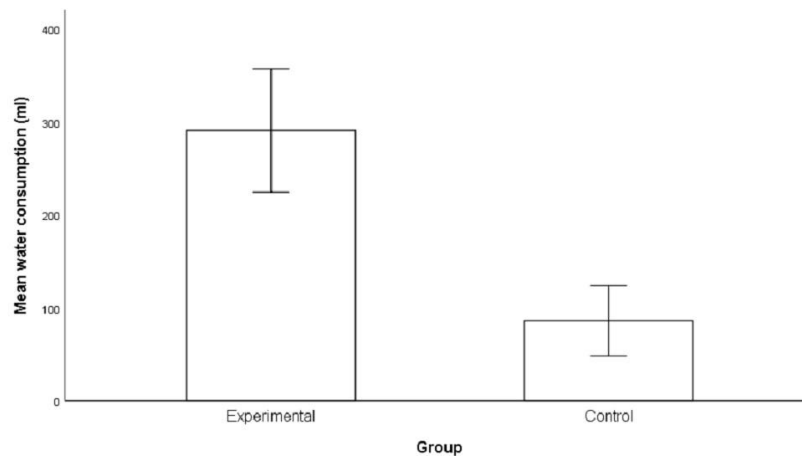
Amount of water consumed. Figure 2 below shows actual differences in the amount of water consumed by participants in the experimental group and control group. Participants in the experimental group consumed on average 291.1 ml of water ($SD = 124.7$, range = 138–500 ml). Three participants consumed the full amount of water in the 500 ml bottle in the experimental group. Consumption of water in the control group was 86.1 ml on average (SD

= 71, range = 0–242 ml). Five participants refused the option to consume water in the control group.

For water consumption, the Shapiro-Wilk tests provided evidence of departure from normality for the experimental group $W(16) = 0.875, p = 0.03$. The consumption values for the control group did not show evidence of non-normality $W(16) = 0.87, p = 0.06$. Therefore a Mann-Whitney U test revealed significant differences in water consumption between participants in the experimental group ($Mdn = 254.00, n = 16$) and participants in the control group ($Mdn = 99.50, n = 16$), $U = 10.00, z = -4.46, p < 0.001$, with a large effect size $r = 0.79$.

Figure 2

Differences in consumption of water in session 3



Note. The error bars represent the standard errors.

3.4 Discussion

The main aim of this study was to contribute to a fuller picture of the relationship between antecedent events that have a motivating function on consumer behaviors, and how to study them by capturing their complexity using multiple methods. In foodservice contexts, deprivation is a relevant antecedent state that individuals experience. To capture the complexity of this relationship between antecedents, consumer behavior, and consequences, we used three experimental sessions to examine visual attention (eye movements), neural

responses, choices, and water consumption. The results provide preliminary evidence that that the effect of motivating operations can be measured using eye-tracking, EEG, choice, and consumption registration.

Our first question examined whether deprivation would have an EO effect on beverages and evoke a higher fixation count and longer average fixation duration toward the relevant reinforcer. Satiation (having an AO effect) will not show the same impact. A comparison across the two stimulus images (water and salty biscuit) for fixation count and average fixation duration shows that deprivation can affect eye movement. The finding shows that participants in the experimental group had a significantly higher average fixation duration on the stimulus that had an EO effect (water). No differences were present for average fixation duration in the control group. This finding is in line with literature that has demonstrated that deprivation can cause changes in eye movement behavior especially in terms of the attentional duration metrics towards relevant reinforcers (Castellanos et al., 2009; Hardman et al., 2021). Such research suggests that deprivation might induce a heightened state of attention towards relevant reinforcers in a visual processing stage related to stimulus recognition and focused attention (Stockburger et al., 2009). For fixation count, the salty biscuit image had higher number of fixations than the water image for the deprivation group. No differences were present for fixation count in the control group. A possible explanation for this result could be due to the stimulus images being presented for a limited time in the experimental sessions. In time-bound conditions, fixation count and average fixation durations seem to have an inverse relationship. This might not be the case in free-viewing conditions. In this research we can only state that under the influence of deprivation, only the average fixation duration metric provides some evidence of how the value-altering and behavior-altering effects of motivating operations influence eye movement behavior.

The second question was to examine whether deprivation would have an EO effect on beverages and evoke relatively greater left frontal activity (approach motivation) toward the relevant reinforcer. Satiation (having an AO effect) will not show the same impact. There was no significant difference in frontal asymmetry activity in the experimental group when viewing the image of the water or the salty biscuit image. There was also no difference present in the control group. However, the results for the experimental group provide us with enough evidence to warrant further replication and extension of this study using the same method. Future studies with a larger sample size would be able would be better equipped to demonstrate differences using frontal EEG asymmetry. Even though prior research has shown that this is a reasonable sample size to demonstrate differences between groups when using neurophysiological tools (e.g., Glaholt & Reingold, 2011; Indira et al., 2012; Telpaz et al., 2015), our results demonstrate otherwise. Consequently, the neurophysiological results of the study depart from previous literature which has reported that frontal EEG asymmetry can be used to measure the motivating function of deprivation (Gable & Harmon-Jones, 2008; Harmon-Jones & Gable, 2009; Zinser et al., 1999).

The third and fourth research questions examined whether deprivation has an EO effect on beverages and evokes a) choices of the relevant reinforcer and b) greater consumption of the reinforcer. Satiation (having an AO effect) will not show the same impact on choice and consumption. The empirical results are in accordance with the logic of the concept of motivating operations. Deprivation caused changes in the preferences of participants in the experimental and control groups, supporting previous studies that have examined the influence of motivating operations on choice behavior (Fagerstrøm et al., 2010; Fagerstrøm & Ghinea, 2011). It is interesting to note that the value-altering and behavior-altering effect of motivating operations caused by water deprivation was particularly evident in the consumption of water (the reinforcer). The experimental group consumed almost three

times the amount of water compared to the control group. These results demonstrate the EO effect of deprivation and the AO effect of satiation on choice and consumption.

This study makes several important contributions. Due to the current progress in neurophysiological research and greater accessibility to neurophysiological tools, researchers in several fields have shown interest in cross-disciplinary collaboration with neuroscientific research to understand human motivation. This research contributes by complementing existing sources of data, using a multi-method approach, to gain a more comprehensive understanding of antecedent events that have motivating functions on consumer behavior. We measured observable phenomena, namely, behavior and the range of activity on the brain level (Ortu & Cihon, 2019), thus providing objective and reliable insights into consumer behavior (Nevid, 2010; Shaw & Bagozzi, 2018). This research captures the complexity of such interactions by measuring multiple value-altering and behavior-altering effects of motivating operations on consumer behavior.

The findings from the current study contribute to the knowledge by integrating behavioral and neural data for a fuller assessment of behavior (Donahoe, 2017; Hantula, 2018; Ortu & Vaidya, 2016). Such collaboration between research fields will help shed light on complex behavioral phenomena (Newland, 2020; Ortu & Cihon, 2019) by using behavior analysis principles to explain phenomena on neural levels (Hantula, 2019). This is in accordance with current research that studies behaviors that neurophysiological tools can measure. These tools can be used to examine stimuli with reinforcing, punishing, and discriminative functions or as motivating operations that alter the reinforcing or punishing effectiveness of other stimuli (Soto, 2020). Such an expanded repertoire of experimental and analytical tools might permit us to make progress in our understanding of complex behavior (Granerud-Dunvoll et al., 2019; Ortu & Vaidya, 2020; Palmer, 2010). To the best of our knowledge, human participants have not been used when studying the effect of water

deprivation from a behavioral perspective, i.e., as a motivating operation. We show the role of motivating operations in controlling human behavior, thereby enabling a richer assessment of behavior (Sundberg, 1993). The benefit of using such a functional account of behavior is that it is predictable and the possibility to control behavior is strong (Pierce & Cheney, 2013). Such an approach should be attractive for researchers and practitioners who focus on consumer motivating functions in retailing, both in physical and online stores.

The sample consisted of 32 participants, in spite of this, the study was able to indicate some differences in a diverse topographies of behavior. However, it would be advisable for future studies to use larger sample sizes. Data collection in this study was conducted in an artificial setting, that is, in a laboratory. The laboratory setting enabled the reduction of artifacts in the collection of neurophysiological data. For this study, data collection was carried out in a controlled experimental setting. Future research could replicate this study in-store with a few more participants to see whether the results differ from laboratory settings. Using a similar multi-method approach, future studies could also examine other relevant motivating operations to test the robustness of the proposed approach. Some research has demonstrated that food-related attentional behavior varies along with different time courses, and is modulated by the type of stimulus and food energy (Luo et al., 2023). Future research can replicate this study and examine the relationship between stimulus type, calorie content, deprivation duration, and visual search behavior. More and more companies are using neurophysiological measures to evaluate and tweak the design of their products (Burkitt, 2009). Our goal was to provide a methodological procedure for management and academia that can remove some of the speculative interpretation of neurophysiological and biometric data. The procedure enables this by framing everything in a behavioral science logic.

3.5 Conclusion

The use of neurophysiological methods to examine different marketing effects is evident through a number of commercial applications by many notable companies. In a similar vein, the procedure outlined in this study can help store owners assess the influence of relevant antecedent events that influence consumers inside the store. Such an approach can be used to evaluate the effectiveness of design elements (like in-store layouts and interface designs of in-store technology) within store settings. Thus, the contribution to practice is a systematic procedure for using multiple neurophysiological methods. The study provides preliminary evidence that situational antecedent events have motivating effects on attention, neural responses, choice, and actual consumption. In turn, these situational factors have an influence on consumer behaviors. This research presents a thought provoking and challenging perspective on behavior science. The combination of multiple methods yields richer insights to examine such complexity compared to using a single method. Our results provide a fuller understanding of antecedent situational effects on consumer behaviors, as well as highlighting the potential application of neuroscientific tools in consumer behavior analysis. Future research could use the methodological procedure of this study using the same design and number of conditions. This will help test the robustness of the multi-method approach that combines behavioral science with neurophysiology to examine the motivating functions of consumer behavior using a larger sample size. Future research can examine other antecedent motivational factors besides water deprivation. Such efforts will help provide more empirical evidence of how motivating operations impact attention, neural activity, choice and consumption.

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Chapter 4

An Explorative Study of How Visceral States Influence the Relationship Between Social Proof Heuristics and Donation Behavior When Consumers are Using Self-service Kiosks

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Abstract

Self-service kiosks are increasingly being used in situations where a person is out to buy food and/or drinks. Several cause-related marketing initiatives have capitalized on using self-service technology to include small donation requests at the point of purchase. In this context, it is highly likely that during such purchase situations, a person is under the influence of a visceral state like hunger or thirst. This study investigated how a simulated visceral state of thirst could influence donation behavior. More specifically, how donation social proof indicators presented on self-service kiosk screens can impact likelihood to buy. Results of a conjoint study (n=83) demonstrate that, in a visceral state situation, only a high level of social proof related to donation has a positive impact on likelihood to buy. Any other level of social proof (medium, low and not mentioned), decrease the likelihood to buy in such situations. A scenario simulation analysis shows that cases which included a high level of social proof have relatively higher preference. Consequently, antecedent situational variables like visceral states must be taken into consideration when cause-related marketing activities such as social proof (related to donation) are used in self-service kiosks.

4.1 Introduction

Kiosks are one type of self-service technology that have been around for decades in the service sector (e.g., ATMs, vending machines, travel and ticketing machines). When used within the retail landscape, kiosks mainly deliver information to the customer or promote and sell products/services (Inman & Nikolova, 2017). These standalone terminals are slowly making their way into diverse retail sectors, including food service, supermarkets, department stores, specialty stores, drug stores, bookstores, and entertainment (Cho & Fiorito, 2010). It is logical to expect that kiosks provide functionalities tailored to the retail context. The practical applications of kiosks are quite extensive as they make way into many different sectors. For example, many restaurant companies like Olive Garden and Buffalo Wild Wings are equipping their facilities with self-service kiosks (Puzder, 2016). McDonald's plans to systematically introduce self-service kiosks to 1000 facilities each quarter for the next eight to nine quarters (Whitten, 2018). However, most research on self-service kiosks originates from the wider field of self-service technology research, which leads to a high degree of generalization (Vakulenko et al., 2018). Research has shown that situational states influence actual usage of self-service technology in retail (Demoulin & Djelassi, 2016; Meuter et al., 2003; Wang et al., 2012). On a global scale, retailing sectors like supermarkets and convenience stores are increasingly under pressure to implement cause-related marketing activities to support sustainable social and/or environmental causes (Jones et al., 2011; Lehner, 2015; Yen & Yang, 2018). Self-service technologies have shown promise in supermarket contexts to motivate consumers to adopt more sustainable behaviors through interactive displays e.g., (van Giesen & Leenheer, 2019). Thus, there is a need to study situational variables as they occur naturally (e.g., in the convenience context) when consumers interact with self-service kiosks. According to Belk (1975), situational states are imperative in understanding of consumer behavior. Ward and Robertson (1973, p. 26) argue

that “situational variables may account for considerably more variance than actor-related variables”. Belk (1975) suggests the following situational characteristics that may influence consumer purchases: (1) Physical Surroundings, (2) Social Surroundings, (3) Temporal Perspective, (4) Task Definition, and (5) Antecedent States. Antecedent states such as visceral states (e.g., thirst, hunger, pain, warmth, sexual desire) are obvious situational conditions that might impact consumers’ choice when purchasing products in a convenience context, since they most probably will be in a state of thirst or hunger.

In recent times we have seen an increasing frequency of cause-related marketing initiatives that have capitalized on using self-service technology to include small donation requests at the point of purchase. Cause-related marketing involves a collaboration between a non-profit organization and a profit business for a common benefit (Baghi & Gabrielli, 2018). For example, UNICEF can collaborate with a convenience store that has self-service kiosks to include a donation to a charitable cause when consumers are purchasing products. In this context, it is highly likely that during such purchasing situations a person is under the influence of a visceral state like hunger or thirst. In general, people are more charitable if they are told that others have previously behaved in a similar fashion (Croson et al., 2009; Nook et al., 2016; Shang & Croson, 2009). Consequently, in the context where donation to a charitable cause is present on the self-service kiosk, the inclusion of social proof might also influence the donation behavior.

The aim of this exploratory study is to contribute to understanding of how visceral states influence the relationship between social proof and donation behavior when consumers are using self-service kiosks to purchase products. Therefore, research objective of this study is to examine how donation social proof indicators presented on self-service kiosk screens can impact likelihood to buy. Knowledge about the influence of such situational characteristics could give researchers a better foundation for understanding donation behavior in a setting

where consumers usually are in a visceral state (e.g., when using self-service kiosks). A deeper insight to the relationship between social proof and donation behavior would also help non-profit organizations such as UNICEF, Save the Children, and Red Cross to manage their cause-related marketing activities with the profit business.

This paper has four parts. Firstly, the concept of visceral states and social proof is reviewed in relation to donation behavior. This is followed by a description of the conjoint design used in the study. Next, the findings based on conjoint analysis are discussed and summarized. The paper concluded with a discussion of academic and managerial implications, and directions for future research are given.

4.2 Literature Review

Visceral States and Donation Behavior

Antecedent states often have a strong influence on preferences, behavior and final purchase. Visceral states are one example of situational variables that can be modelled as an instance of state-dependent preferences (Loewenstein, 2000). Visceral states is a collective term used to categorize intense states (e.g., thirst, hunger, pain, warmth, sexual desire) that have a disproportionate effect on attention (Loewenstein, 1996). The two main characteristics of visceral states are that: (1) they have a disproportionate effect on immediate behavior (which takes precedence over all goals other than that of mitigating the visceral state); and (2) people under weigh or ignore, the impact visceral states on past/future behavior, or that are experienced by other people (Loewenstein, 1996, 2000). In other words, people are unable to recall the impact of visceral states on themselves or others and are likely to underestimate the influence of visceral states.

These characteristics of visceral states have three distinct forms of attention-arousing effects caused by the experience of visceral states on the behavior of individuals. The first is

that with increasing intensity visceral states focus attention and motivation on activities (like consumption) that are associated with the visceral state (e.g., thirst draws attention and motivation toward water).

The second form is increased temporal focus on the present. This present orientation, only applies to goods that are associated with the visceral state, and only to trade-offs between the present and some other point in time (Loewenstein, 1996). Empirical evidence has provided support for the present orientation for the visceral state. Research has demonstrated that hungry individuals show an increase in their desire to acquire hedonic food (vs. non-food) items, and this effect is driven by a shift in their time orientation, with a more prominent focus on present pleasures (Otterbring, 2019).

Visceral states focus attention inwardly, thus, the third form of attention-narrowing increases focus on oneself over others, effectively undermining altruism (Loewenstein, 1996). Empirical evidence suggests that people are less generous when experiencing a visceral state. Hunger promotes the intention to acquire food and even nonfood objects (e.g., binder clips), when these items are freely available and when they must be paid for (Xu et al., 2015). Research has found the same effect in children between 4-9 years of age. Children that reported higher levels of hunger were less likely to share both food and nonfood resources, and this effect was particularly pronounced when it came to sharing food (Huppert et al., 2020). Similarly, evidence suggests that hunger affects donation behavior. Hungry participants were found less to donate to charity than satiated participants (Briers et al., 2006). Harel and Kogut (2015) found that for donation decisions, people tend to be less generous when actively experiencing a visceral state (hunger) when compared to being satiated and are less responsive to others' needs even when those needs match their own visceral state. Based on this, when consumers are experiencing a visceral state like thirst

(which is often the case when using a self-service kiosk to buy something to drink) the likelihood to donate is low.

Social Proof and Donation Behavior

It is accurate to assume that visceral states are more essential to the daily functioning of an individual than many higher-level cognitive deliberations, that are often assumed to underlie decision-making (Loewenstein, 2000). On a daily basis, individuals are confronted with immeasurable amounts of information that can potentially influence a vast array of decisions. It is practically impossible to process each individual unit of information for a majority of daily decisions. In conditions of uncertainty, or in situations where a well-deliberated decision cannot be made, individuals use fast, general, mental shortcuts called heuristics to guide their decisions (Tversky & Kahneman, 1974). In the marketing of food products, a frequently used heuristic is the social proof heuristic, which refers to the tendency to adopt the option preferred by others (Salmon et al., 2015). It is based on the general heuristic rule that if many others are doing it, it must be good (Cialdini & Goldstein, 2004). Social proof has been shown to be an effective nudge in situations where individual deviate from “ideal” behaviors. Studies have applied social proof to nudge pro-environmental towel reuse (Goldstein et al., 2008), promote household energy conservation (Schultz et al., 2007), and to promote healthy food purchase (Salmon et al., 2015; Salmon et al., 2014; Sigurdsson et al., 2020). Research has shown that under the visceral state of hunger, social proof can be an effective heuristic to help people make healthy decisions. Cheung et al. (2017) found that when social proof heuristics are used to promote healthy food options, hungry participants made more healthy purchases in the presence of a social proof heuristic (vs. no social proof heuristic), and made just as many healthy food purchases as satiated participants. Thus, the simple inclusion of a social proof heuristic can “nudge” people to make optimal decisions.

In the donation context, the presence of social proof influences the decisions of potential donors. In general, people are more charitable if they are told that others have previously behaved in a similar fashion (Croson et al., 2009; Nook et al., 2016; Shang & Croson, 2009). People do as other people do, presumably because they think that this is an effective and appropriate course of action in that situation (Lindersson et al., 2019). Increasing attention to social proof heuristics increases donation behavior because when people learn that most other people give to charity, they are more likely to do so themselves (Bartke et al., 2017). Studies have shown that social proof which describes common behavior (e.g., 73% of students have contributed previously) triggered higher donations than standardized altruistic appeals (Agerström et al., 2016; Lindersson et al., 2019). Overall, evidence suggests that the relationship between social proof and donation is quite robust (Lay et al., 2020). Consequently, when social proof is presented on the self-service kiosk that describes common behavior it would trigger higher likelihood of donations.

4.3 Method

Participants and Procedure

An initial convenience sample of 101 undergraduate students willingly participated in the study (no compensation was offered). Ten cases had incomplete data and were removed. An additional eight responders were screened out from the analysis due to invalid cases. The final sample comprised of 83 participants with 50 females, 31 males, and 2 participants preferred not to disclose their gender. In this sample, one participant was in the <18 age category, 57 participants were in the 18–22 age category, 23 in the 23–30 age category, and 2 in the 31–45 age category. Eighty-eight percent of the participants had previously interacted with a self-service kiosk (either for shopping or in general).

Previous donation behavior was measured by asking, “How many times do you donated to charitable causes in a year?” Twenty-two participants were in the “never” category, 42 were in “1-2 times” category, 10 were in the “3-5 times” category, 4 were in the “6-10 times category, and 5 were in the “more than 10 times” category. All participants had heard of UNICEF, and 47% had previously supported UNICEF (with cash or time), while 53% were aware of UNICEF, but had not supported. In general, sample had a positive perception of UNICEF (69%), while 24% were neutral. Similarly, the perception towards the selected UNICEF cause aimed at supporting vulnerable children was overall positive (77%), and 17% were neutral.

Participants were informed that the purpose of the study was to examine interaction with self-service technologies (kiosks). The participants were then presented with a link to the study, which was conducted in Qualtrics. The participants were told to imagine a typical shopping trip where the person will make a few stops during their journey.

To make the scenario more realistic, the following information was presented: Imagine you are in a shopping mall. You enter an electronics store to buy a VR headset for your phone. You wear a demo unit, scan the QR code, and attach your phone to the headset. The headset transports you into a virtual 360 desert environment. You actually feel like you are in a desert. Imagine yourself in this place. Look around, notice all aspects of this environment. Pay attention to the colors. Imagine yourself breathing in the air and imagine any sounds you may hear in this environment. This was followed by the scenario to manipulate the visceral state of thirst. It has been shown that mentally simulating visceral states can substitute for actual visceral experiences (Keesman et al., 2016; Steinmetz et al., 2018). Additionally, such simulations can be made more effective when used in conjunction with images (Shalev, 2014; Steinmetz et al., 2018). Therefore, for the manipulation of thirst consisted of a scenario similar to Keesman et al. (2016), along with a picture of an arid desert. The manipulation

scenario was presented as follows: for the next 60 seconds, imagine that you are in this environment and are very thirsty. Please think about what it would be like to feel very thirsty in as much detail as possible. Think about what your experience would be like: What would you be thinking about? How would your body feel? How would you act? Please try to give us a general description of your thoughts and feelings (4-5 lines).

This was followed by the general scenario to ensure a common frame of reference when interacting with the self-service kiosk. The scenario was as follows: you have managed to buy all the items on your shopping list for today. You pass through a place where you can get something to eat and drink. As you enter, you notice a digital kiosk, with the words “order here” written at the top. This digital kiosk allows you to place your order without going to the cash counter. You have ordered your food. Now you are in a situation to order your favorite drink. You see the following information on the digital screen when you are placing your order. Based on the scenario, the participants were presented with 20 different stimulus cards (randomized) (see Figure A1 in the Appendix A for an example of the stimulus cards used in the study). They were asked to evaluate the purchase situation based on the information provided by the self-service kiosk. After the participants evaluated the 20 stimulus cards, they filled out demographic and questions related to donation behavior, perception of UNICEF, the selected cause and interaction with self-service kiosks.

Design

Conjoint analysis is a research technique allows for the composition of consumer preferences while maintaining a high degree of realism (Hair et al., 2014). Basically, conjoint analysis measures the relative importance of the predetermined independent variables and their levels. The relative utility of the different states and levels is “decomposed” from consumer purchases as they are presented with systematic combinations of the factors and

levels. As a result, it is quite suited to measure the relative impact of the different variables encountered during the purchase situation.

A main effect model was used to design the combinations. This method assumes that participants add the values for each stimulus to get the total value of combinations of stimuli (Hair et al., 2014). The conjoint data collection procedure was a full-profile approach that utilizes the complete set of factors (defining each levels of the factors) because it gives a more realistic description of the stimuli (Green & Srinivasan, 1978). Thus, a full-profile method is also preferred when using actual images for the construction of experimental stimuli (Wittink et al., 1994). This method is also recommended when the number of factors is below six along (Green & Srinivasan, 1978). In addition, the full-profile method is recommended to be used with a fractional factorial design as long as the number of attributes is small (up to six) (Green & Srinivasan, 1990; Hair et al., 2014). The fractional factorial design is a method of designing stimuli that uses a subset of the possible stimuli needed (called an orthogonal array), to estimate the results based on the assumed composition rule (Hair et al., 2014). We used IBM SPSS version 26, the fractional factorial design resulted in 20 stimulus cards, including four hold out cards (see Table A1 in Appendix B).

Table 1 summarizes the stimuli and levels used in the study. Based on the literature reviewed, social proof was operationalized at four levels: high level (3104 7-eleven customers have supported this cause); medium level at 25% of the high value (776 7-eleven customers have supported this cause), low level at 12.5% of the medium value (97 7-eleven customers have supported this cause), and not mentioned.

Table 1. Stimuli and levels used in the study.

Stimuli	Levels
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Social proof heuristic	1. High level 2. Medium level 3. Low level 4. Not mentioned
Price format	1. Donation mentioned separately 2. Donation included as a percentage
Cause proximity	1. Local 2. Region: Close 3. Region: Far

Literature on donation has shown that for cause-related marketing, the presentation format of the donation amount can cause confusion (Olsen et al., 2003; Pracejus et al., 2003). It is not surprising that consumers prefer to know exactly how much of their purchase is being contributed to the cause (Grau et al., 2007). We presented donation formats as actual amounts (price plus absolute value donated) or as the full amount (with the donation being included in price and the percentage mentioned in parenthesis). Thus, we included two price formats where donation was mentioned separately in absolute NOK amount (price plus donation) and donation included in the price where the percentage being donated was mentioned in parenthesis. The final cost of the water bottle was the same at NOK 30. The “donation mentioned separately” level was operationalized as NOK25 + NOK5 donation. The “donation included as a percentage” condition was operationalized as NOK 30 (15% of proceeds will go to....), donating an amount of NOK 4.5 from the NOK 30 cost of the water bottle. The difference between amounts donated in the two operationalizations was negligible (0.50NOK).

We also included cause proximity as an additional independent variable. Cause proximity deals with the geographic distance between the donation cause and the consumer (Varadarajan & Menon, 1988). Studies have shown that cause proximity has an effect on donation behavior e.g., (Grau & Folse, 2007; Kulshreshtha et al., 2019). However, sometimes

mixed effects occur with regards to cause proximity e.g., (Ross et al., 1992; Smith & Alcorn, 1991), we suspect that cause proximity effects are context-dependent. Visceral states themselves are transient and depend on external circumstances (Loewenstein, 1996). Therefore, we decided to include cause proximity as an additional independent variable. We operationalized cause proximity at three levels: “Local” (local region), “Close” (Scandinavia), and “Far” (East Africa). The dependent variable was purchase and was operationalized as “based on the information provided by the digital screen, what would be the likelihood that you would buy the product?” The response scale ranged from “Not at all” (coded 0) to “Extremely” (coded 7). See figure A1 in appendix A for an example of the stimulus cards used in the study.

4.4 Findings

Since the nature of this study was exploratory, we had no prior assumptions about the relationship between the variable levels and purchase. Thus, a discrete effect was used to analyze the data. The correlation between the observed and estimated preferences for likelihood to buy (Pearson’s $r = .900$, $p = .000$) shows a positive linear association. Table 2 demonstrates the impact estimate, standard error, and importance values for each stimulus and their levels. Cause proximity stimulus, with an importance value of 42.12%, was marginally more important than social proof heuristic value of 41.33%. Price format was the least important stimuli with a value of 16.55%

Table 2. The impact of stimuli and levels on likelihood to buy.

Stimuli and levels	Likelihood to buy		
	Impact estimate	Standard error	Importance values
Social proof heuristic			41.33%
1. High level	0.121	0.060	
2. Medium level	-0.047	0.060	
3. Low level	-0.044	0.060	
4. Not mentioned	-0.029	0.060	

Price format			16.55%
1. Donation mentioned separately	-0.067	0.035	
2. Donation included as a percentage	0.067	0.035	
Cause proximity			42.12%
1. Local	-0.174	0.046	
2. Region: Close	-0.112	0.054	
3. Region: Far	0.286	0.054	
(Constant)	3.573	0.037	

Table 2 shows that a high social proof level value increases the likelihood to buy, with an impact estimated score 0.121. However, medium social proof level, low social proof level and not mentioned, decrease the likelihood to buy, with an impact estimate score of -0.047, -0.044, and -0.029, respectively. It is interesting to note that that the not mentioned level had a lower negative impact than medium social proof level and low social proof level. In addition, another interesting finding is that the difference between medium social proof level and low social proof level is not very large.

Table 3. Scenario simulation analysis.

Scenarios	Cases	Social proof heuristic	Price format	Cause proximity	Preference scores	Maximum Utility ¹
High level	A	High level	Separately	Local	3.453	14.1%
	B	High level	Included	Far	4.047	16.3%
Medium level	C	Medium level	Separately	Local	3.285	4.5%
	D	Medium level	Included	Far	3.878	14.8%
Low level	E	Low level	Separately	Local	3.288	7.6%
	F	Low level	Included	Far	3.881	15.3%
Not mentioned	G	Not mentioned	Separately	Local	3.303	8.1%
	H	Not mentioned	Included	Far	3.898	19.4%

¹. Including tied simulations.

Table 3 shows the scenario simulation analysis for the study. Maximum utility is the most suitable for the scenario simulation analysis because it is suited for non-routine purchases (Hair et al., 2014). Thus, it was used in this context because purchasing food/drinks from a smart kiosk is not routine for the majority of the population. Case H is the most preferred (19.4%), which comprises of a situation with no mention of social proof, donation included in the final price and donation towards a proximally far cause. The least preferred combination, case C, was a situation where only 4.5% of the participants preferred a medium level of social proof, donation mentioned separately and donation towards a local cause. Overall, both cases that included a high level of social proof have relatively higher values and less of a difference between them (14.1% and 16.3%), when compared to the other social proof levels and combinations of factors.

4.5 Discussion

Intense visceral states tend to narrow one's focus inwardly to undermine altruism (Loewenstein, 1996). The aim of this exploratory research was to examine how visceral states influence the relationship between social proof and donation behavior when consumers are using self-service kiosks to purchase products. Using a conjoint study, we examined relevant situational stimuli when interacting with a smart kiosk to order a drink. A conjoint study was employed to create an ecologically valid situation that included relevant cause-related marketing stimuli, i.e., social proof heuristic, price format and cause proximity. Results demonstrate that the most important stimulus in a visceral state situation is cause proximity, closely followed by social proof heuristic. Price format was the least influential stimuli in this context.

The results demonstrate that, in a visceral state situation, a high social proof level has a positive impact on likelihood to buy. This is in accordance with literature that demonstrates that social proof has a positive relationship with prosocial behaviors (Agerström et al., 2016;

Bartke et al., 2017; Lindersson et al., 2019), and partly supports literature that suggests that social proof heuristics can be used to lessen the impact of visceral states (Cheung et al., 2017). The results of the scenario simulation show that, overall, the scenarios with high social proof were more preferred when compared to factor combinations that included other social proof levels. Additionally, the utility scores for high social proof scenarios are relatively more preferred in a visceral state situation, and have a less polarizing difference between the scores (as seen in the combinations for the other factors). Social proof under lower levels, i.e., medium and low had the strongest negative impact on likelihood to buy. No mention of social proof had less of a negative impact than these two levels. These results demonstrate partial support for the notion that visceral states have a negative impact on sharing of resources as evident by the negative impact on likelihood to buy (Briers et al., 2006; Harel & Kogut, 2015; Huppert et al., 2020; Xu et al., 2015). Taken together, these results suggest that only high levels of social proof might be an effective nudge strategy towards prosocial donation requests when individuals are actively experiencing a visceral state.

For cause proximity, the results indicate that the further the donation cause, the more positive impact on likelihood to buy. This finding is in contrast to other literature that has found that the proximally close cause is the most impactful e.g., (Grau & Folse, 2007; Kulshreshtha et al., 2019). Cultural effects could explain our findings, as the local Norwegian government, and the regional Scandinavian governments provide a lot of support to the local charities. Therefore, our finding might be explained by advantageous inequity aversion, which states that people tend to respond negatively to unfairness in situations where they receive more than others (Shaw & Choshen-Hillel, 2017). To reduce this inequality, people end up giving more to others in situations where they have more resources e.g., (Sweeney, 1990). In the context of our study, the inequality between East Africa and Norway is greater

than Norway and Scandinavia. Therefore, in our study, we view that donation towards proximally close cause had a negative impact.

For price format, results show that donation included (as a percentage in the price) had a positive impact on likelihood to buy and donation is mentioned separately has a negative impact on likelihood to buy. The literature on copy formats suggests that consumers prefer to know exact donation amounts (Grau et al., 2007). However, during the experience of a visceral state, consumers' attention is more focused on satisfying the visceral state (Loewenstein, 1996). Therefore, our results can be explained by the assumption that consumers would not prefer to make even simple calculations in when under the influence of a visceral state. From a general perspective, there is some indication for the attention-narrowing effects (Loewenstein, 1996) of visceral states in our results. All of the factors studied in the conjoint study (social proof heuristic, cause proximity and price format) have a positive impact on purchase behavior, but only at "greater" levels. Since the focus is on oneself, cues at lower levels have a negative impact.

One limitation of this research is that visceral states were simulated. Even though previous research states that mentally simulating visceral states can substitute for actual visceral experiences (Keesman et al., 2016; Steinmetz et al., 2018). Actual manipulation of visceral states like hunger or thirst (through deprivation) might influence the results differently. As the intensity of a specific visceral state increases, its influence on behavior tends to increase and to change in a characteristic fashion (Loewenstein, 1996). Using deprivation as manipulation, future research can examine different intensities of visceral states and their relationship with social proof. The current study only measured self-reported intentions to buy and not actual purchasing behavior. The interplay of visceral states with other demographic factors (e.g., gender, previous donation behavior etc.) could be examined further. We kept the product constant (an inexpensive water bottle from a well-known local

brand). Replicating this study with a relatively more expensive product could change the relationship between visceral states and the influence of different social proof levels. In addition, ethnocentrism is another product attribute that can be studied in relation to the perception of the product used e.g., (Casado-Aranda et al., 2020; De Nisco et al., 2016). Cause-related marketing can include a wide range of cause types (e.g., current local issues or broader environmental issues), future research can examine how different types of causes influence consumer donation intentions. For cause proximity, the use of specific countries as a distant location might also be a factor. While we tried to circumvent this by using regions instead of countries (Scandinavia as the “close” region and East Africa as the “Far” region). Future research could replicate this study and using other regions and with populations from different countries to see how purchase behavior is affected.

This research contributes to the understanding of circumstances that give rise to biases in consumer evaluations and decisions making. More specifically, how the influence of cause-related marketing is modulated by visceral states. We contribute to the literature that examines the influence of cause-related marketing efforts in different retail contexts, especially in cases where it works and where it does not. In our case, we focused on the convenience context. Future research could replicate this study in contexts where consumers are under the influence of visceral factors and has to interact with self-service technologies like in the case of restaurants e.g., (Puzder, 2016; Whitten, 2018). This study improves the understanding of possible consequences of including donation requests in self-service kiosks.

The main takeaway of this exploratory research is that situational states must be taken into consideration when cause-related marketing is used in relation to self-service technology. In the specific context examined in this research, only high levels of social proof is effective for donation requests when interacting with self-service kiosks while under the influence of visceral states. In this case, social proof is one attribute that can significantly influence

consumer choice when under the influence of visceral states. Only the most important, relevant states should be considered for cause-related marketing initiatives that are encountered when a person is actively experiencing a visceral state. Practitioners can better understand the effects of visceral states on buying behavior and use nudge strategies that are effective. In the context of this study, only high levels of social proof might be an effective nudge towards prosocial donation requests when individuals are under the influence of a visceral state. The practical implications that arise from this work demonstrate the usefulness of conjoint analysis as a tool to evaluate the impact of situational states present in self-service kiosks. More specifically, this method is useful to examine how various situational states come together to influence the consumer. In addition, it is useful to examine the use and eventual adoption of novel technologies like self-service kiosks.

4.6 Appendix A



Figure A1. An example of a stimulus card used in the study.

4.7 Appendix B

Table A1. Factorial design used to synthesize the stimulus cards.

Stimulus card	Stimuli and levels		
	Social Proof heuristic	Price format	Cause proximity
1	Low level	Included	Close
2	Low level	Included	Local
3	Not mentioned	Included	Local
4	Medium level	Included	Local
5	High level	Included	Local
6	Low level	Separately	Far
7	Low level	Separately	Local
8	Not mentioned	Separately	Far
9	High level	Separately	Local
10	High level	Included	Far
11	Medium level	Separately	Close
12	Not mentioned	Separately	Local
13	Medium level	Included	Far
14	High level	Separately	Close
15	Medium level	Separately	Local
16	Not mentioned	Included	Close
17	Not mentioned	Included	Far
18	Not mentioned	Separately	Close
19	High level	Separately	Far
20	Low level	Included	Far

Antecedent stimuli and their levels correspond to Table 1.

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Chapter 5
Discussion and Conclusion

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Discussion and Concluding Comments

In consumer research, situational factors have always been included to improve precision in the analysis of consumer behavior. Here the dominant cognitive approaches in marketing can be utilized. However, the requirements placed on the description of situations for these approaches become cumbersome and limit their usefulness (Foxall, 2002).

Cognitive logic is also inconsistent with the conceptualization of situations in consumer research, as this excludes the *interpretation* of the situation by the individual, or any other unique characteristics that can be attributable to the individual (Belk, 1974). The alternative is to use a behavior analysis approach to study consumption situations. The common thread tying consumer behavior analysis and the conceptualization of situations in consumer research is the focus on the objectively defined extensional situation and the controllable features of the environment (Belk, 1974; Foxall, 2001, 2002). Thus, consumer behavior analysis is an approach that is consistent with the core principles of situational consumer research.

The motivating operations concept, situated within the BPM framework from consumer behavior analysis, was used to study antecedent situational consumer motivating functions of deprivation within the area of consumer behavior analysis. The benefit of using this comprehensive framework is that it is just as applicable when explaining the motivating impact of promotion and advertising as when explaining the motivating effect of food deprivation (Fagerstrøm, Foxall & Arntzen 2010). The inclusion of motivating operations in consumer behavior analysis has the improved categorization of antecedent variables and has increased the precision with which the consumption situations can be studied (e.g., Fagerstrøm & Arntzen, 2013; Fagerstrøm et al., 2010; Fagerstrøm & Ghinea, 2011). This concept was proposed for the analysis of neurophysiological responses because it has been previously suggested that neurophysiological tools can be used to examine motivating

operations that alter the reinforcing or punishing effectiveness of other stimuli (Soto, 2020). In addition, examining changes at the physiological level can be used to predict reinforcer effectiveness, and might extend the scope and value of the MO concept (Poling et al., 2017).

The overall aim of this thesis is to progress research on antecedent situational factors in consumer research using the consumer behavior analysis framework. Focusing on how to study consumer motivating functions using a quantitative multi-method approach. Also, to investigate the impact of deprivation on consumer behavior using a controlled experiment and a retail-inspired situation. The broad objectives of this thesis were, first, to discuss how consumer behavior analysis can benefit from the inclusion of neurophysiological, sub-personal level of analysis of behavior with the super-personal extensional level of consumer behavior (Study I). Second, to provide a process for measuring and analyzing motivating operations of deprivation using a multi-method quantitative approach using eye-tracking and electroencephalography, in a manner consistent with the functional approach of consumer behavior analysis (Study II). Third, to managerially test how the influences of motivating functions can be mitigated using in-store kiosks. Specifically whether donation requests along with social proof information on self-service kiosk screens can overcome the attention-narrowing effects experienced during a visceral antecedent state like water deprivation (Study III).

5.1 Summary, Discussion, and Contribution

This section summarizes the study, presents the findings, and discusses them in relation to the literature presented in Chapter 1 of the thesis. The contributions of individual studies are also discussed within the broader context, especially in reference to mainstream consumer research, the field of consumer behavior analysis, and the concept of motivating operations.

5.1.1 Study I - Conceptual Advocacy Study

The first study, “The Marketing Firm and the Consumer: Predicting Motivating Functions Using Neurophysiology,” had the purpose of discussing how the contextual explanation of consumer-situations, in the broader context of the marketing firms, can be better understood by supplementing the extensional (super-personal level) with neurophysiological data (sub-personal level). Such an approach would enable the objective assessment of covert behaviors to improve the predictability of future consumer behavior. Using the Behavioral Perspective Model (BPM: Foxall, 2004, 2007) of consumer choice, the impact of different motivating operations (e.g., long-term vs short-term) can result in consumers experiencing intra-personal conflicts. These intra-personal conflicts can be interpreted as a bilateral contingency linking two diametrically opposed kinds of self-interest (Foxall, 2021). The chapter discusses examples of how to achieve such an integration of the extensional, super-personal level with the neurophysiological, sub-personal level. The chapter focuses on the example of Frito-Lay to highlight how examining different levels of consumer behavior helped them gain a better understanding of the intra-personal bilateral contingencies of women. This allowed Frito-Lay to tweak elements of its promotional material to target this segment more effectively.

Three levels of explanation of individual behavior were discussed, i.e., the sub-personal, personal, and super-personal levels (Foxall, 2021). Mainstream cognitive consumer research has incorporated the personal (intentional/personal accounts) with the sub-personal level, which has resulted in the fields of consumer neuroscience and neuromarketing. However, a major critique of such an integration is the issue of agency, where the use of cognitive psychological vocabulary in reference to cognitive or brain processes associated with centrism can turn the brain into the principal agent responsible for causing behavior (Zilio, 2016). This agent will also need to be explained, and this will shift the focus away

from environmental variables outside the organism. This also links well to the broader issues discussed in Chapter 1, highlighting the difficulty of integrating behavior analysis and neuroscience at a theoretical level, since the interpretations and explanations of behavior are fundamentally different in the two fields (Moore, 1997). Thus, such an approach is not well suited for the objective study of extensional, super-personal situational variables.

While some previous research within consumer behavior analysis has conceptually tried to connect the extensional, super-personal level with the neurophysiological, sub-personal level within the field of consumer behavior analysis and the marketing firm (e.g., Foxall, 2014), no study has proposed such an integration to study motivating operations of consumer behavior. The chapter proposes the use of electroencephalography, and the measurement of frontal EEG asymmetry, as this approach has previously been used in consumer research. Frontal EEG asymmetry is used to measure the electrical neural differences between the frontal regions of the right and left regions of the brain (Allen & Reznik, 2015). These differences have been associated with motivation in neurophysiological studies (Harmon-Jones et al., 2010; Harmon-Jones & Gable, 2018) and can be used to index motivational or behavioral tendencies to approach versus withdraw (Davidson, 1998, 2004). The study presents previous findings from consumer research where the measure of neural, covert, frontal EEG asymmetry responses has been used to predict consumer purchases. This measure was introduced as a possible instance where enough is known about the neurobiological phenomena (frontal EEG asymmetry) and the behavioral phenomena (motivating operations) to integrate the sub-personal and super-personal levels successfully (Timberlake et al., 2005). The measurement of these covert, sub-personal, neurophysiological responses can predict eventual overt responses in regard to the impact of behavior-altering and make inferences about the value-altering effects of motivating operations in consumer research.

The contribution of this study to mainstream consumer research is that it progresses the conceptual discussion on how to connect the extensional, super-personal level with neurophysiological, sub-personal levels, especially with regard to motivating operations for the study of antecedent situational factors, which has previously received little attention. The same applies to the field of consumer behavior analysis and the theory of the marketing firm. Understanding the implications of a contribution is important for understanding the value of the contribution itself (Ågerfalk, 2014). The implications for research were conceptually discussing how a synthesis between the motivational measure of frontal EEG asymmetry from neurophysiological research and the concept of motivating operations from consumer behavior analysis can be made possible. Such an approach can improve the prediction of consumer behavior by measuring both covert and overt behaviors and analyzing them using the MO concept. The implication for practice was that the discussion presented in the study can improve research-informed action regarding the creation of marketing intelligence, using a functional approach to the use of neurophysiological data in the extensional analysis of situational consumer motivation.

5.1.2 Study II – Experimental Laboratory Study

The second study, “Analyzing Motivating Functions of Consumer Behavior: Evidence from Attention and Neural Responses to Choices and Consumption,” had the purpose of providing a detailed experimental procedure that can be used to incorporate eye-tracking and EEG methods into the examination of consumer motivating operations, in a manner consistent with consumer behavior analysis principles. In addition, the study tests the applicability of including eye-tracking metrics and the frontal EEG asymmetry index in the functional analysis of consumer motivating operations. The experimental procedure in this study was divided into three smaller sessions to improve control over the research process.

Participants (n=32) were randomly allocated to the experimental and control conditions. As an establishing operation, 11–12 hours of water deprivation was manipulated, where the participants did not consume water for 3-4 hours after awakening. The manipulation in session 1 further established the effectiveness of water for the experimental group and abolished it for the control group under the guise of a taste test. These were dry, salty biscuits (three flavored, one standard salt) for the experimental group and water (three flavored, one regular) for the control group. Session 2 was used to collect eye-tracking and EEG data without movement to minimize artifacts. Session 3 was used to collect data on choice and actual water consumption to see if there was consistency between covert and overt responses.

The results show that in session 1, the effectiveness of water was established for the experimental group and abolished for the control group. Results from session 2 show that participants in the experimental group had significantly higher average fixation duration for the image of water. Their frontal asymmetry did not provide significant evidence of greater left frontal activation (approach motivation) toward the water image. The results of session 3 demonstrated that the choice and consumption behavior of the relevant reinforcer was significantly higher for participants in the experimental group. The findings show the potential application of a quantitative multi-method approach using neurophysiological tools for the examination of motivating operations and their impact on attention, neural responses, choice, and consumption. The results provide preliminary evidence that the behavioral effect of motivating operations can be measured using neurophysiological methods like eye-tracking and EEG. The findings show that deprivation evoked a higher average fixation duration on the water image for the experimental group. This provides some evidence of how the value-altering and behavior-altering effects of motivating operations impact eye-movement behavior. For frontal EEG asymmetry, there was no significant difference in frontal asymmetry activity in the experimental group when viewing the water image or the

salty biscuit image. However, the results do provide sufficient evidence further to warrant a replication and extension of this study using the same multi-method approach. The findings for paired choice show that choice proportions towards cold beverages (vs. salty snacks) were higher in the experimental group. For water consumption, the experimental group consumed almost three times the amount of water compared to the control group.

This study empirically demonstrated that the motivating operations of deprivation impact changes at covert and overt levels. The results do demonstrate that neurophysiological techniques can act as an enabling factor to investigate previously inaccessible behaviors and their relationships to environments (Baer, 1996), especially in the case of motivating operations. The study provided support for an approach to incorporate neural responses within a consumer behavior analysis framework as behavioral events. The study incorporated neural frontal EEG asymmetry responses as behavioral events for studying motivating operations within the consumer behavior analysis framework. The requirement here is that if neural responses show sensitivity towards antecedent and consequential manipulations, they can be treated as any other form of response as measured by behavior analysts, enabling analysis at a behavioral level (Barnes-Holmes, 2003; Ortu & Vaidya, 2016). The research discussed in the study, and the results of the study itself have provided evidence that frontal EEG asymmetry is consistent with the orderly functional relations of deprivation identified at the behavioral level (Donahoe, 1996). Within the broader discussion on integration between the two fields, the study has shown that interdisciplinary collaboration can contribute towards a more comprehensive assessment of behavior that can contribute towards improving explanations (and prediction) of behavior. Each science can inform the other in a characteristic way (Moore, 1997, 2002): Behavior analysis can provide experimental approaches and a functional (non-dualistic) approach to interpret behavior, while neurophysiological methods can improve the assessment of covert behavioral responses. This

is one of the main contributions of this study to the field of consumer research. In mainstream consumer research, using cognitive approaches to study consumer behavior by using a neurophysiological approach can be challenging if one does not possess an impressive understanding of the brain and its neural processes. Consumer behavior analysis, based on the principles of behavior analysis, is well positioned to parsimoniously explain neural processes within a behavior-analytic framework. In these instances, the inclusion of neurophysiological data performs a supplementary function to the experimental analysis of behavior (Donahoe et al., 1993). The considerations for integration are pragmatic as the inclusion of data at the physiological level offers an additional source of data, providing a supplementary function to the behavioral dependent variables used in behavior analysis. For consumer research, the study of antecedent situational factors using the approach presented in the study can improve our ability to explain, predict, or influence consumer behavior as originally envisaged by Belk (1975a).

The contribution of this study to consumer behavior analysis has been in terms of introducing frontal EEG asymmetry for the study of consumer motivating operations. This approach has been used in neuroscience and consumer research independently, but to the best of my knowledge, it has not yet been used within the areas of consumer behavior analysis and even broader research on motivating operations. For methodological contributions, two dimensions are considered important: the extent of change that the contribution delivers to current theory and practice (i.e., minor vs. major) and the potential audience for whom the contribution is useful (i.e., limited vs. large) (Bergh et al., 2022). Based on this approach, the methodological contribution can be seen as an incremental methodological contribution since the changes to the practice of studying situational MOs are modest but are relevant to a group of moderate (consumer behavior analysis) to a large (consumer situation research) audience. The contribution to the study of motivating operations in consumer behavior analysis is

predominantly made by revisiting the approach to study the influence of MOs in a more rigorous manner. Previous approaches have utilized behavior analytic *interpretations*, which do not necessarily require identifying behavioral elements through controlled, formal experimental analysis (Moore, 1997). Research on the impact of MOs on consumer behavior has predominantly been conducted using conjoint analysis (e.g., Fagerstrom, 2010; Fagerstrøm & Ghinea, 2011). The MOs used in these studies were inferred and not directly manipulated. The stimulus conditions used in these studies were interpreted to *likely* function as MOs since the manipulations reliably altered the dependent measures (Lotfizadeh et al., 2014). Here it can reliably be said that MOs were impacting the different behavioral topographies, minimizing the plausibility of alternative explanations (other than MOs) being the cause of the demonstrated change in behavior. In study II, the motivating operation of deprivation was examined using actual water deprivation, where the behaviors under study changed in the presence (and absence) of the MO. To the best of my knowledge, no other studies within consumer behavior analysis have done this before in such a rigorous manner. This is also consistent with the recommendation to directly manipulate situational variables in consumer research (Belk, 1975b). The experimental approach in this study improved the rigor with which MOs are examined in consumer behavior analysis and for the inclusion of a quantitative multi-method employing neurophysiological measures. While this approach is more demanding and challenging in terms of the researchers' abilities, it improves the reliability and validity of the conclusions.

For the broader research on motivating operations, especially deprivation, awareness of frontal EEG asymmetry as a measure can help with the empirical challenge when there seem to be no overt responses present or when responses might be latent. This study also demonstrates that motivating operations is a suitable concept for the inclusion and analysis of neurophysiological responses (Soto, 2020) within consumer behavior analysis. A minor

contribution was that the study was able to demonstrate the MO effects on actual human participants (and not animals) with regard to water deprivation, especially from a consumer behavior analysis perspective. As several publications have dealt with the idea of synthesizing neuroscience with behavior analysis (e.g., Donahoe, 2002, 2017; Ortu & Vaidya, 2016), the quantitative multi-method approach should prove attractive for researchers and practitioners interested in empirically studying consumer motivating operations, and thus demonstrating the potential benefits of the experimental interdependence achieved by such an undertaking.

5.1.3 Study III – Managerial Conjoint Study

The focus of behavior analysis within the field of consumer research is on pro-social and social marketing applications (DiClemente & Hantula, 2003). Therefore, consumer behavior analysis has been concerned with the application of behavioral economics principles to consumer behavior in marketing-oriented economies since its inception (Foxall & Sigurdsson, 2013). The third study “An explorative study of how visceral states influence the relationship between social proof heuristics and donation behavior when consumers are using self-service kiosks”, focuses on the concept of visceral states (Loewenstein, 1996). This concept is often used in behavioral economics and is theoretically similar to the concept of motivating operations. The logic behind the paper was that water deprivation as an MO will have value-altering and behavior-altering effects that will increase attention to the relevant reinforcer. Since water deprivation is a common antecedent situational factor experienced in everyday life, this inward focus of attention will undermine any form of altruism (Loewenstein, 1996). This impact of visceral states can negate the impact of any cause-related marketing efforts that retailers usually employ at the point of purchase. As interactive displays like self-service kiosks are increasingly being used for such purposes, the study

explored the impact of presenting a social proof indicator on a self-service kiosk display as a nudge to encourage donations during checkout. A scenario was used to simulate the visceral state of thirst and present the participants with a purchase situation. Results (n=83) indicate that, in such a situation, cause proximity had the highest impact (42.12%), closely followed by social proof (41.33%), and price format had the lowest impact (16.55%). For social proof, only a high level of social proof had a positive impact on likelihood to buy a product that included a small donation amount in the final purchase price. Any other level of social proof (medium, low, and not mentioned) decreased the likelihood to buy. As the manipulation of these three independent variables reliably altered the dependent measure, social proof and cause proximity could be pursued as interventions for social consumption behaviors when consumers are under the influence of visceral states.

When placed within the broader goal of consumer behavior analysis to apply behavioral economics principles to consumer behavior (Foxall & Sigurdsson, 2013), this study contributes by exploring how the non-altruistic effects of visceral states can be mitigated using social proof heuristics on self-service kiosks screens. The study adds to the literature on utilizing consumer behavior analysis to understand and potentially impact socially significant consumer behaviors (e.g., Fagerstrøm et al., 2015; Foxall et al., 2006). This study contributes to the understanding of situational factors that can potentially introduce biases in consumer behaviors: more specifically, how cause-related marketing interventions are modulated by visceral states. The exploratory study tests the presentation of social proof, cause proximity, and price formats on purchase behavior. Such an understanding can contribute by enabling empirically informed design and change (Ågerfalk & Karlsson, 2020), to include cause-related marketing activities in retail situations (especially self-service kiosks). Thus, the contribution is in testing the feasibility of using technology-enabled information on self-service kiosk screens to influence purchases. For practice, the study

provides a clearer understanding of the possible consequences of including different types of donation requests in self-service kiosks. This can enable the manipulation of information presented to influence donation requests, especially with regard to social proof and cause proximity. This study also demonstrates the practical application of applied consumer behavior analysis principles in terms of manipulating environmental determinants to account for antecedent situational motivational variables at the point of purchase.

5.2 Limitations and Future Research

The limitations of the conceptual advocacy study are those that apply to most conceptual research. The interpretations and views will always be influenced by a subjective lens. Some of the examples discussed might lack empirical support. Therefore, there can always be questions regarding reliability and validity. The second experimental study was conducted in a laboratory with improved rigor and greater control. Whilst this improves the internal validity of the experiment, the external validity is likely to be more difficult to establish (Saunders et al., 2009). The third managerial study was based on a scenario where situational factors cannot be directly manipulated. Therefore, a question can arise regarding the simulated thirst manipulation. In addition, as this thesis is based on the principles of consumer behavior analysis and, by extension, behavior analysis, it is subject to all the relevant broader critiques that apply to the field.

The empirical studies have mostly focused on unconditioned motivating operations like deprivation. Deprivation was chosen due to the extensive research support and the ability to be accurately manipulated. However, this study only focused on unconditioned motivating operations. As there is a considerable amount of research devoted to conditioned motivating operations, future research could test the approach presented in this study and provide the necessary refinement to extend into the study of conditioned MOs. However, conditioned

motivating operations might also be more difficult to control experimentally as they are acquired because of an individual's learning history (Tapper, 2005). In such cases, it might be beneficial to employ conjoint analysis to test and narrow down the list of conditioned motivating operations. These can be followed by a controlled study to assess the usefulness of neurophysiological tools in consumer behavior analysis. Some have also suggested reducing (or eliminating) the focus on conditioned motivating operations (Edwards, Lotfizadeh, & Poling, 2019a). However, for analysis of conditioned motivating operations, there is considerable empirical support attesting to its utility (Laraway & Snyderski, 2019; Lechago, 2019; Miguel, 2019). While this discussion is beyond the scope of this thesis, in consumer behavior analysis, the study of conditioned motivating operations is required for the analysis of consumer choice in many situations (see Fagerstrøm, Foxall, & Arntzen, 2010). Therefore, the concept holds its utility in the field of consumer research.

This thesis utilized the established conceptualization of motivating operations by Michael (1982, 1993, 2000). Conceptually, the value-altering and behavior-altering effects of MOs occur simultaneously and independently Michael (2000). However, Michael himself does not explore the extent of the independence between value-altering and behavior-altering effects (Tapper, 2005). The value-altering effect influences the capacity of operant consequences (reinforcers and punishers) to alter the strength of future behavior, and the behavior-altering effect influences the current strength of behaviors related to the consequences affected by the MO (Laraway et al., 2014). Due to these differences in temporal orientation, it might be difficult to account for the value-altering effect based on single studies. In consumer research, this might not be feasible or even possible without compromising the true purpose of the research. Future discussions in consumer behavior analysis can determine how to proceed and evaluate such a tradeoff. In consumer behavior

analysis, the approach has been to *assume* the value-altering effect will be impacted (in the future) based on changes in the current behavior (behavior-altering effect) due to MOs. This was the approach used in Study II. While the distinction remains useful for the prediction and control of behavior. As discussed earlier, neurophysiological data can help improve the predictability of future behavior, allowing for improved inferences being made about the value-altering effect of MOs in consumer research.

Some newer studies have suggested dropping the distinction between the value-altering and behavior-altering effects of MOs, critiquing that they provide little value (see Edwards, Lotfizadeh, & Poling, 2019a, 2019b). It is also possible that the strength of an MO's value-altering effects could be independent of the strength of its behavior-altering effects, or an MO might have value-altering effects in the absence of behavior-altering effects or vice versa (Tapper, 2005). The value-altering and behavior-altering effects might, in some cases, be confounded (Edwards, Lotfizadeh, & Poling, 2019a). This demonstrates that more refinement is needed either in terms of methods or procedures. This is an interesting discussion, future research, both conceptual and empirical, can assess the utility of such an approach. More research is needed to evaluate the usefulness of this distinction and examine when it is useful in the prediction and control of consumer behavior.

5.3 Conclusion

Based on three studies, this thesis has contributed to knowledge about combining sub-personal and super-personal levels of analysis within consumer behavior analysis to study motivating functions. This synthesis has the potential to change how neurophysiological levels of analyses are interpreted in interdisciplinary approaches within consumer research. This approach has been discussed to a limited extent in previous research, but not investigated from the perspective of studying situational factors in consumer behavior

analysis. Furthermore, this thesis attempts to make a methodological contribution in terms of providing a multi-method quantitative approach. This thesis has presented how frontal EEG asymmetry can be used to study motivating operations using the framework of consumer behavior analysis. This provides a novel approach to measure the impact of motivating functions on attention, neural responses, choice, and consumption. The managerial and practical contribution has demonstrated how consumer behavior analysis can influence socially relevant behaviors, especially concerning antecedent, situational motivational variables. The overall contribution of the thesis is to provide an alternative approach within consumer behavior analysis that can enable the study of antecedent, situational motivating operations using multiple quantitative methods, providing a starting point for future research.

5.4 References

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