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Cue-reactivity to brand logos of consumers with a compulsive buying tendency: A consumer neuroscience perspective

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Abstract

Well-designed brand logos can be critical in effective marketing strategies. By adopting a consumer neuroscience approach and the interaction of person-affect-cognition-execution model, this study analyzes the behavioral reaction and neural activation pattern during the perception of brand logos in relation to the compulsive buying tendencies of participants. Results suggest that women are more cue-reactive toward brand logos and show activity changes in brain regions associated with cue-reactivity in (behavioral) addictions. Conversely, men are less cue-reactive but show increased activity changes in reward-related regions. Women with compulsive buying tendencies may be more susceptible to brand logos, which can evoke neural activation similar to addictive patterns, while men are less cue-reactive but show hidden neural activation associated with rewards. This study enhances understanding of (1) how marketing cues influence pre-addictive behavior and (2) gender differences in brain activations related to cue-reactivity in people with compulsive buying tendencies. We inform further research on implicit and neural processes on how brands are perceived by compulsive buyers, particularly among male consumers. We also emphasize the need to protect vulnerable consumer groups, such as compulsive buyers.

KEYWORDS

behavioral addiction, brand logos, compulsive buying, consumer neuroscience, cue-reactivity, marketing cues

1 | INTRODUCTION

A well-designed brand logo says everything without saying a word, hence being one of the most valuable elements of corporate identity (Westgarth, 2018). Therefore, many companies recognize the high value of a well-designed brand logo and allocate a large proportion of their marketing budget to a unique design that corresponds to the esthetic appeal of the brand and that will strengthen the brand's relationship with customers (Bettels & Wiedmann, 2019).

Many individual differences (i.e., culture, personality) influence how consumers react to brand logos as marketing cues (Kim & Lim, 2019), and consumer neuroscience research shows that investigating implicit neural processes can help explain these differences (He et al., 2021; Plassmann et al., 2015). We focus on a certain group of consumers—people with *compulsive buying tendencies* (CBT; Lawrence et al., 2014; Trotzke et al., 2020). The objective of our explorative task-related functional magnetic resonance imaging (fMRI) study is to explain how consumers'

implicit neural-level processes associated with the perception of marketing cues (e.g., brand logos) differ in people with a compulsive buying tendency. We address the following research question: *Do people with compulsive buying tendency show different neural activation patterns compared with people without compulsive buying tendencies while perceiving brand logos?*

Investigating how people with compulsive buying tendencies perceive attractive marketing cues such as brand logos is relevant because compulsive buying is a prevalent problem (Maraz et al., 2016). The growing opportunities related to online shopping (i.e., continuous accessibility and the possibility to buy secretly online) make compulsive buying an even bigger problem (Müller et al., 2022; Xu et al., 2022). The severe consequences of compulsive buying include debt, social problems, and strong negative emotions (i.e., guilt; Japutra & Song, 2020; Maraz et al., 2016). By examining how people with compulsive buying tendency perceive attractive brand logos, we make the following contributions to consumer research:

First, we enhance understanding of *how marketing cues influence the pre-addictive behavior of compulsive buyers* positively or negative. In accordance with the interaction of person-affect-cognition-execution (I-PACE) model of addiction (Brand et al., 2016, 2019; Martin et al., 2013), compulsive buying tendencies are associated with an understanding of addiction over a consumption continuum. In the near-addiction phase, consumptive behavior can already be an essential part of daily life, which might yield negative consequences, even if the consumer does not move to the addiction phase. Especially in this near-addiction phase, marketing cues can have a reinforcing effect and influence whether people are encouraged to consume even more and proceed to an addictive stage (Martin et al., 2013; Trotzke et al., 2014). Therefore, we examine how marketing cues such as brand logos are perceived by consumers with compulsive buying tendencies, indicating a pre-addictive phase. These insights are relevant for marketing managers and policymakers because the protection of vulnerable consumers is also important for the implementation of responsible advertising practices (Javor et al., 2023).

Second, we deepen knowledge about *differences in brain activations related to cue-reactivity in people with compulsive buying tendencies and provide preliminary insights about gender differences*. Research has shown that perceiving and reacting to marketing cues can be greatly influenced by automatic and subconscious processes that are difficult to measure through self-reports (Friese et al., 2008; Pleyers, 2021). Neuroimaging tools, such as fMRI, can be an effective way to provide insights into underlying mechanisms and implicit processes and better understand individual differences across consumers (He et al., 2021; Plassmann et al., 2015). According to the I-PACE model (Brand et al., 2016, 2019), cue-reactivity and cue-induced cravings are aspects of addiction that often yield continued use and relapse (Hanlon et al., 2014). Although marketing cue–induced cravings associated with compulsive buying have been shown to be relevant, (neuroimaging) evidence and studies that explicitly show how brand information influences compulsive buying are lacking (Müller et al., 2022; Trotzke et al., 2014, 2021). This is important for marketing research, because studies have postulated the need to conduct more neuroscientific studies to investigate the neural correlates of compulsive buying associated with cue-reactivity and craving (Trotzke et al., 2017), calling for more research regarding gender differences in compulsive buying.

The next section reviews the literature on brand logos, compulsive buying, and the I-PACE addiction model to form hypotheses. We then combine findings from three empirical studies. Subsequently, we discuss our findings, offer theoretical and practical implications, acknowledge the study's limitations, and suggest future research directions.

2 | THEORETICAL BACKGROUND AND HYPOTHESIS DEVELOPMENT

2.1 | Brand logos as attractive marketing cues

A brand logo can be defined as "the graphic design that a company uses, with or without its name, to identify itself or its products" (Henderson & Cote, 1998, p. 14). The main function of the logo is the nonverbal communication of brand image that shapes the relationship with the consumer and distinguishes a brand from competitors (Bettels & Wiedmann, 2019; Kaur & Kaur, 2019).

The attractiveness of a brand logo influences customers' commitment to the brand (Park et al., 2013) and can shape brand reputation (Park et al., 2013). Brand logos can impact the brand attitude and purchase intention (Williams & Son, 2022) and perceptions of the brand's products (Bettels & Wiedmann, 2019), positively affect brand personality, and shape the emotional response of customers toward the brand (Kaur & Kaur, 2019). When shopping, a brand logo can trigger positive associations with the brand, helping consumers choose trusted products (Henderson & Cote, 1998; Park et al., 2013; Walsh et al., 2010). Thus, it is an enabler to reduce uncertainty and increase efficiency while shopping, because it reminds the consumer of the positive aspects of a product (Park et al., 2013).

Studies have indicated variations among individuals' perceptions of and responses to marketing cues (Kim & Lim, 2019; Machado et al., 2018; Styvén et al., 2020). This is particularly noteworthy in compulsive buying because marketing cues can have a more intensive impact, especially when an individual is already nearing the addiction stage (Martin et al., 2013). Because brand logos are pervasive in our everyday life, we explore whether individuals inclined toward compulsive buying exhibit distinct perceptions of brand logos, and whether these perceptual variations can be measured on a neural level.

2.2 | Compulsive buying: A severe problem

In consumer and psychological research, there is an ongoing debate about the definition and classification of compulsive buying behavior (Black, 2022; Müller et al., 2019; Ridgway et al., 2008). O'Guinn and Faber (1989) defined compulsive buying as "chronic, repetitive purchasing that becomes a primary response to negative events or

feelings" (p. 155). Ridgway et al. (2008) stated that compulsive buying contains both dimensions of obsessive-compulsive behavior and a lack of impulse control, defining it as the "consumer's tendency to be preoccupied with buying that is revealed through repetitive buying and a lack of impulse control over buying" (p. 622). A related debate is how to classify compulsive buying. Currently, it is not classified as a separate mental health disorder in the Diagnostic and Statistical Manual of Mental Disorders or in the International Classification of Diseases (Müller et al., 2022). However, it could be classified as a behavioral addiction (Müller et al., 2019; Trotzke et al., 2021).

The phenomenology of compulsive buying behavior and its antecedents can vary. Typically, compulsive buyers "specialize" in a certain product (e.g., expensive brands or bargains). Women generally tend to acquire clothing, shoes, music, jewelry, cosmetics, and household items, whereas men prefer, besides clothing and shoes, technical equipment, cars, or sports items (Black, 2007). Because there are numerous psychological, physiological, social, and biological variables involved (Mueller et al., 2011), the pathogenesis of compulsive buying is not completely understood. One main reason for compulsive buying is to improve negative mood and self-worth, and reduce stress and anxiety (Trotzke et al., 2021). During the buying process, the consumer often experiences extreme positive emotions that change to regretful, aversive feelings after the "shopping exhilaration" is over. A characteristic symptom is that consumers do not enjoy and use the items they bought–typically they do not even take them out of the shopping bag, but rather hide their purchases (Faber, 2004; Müller et al., 2022). Instead, they achieve mainly satisfaction through the buying process itself and the connected positive social interaction and appreciation (O'Guinn & Faber, 1989). Compulsive buyers often report losing control over purchases and experience extreme preoccupations with buying and cravings to shop (Müller et al., 2022). Long term, compulsive buyers mostly suffer from negative consequences (e.g., debts, legal problems), negative moods (e.g., embarrassment, regret, distress), and loss of control (Maraz et al., 2016; Müller et al., 2022).

Nevertheless, this "dark side" of shopping is repeatedly trivialized, and patients are often not taken seriously (Neuner et al., 2005). One reason is for this is because shopping is a socially accepted way to spend leisure time or express self-identity (Dittmar, 2005; Koran et al., 2006). A similar effect regarding positive shopping attitude can be seen in exposure to online influencers that are continually trying to motivate their followers to buy certain products (Leung et al., 2022). Within the scope of our study, we acknowledge the significance of compulsive buying for consumer research. More specifically, we are interested in how marketing cues that consumers encountered daily are perceived and processed differently by people with compulsive buying tendencies.

2.3 | The I-PACE model for addictive behaviors

The I-PACE model (Brand et al., 2016; Brand et al., 2019) describes the underlying processes of addictive behavior (Thomas et al., 2023). In alignment with the I-PACE model, addictive behavior emerges because of the interplay between individual predispositions (e.g., gender, personality, values), emotional and cognitive responses to specific stimuli, and executive control functions (e.g., decision-making). The model integrates insights into neurobiological mechanisms that are important for addictive behavior, assuming that an imbalance between prefrontal structures and limbic/reward-oriented brain regions might explain why people engage in addictive behavior (Brand et al., 2019). Important here is the relationship between cue-reactivity/craving and inhibitory control. Applied to compulsive buying behavior, the urge to shop can stem from internal factors (e.g., negative mood, self-insecurity) and/or external factors (e.g., marketing stimuli). Repeatedly experiencing the positive impact of shopping can result in cognitive or emotional reactions, such as increased attentional focus on certain behaviors and heightened responsiveness to cues. These reactions can trigger cravings and enhance engagement in (maladaptive) buying behavior.

2.3.1 | Craving and cue-reactivity in compulsive buying

Compulsive buying is often associated with two important aspects of (behavioral) addiction: *cue-reactivity* and *craving* (Starcke et al., 2018; Trotzke et al., 2021). Cue-reactivity is the "physiological, emotional, and cognitive response when confronted with addiction-related cues." (Trotzke et al., 2021, p. 2). It is a learning response to cues that individuals associate with a rewarding feeling of addictive behavior (e.g., shopping; Müller et al., 2022; Xu et al., 2022). In compulsive buying, craving can be conceptualized as a conscious and intense urge to engage in problematic buying behavior (e.g., overconsumption) to reduce negative affective states (Hormes, 2017). Cue-reactivity and craving also feature in the I-PACE model (Brand et al., 2016, 2019), which understands compulsive buying as a holistic process where it is possible to either move closer to the addiction state or better regulate dysfunctional behavior (Martin et al., 2013). Compulsive buyers are generally more cue-reactive to shopping-relevant cues, which can trigger feelings of craving in the form of an urge to buy (Thomas et al., 2023; Trotzke et al., 2014). We expect individuals with a compulsive buying tendency to have stronger reactions to brand logos, evaluate them as more attractive, and experience a heightened urge to purchase.

H1. On a behavioral level, people with compulsive buying tendencies show stronger cue-reactivity (attractiveness, irresistibility) and higher craving (urge to buy) when perceiving brand logos.

2.3.2 | Neural correlates of compulsive buying

The neural correlates of developing cue-reactivity and craving relevant for addictive behaviors, such as compulsive buying, are

associated with several subcircuits in the brain related to reward (e.g., ventral striatum), craving (e.g., orbitofrontal cortex, insula), memory (hippocampus, amygdala), and control (e.g., dorsolateral prefrontal cortex; Stippekohl et al., 2010). According to I-PACE, there is an imbalance between reward-related limbic structures and control-related prefrontal structures (Brand et al., 2016, 2019). Research into cue-reactivity in behavioral addictions (i.e., substance-use disorders) has shown that brain regions including the prefrontal cortex, the anterior and posterior cingulate gyrus, the dorsal and ventral striatum, the hippocampus, the insula, and the amygdala play a crucial role (Starcke et al., 2018; Trotzke et al., 2021). In compulsive buying, the different neurophysiological patterns associated with cue-reactivity are associated with higher arousal and attachment to goods (Lawrence et al., 2014). Trotzke et al. (2014) found that compulsive buyers' shopping cues can evoke an urge to buy and were rated as more arousing, exhibiting higher skin conductance responses regarding shopping cues compared with non-compulsive buyers. Because we expose people with compulsive buying tendencies to attractive brand logos, we assume that they are more cue-reactive and, therefore, will show different neural activation patterns compared with people without compulsive buying tendencies. In particular, we assume that brain regions associated with cue sensitivity and craving (Stippekohl et al., 2010) will be activated.

H2. On a neural level, people with compulsive buying tendencies show higher activity changes in brain regions related to cue-reactivity and craving (i.e., insula, hippocampus, anterior, and posterior cingulate gyrus) when perceiving brand logos.

More specifically, we expect activation in regions associated with the perception of reward to be higher in people with compulsive buying tendencies (Raab et al., 2011). According to the I-PACE model, in earlier stages of addiction the ventral striatum is critical when perceiving addiction-related cues, whereas the dorsal striatum is more strongly activated in later stages of addiction (Brand et al., 2019). Regions of the brain associated with reward, such as the ventral striatum (Raab et al., 2011) and dorsal striatum (Starcke et al., 2018; Trotzke et al., 2021) have been found to play a significant role in heightened sensitivity to cues related to this behavior. Trotzke et al. (2021), in an fMRI study, found that compulsive buyers exhibited higher activity in the dorsal striatum during exposure to shopping-relevant stimuli; they did not find increased activity in the ventral striatum, but activity here was positively related to the symptom severity of compulsive buyers. Raab et al. (2011) identified higher activity changes in compulsive buyers in the ventral striatum during the presentation of shopping-related cues. Lawrence et al. (2014) investigated cue-reactivity of people with a compulsive buying tendency using electroencephalogram, finding that they partly reflected a sensitivity to reward and dorsal and ventral processing streams from the frontal brain regions that are important for increased attention when shopping-relevant cues were presented.

H2a. On a neural level, people with compulsive buying tendencies will show higher activity changes in brain regions associated with reward (e.g., ventral/dorsal striatum).

2.3.3 | Compulsive buying and gender differences

In the I-PACE model, personal characteristics (e.g., gender, genetics, personality) are critical in developing addictive behavior (Brand et al., 2016, 2019). Research shows that 80%–95% of compulsive buyers are women (Mueller et al., 2011; Tarka et al., 2022). Hence, marketing cues may influence women more than men, making women more likely to buy compulsively (Aw et al., 2018). The reason for this might be that women tend to have more positive attitudes toward shopping and focus more on the emotional and identity-related aspects of buying (Dittmar, 2005).

However, there is ongoing discussion about the estimated number of unreported cases for male compulsive shoppers (Hubert et al., 2011). Men tend to hide their problematic shopping behavior better, for example, by calling themselves "collectors" (Tarka et al., 2022). Xu et al., (2022) found that online shopping is relevant for compulsive buying for both male and female shoppers, and Trotzke et al., (2014) did not find gender differences in a cue-reactivity paradigm. Regarding cue-reactivity in general, gender differences are not well understood (Betts et al., 2021). Although the precise reasons behind the higher prevalence of compulsive buying in women remain unclear, the frequency of this behavior among females suggests that gender differences likely influence both behavioral assessments and brain activation patterns.

H3. There will be gender differences regarding cue-reactivity, craving, and neural activation patterns in people with compulsive buying tendencies.

Because of the high prevalence of compulsive buying in females, women will react more strongly to shopping-related cues and exhibit higher activity changes in reward-related brain regions.

H3a. Women (vs. men) with compulsive buying tendencies will show higher activity changes in brain regions associated with rewards (e.g., ventral/dorsal striatum) when perceiving brand logos.

3 | MATERIALS AND METHODS

3.1 | Study 1 and 2: Survey studies

3.1.1 | Study 1: Purchase situation and CBT

Study 1 shed light on the relevance of investigating individuals' compulsive buying tendencies regarding purchase situations as hedonic events and potential adverse consequences (i.e., debts).

Seventy-eight participants (female = 43; M_{age} = 28.36 years, SD = 3.68, range = [23, 42]; no gender differences in age, t(76) = 1.59, p = 0.12) completed a questionnaire about (1) their compulsive buying tendencies (CBT; five items; Cronbach's α = 0.87 [Ridgway et al., 2008]; 1 = "totally disagree"–4 = "total agree;" see Appendix 1 for items), (2) their hedonic motivation toward purchase situations (*HED1*: "I love to go shopping, when I have the time;" *HED2*: "Shopping helps me to relax"; 1 = "totally disagree"–7 = "totally agree)," (3) their spending for "shopping" per month (*SPEND*; in €), and (4) adverse effects of shopping situations (*DEBT1*: "I often overdraw my bank account;" *DEBT2*: "I have problems covering my debts;" 1 = "totally disagree"–7 = "totally agree)." Table 1 shows the results of the correlational analysis.

The results assume a relationship between individuals' compulsive buying tendencies (CBT), perceptions of a shopping situation as hedonic, and potential adverse effects from compulsive buying. Although the results regarding gender largely align with the general correlations and show no difference regarding CBT (t(76) = −1.20, p = 0.24), SPEND (t(76) = 0.75, p = 0.46), and DEBT2 (t(76) = 0.74, p = 0.46), we observed a difference with HED1 (M_{female} = 5.33, SD = 1.54; M_{male} = 3.86, SD = 1.73; t(76) = −3.96, p < 0.001); HED2 (M_{female} = 4.58, SD = 1.65; M_{male} = 3.77, SD = 1.75; t(76) = −2.10, p = 0.04); and DEBT1 (M_{female} = 2.52, SD = 1.56; M_{male} = 3.32, SD = 1.53; t(76) = 2.24, p = 0.03). Thus, we further investigated the perception of marketing cues and potential gender differences related to compulsive buying tendencies.

3.1.2 | Study 2: Brand logos

Because individuals with compulsive buying tendencies often report that they buy products based on attractiveness (Black, 2007), and we were interested in their cue-reactivity to attractive and highly attractive brand logos, study 2 aimed to validate brand logos in terms of proxies for brand attractiveness. Sixty-one brand logos from the moderate-to-high price segment from various categories (e.g., fashion brands, cars, jewelry, sport, and technical equipment) were pre-tested by 20 women and 24 men who evaluated the attractiveness of a brand (1 = "very unattractive"–7 = "very attractive"; we also included the response option "I do not know this brand)." The analysis showed suitable attractiveness ratings for all brands, ranging from 2.96 to 6.11 (M = 4.59, SD = 0.73). Study 2 indicated gender differences in relation to all brand logos and associated category (M_{female} = 4.43, SD = 0.80; M_{male} = 4.75, SD = 0.62; t(120) = −2.47, p = 0.02).

3.2 | Study 3 - fMRI experiment: Participants and stimulus material

3.2.1 | Participants

Eight female and eight male healthy, right-handed subjects participated in the fMRI study (M_{age} = 32 years, SD = 1.79, range = [30, 35]; no gender differences in age, t(14) = −1.44, p = 0.17). We applied a convenience sampling method in line with research on compulsive buying disorders (Thomas et al., 2023; Trotzke et al., 2020). Because we did not focus on participants with diagnosed compulsive buying and instead investigated compulsive buying tendencies in the general population, there was no prescreening for compulsive buying tendencies (Lawrence et al., 2014; Trotzke et al., 2020). However, we ensured a homogeneous and balanced sample regarding gender and age and applied standard exclusion criteria for fMRI. All participants provided written informed consent before the scanning sessions. Participants were informed that the examination could reveal medically significant findings and were asked whether they would like to be notified. An ethics commission approved the study.

3.2.2 | Stimulus material

The stimulus material contained 35 brand logos randomly selected from study 2 varying across high, medium, and low attractiveness ratings (Figure 1, Table A2). According to gender differences in study 1, we used different presentations for the female and male groups (Mueller et al., 2011). The attractiveness tendency of the 35 brand logos was confirmed (M(women) = 4.7, SD = 0.54; M(men) = 4.8, SD = 0.68). Given that the neutral point equals four (on the scale from 1 to 7), a one-sample t-test for women (t1) and men (t2) showed significant differences (t1 = 9.46, p < 0.001; t2 = 4.24, p < 0.001).

TABLE 1 Construct correlations for all participants.

Construct	Mean	SD	CBT	HED1	HED2	SPEND	DEBT1	DEBT2
TCB	2.16	0.76						
HED1	4.61	1.84	0.51**					
HED2	4.16	1.78	0.54**	0.60**				
SPEND	110.13	84.46	0.21	0.18	0.16			
DEBT1	2.88	1.59	0.27*	0.20	0.04	0.13		
DEBT2	1.88	1.25	0.34**	0.17	0.10	0.15	0.53**	

*p < 0.01; **p < 0.05.

FIGURE 1 Examples of stimuli for female (upper part) and male (lower part) participants.

3.3 | Study 3: Experimental design fMRI experiment (behavioral and neural Data) and questionnaire

3.3.1 | fMRI experiment

The brand logos were projected on a transparent screen with an LCD beamer and viewed from the other side via a 45° mirror mounted on an element-phase array coil. The brand logos were selected for equality in size, position, background, and luminance to prevent external confounding visual stimulation. The image sequence was pseudorandomized. The participants had to judge whether the brand was attractive or unattractive by pressing the corresponding button on a magnetic resonance–compatible response box. Each brand logo was shown for a maximum of 6 s. If participants made their decision earlier, the brand was blanked out and the fixation cross appeared. The cross was shown for the rest of the 6 s and for 3 more seconds to separate each trial. Thus, each trial had a maximum duration of 9 s. In the forced-choice task, participants evaluated each selected brand twice (70 decisions) based on attractiveness. Shares of attractiveness for each brand logo and participant were calculated by dividing the sum of attractive evaluations from the total number of potential attractiveness evaluations. The share of attractiveness ranged between 0 and 1.

3.3.2 | Questionnaire

After the scanning session, participants completed a questionnaire containing demographic information, questions regarding cue-reactivity, attractiveness of the brands presented in the scanner (ATT; "This brand is very attractive."), brand irresistibility (IRR; "This brand is irresistible."), perceived urge to purchase (URGE; "Without budget constraints, I feel an urge to purchase this brand."), and purchase probability (BUY; "Without budget constraints, there is a high probability that I would buy this brand.") on a 5-point Likert scale (1 = "totally disagree"–5 = "totally agree;" Trotzke et al., 2014, 2015). Compulsive buying tendencies were measured using the German Addictive Buying Score (GABS; 16 items,[1] Cronbach's $\alpha = 0.82$; 1 = "totally disagree"–4 = "totally agree;" Reisch et al., 2004; Scherhorn et al., 1990). The German Addictive Buying Score is an established and widely applied measurement instrument to observe and predict compulsive buying (tendencies) in convenience and clinical samples (Thomas et al., 2023). The sum of scores indicated participants' compulsive buying tendencies (16–64). Sample values ranged from 17 to 43, indicating a good fit with existing studies regarding a balance between lower and higher values in sampling a general population (Reisch et al., 2004; Thomas et al., 2023).

3.4 | FMRI data acquisition

3.4.1 | Data acquisition

The study was executed on a 3 T fMRI-scanner (Magnetom Trio; SIEMENS). Gradient echo T2*-weighted echo-planar images (EPIs) with blood oxygen level–dependent (BOLD) contrast were acquired. The data set comprised 36 transversal slices of 3.6 mm thickness without a gap, a field of view of 230 mm x 230 mm, and an acquired matrix with 64 × 64 (i.e., isotropic voxels with 3.6 mm edge length). Contrast parameters were a repetition time (TR) of 3000 ms, echo time (TE) of 50 ms, and flip angle of 90°. Whole-brain high-resolution T1-weighted structural scans (1 × 1 × 1 mm) were acquired from every subject.

3.4.2 | Data preprocessing

Data analysis was conducted with SPM12 freeware (Friston et al., 1994; Welcome Trust Centre for Neuroimaging, London, UK, http://www.fil.ion.ucl.ac.uk/spm/software/spm12) using MatLab as the working base. Functional images were realigned and resliced to the mean image of the session, slice-timing (TA = 2.917; interleaved-ascending slice order, referenced to the middle slice) corrected, coregistered to the participants' T1-weighted high-resolution structural image, and normalized (new normalization in SPM12) to the individual mean EPI template before segmenting according to the individual T1 scan. Normalized images were smoothed with an 8 mm width at a half-isometric Gaussian kernel. Intensity normalization and

[1]GABS measures compulsive buying tendencies (Raab et al., 2011). To improve applicability and in-depth insights, we used GABS as a measurement instrument instead of the short scale used in study 1 (see Appendix A1 for an overview of items).

high-pass temporal filtering (using a filter width of 128 s) were also applied.

4 | ANALYSES AND RESULTS

4.1 | Behavioral analyses and results

Brand logo perception regarding attractiveness evaluations in the scanner versus the *ex post* ratings showed significant correlations (female: r(35) = 0.36, $p = 0.034$; male: r(35) = 0.68, $p < 0.001$); these were slightly lower for women versus men, indicating differences between forced binary choices and the possibility of a scaled evaluation, especially for female participants. Furthermore, although men also showed significant correlations between all constructs (ATT, IRR, URGE, and BUY) and the share of attractiveness rating extracted from the scanner, women showed significant correlations between *ex post* brand logo evaluation but no correlation with the share of attractiveness rating extracted from the scanner (Table 2).

Second, women showed significant correlations between compulsive buying tendencies (CBT) and ATT (r(8) = 0.75, $p = 0.03$) and CBT and IRR (r(8) = 0.85, $p = 0.01$). However, for men no correlations were observed. Tables 3 and 4 show descriptive findings and correlations pertaining to each gender and construct.

4.2 | FMRI data analyses and results

Using three steps, we estimated a mixed-effects general linear model (GLM: attractive vs. unattractive in scan ratings) of the BOLD activity for each subject and each segment (female/male).

First, for the GLM the independent variables were (regressor [R] 1) an indicator variable for the brand presentation of perceived attractive brands in scan ratings (ATT), (R2) an indicator variable for brand presentation of perceived unattractive brands in scan ratings (UNATT), and (R3–R8) six movement regressors and (R9) the session constant. R1–R2 were modeled with durations equal to the subject's response time in that trial (maximum 6 s). They were convolved with a canonical hemodynamic response function. Second, we calculated first-level single-subject contrasts for R1 (ATT) versus baseline, R2 (UNATT) versus baseline, and R1 (ATT) versus R2 (UNATT) and vice versa. Third, for each of the first-level contrasts, we estimated the second-level mixed-effects analyses by computing a one-sample t-test on the coefficients of each single-subject contrast and on the added covariate: the score of participants' compulsive buying tendency. The results are reported and visualized at $p < 0.001$ (uncorrected) with an extent threshold of $k = 5$. Anatomical localizations were visualized by overlaying the t-maps on a structural T1 template provided by the xjView toolbox (https://www.alivelearn.net/xjview).

4.2.1 | Results for female participants

Regarding brand perceptions in the scanner (ATT vs. UNATT) and the interaction between attractive brand logos and their Compulsive buying tendencies (CBT), we found mainly increased activity within the middle occipital gyrus, the posterior cingulate gyrus, the precentral gyrus, the precuneus, and the superior frontal gyrus for higher CBT scores (Table 4, Figure 2).

4.2.2 | Results for male participants

Regarding brand perceptions in the scanner (ATT vs. UNATT) and the interaction between attractive brand logos and their Compulsive buying tendencies (CBT), we found mainly increased activity within regions such as the hippocampus, the insula, the putamen, the precuneus, and the caudate head with increasing TCB scores (Table 5, Figure 3).

5 | DISCUSSION

We investigated whether there are differences in cue-reactivity toward brand logos between men and women related to their Compulsive buying tendencies. We based our research on the I-PACE model, which describes the psychological and neurobiological

TABLE 2 Construct correlations regarding brand logo evaluations for women (lower part) and men (upper part).

Construct	Mean/SD (female)	Mean/SD (male)	ATT	IRR	URGE	BUY	%ATT
ATT	2.66/0.37	3.30/0.47		0.90*	0.92*	0.84*	0.58*
IRR	2.44/0.29	2.65/0.50	0.53*		0.90*	0.82*	0.68*
URGE	2.60/0.29	2.85/0.47	0.73*	0.67*		0.90*	0.61*
BUY	2.67/0.30	2.61/0.46	0.72*	0.65*	0.93*		0.56*
%ATT	0.66/0.22	0.69/0.20	0.36**	0.24	0.19	0.08	

Abbreviations: %ATT, share of attractiveness evaluations (main experiment); BUY, ex post probability of purchasing rating; IRR, ex post irresistibility rating; TT, ex post attractiveness rating; URGE, ex post urge to purchase rating.

*$p < 0.01$; **$p < 0.05$.

TABLE 3 Construct correlations for women (lower part) and men (upper part).

Construct	Mean/SD (female)	Mean/ SD (male)	Age	CBT	ATT	IRR	URGE	BUY
Age	32.63/1.92	31.38/1.51		−0.63	−0.54	0.06	0.11	0.27
CBT	28.38/9.56	30.13/5.06	0.63		0.03	0.10	0.40	0.49
ATT	2.66/0.62	3.30/0.46	−0.10	0.75**		0.18	0.22	0.18
IRR	2.46/1.27	2.65/0.41	.008	0.85*	0.59		0.45	0.59
URGE	2.60/0.82	2.85/0.51	−0.41	0.52	0.77**	0.46		0.93
BUY	2.67/0.90	2.61/0.53	−0.36	0.52	0.80**	0.46	0.99*	

Abbreviations: ATT, ex post attractiveness rating; BUY, ex post probability of purchasing rating; CBT, compulsive buying tendency; IRR, ex post irresistibility rating; URGE, ex post urge to purchase rating.

*$p < 0.01$; **$p < 0.05$.

TABLE 4 Overview of regions with activity in correspondence to the contrasts of interest for female participants.

$GLM_{1.1}$: Attractive versus unattractive brand logos (in scanner)								
Parameter	*Region*	*Side*	*No. of voxels*	*BA*	*MNI coordinates of peak voxel*			*T-score*
ATT versus UNATT	Postcentral gyrus	L	104		−36	−26	48	−8.92
ATT x CBT	Middle occipital gyrus	L	30		−30	−72	2	9.04
	Cingulate gyrus	L	9		−10	−4	30	7.12
	Cingulate gyrus	L	25	(31)	−14	−28	36	7.87
	Precentral gyrus	R	13	6	40	−8	38	12.98
	Precuneus	L	8	7	−24	−58	52	6.87
	Superior frontal gyrus	R	26	6	8	12	68	9.59
UNATT x CBT	Precentral gyrus	R	5	6	64	−2	36	12.71
	Middle frontal gyrus	R	13		32	−10	58	−8.78

Note: A positive sign in the main contrast is associated with increased activity for attractive brand logos and vice versa a negative sign in the main contrast is associated with increased activity for unattractive brand logos; A positive sign in the interaction contrast is associated with increased activity for higher values of CBT and vice versa.

processes of behavioral addiction as the result of interactions between personal antecedents and affective/cognitive reactions to specific cues (Figure 4).

All participants reacted positively to attractive brand logos as marketing cues, experienced some brands as irresistible, and were willing to buy the brand. This aligns with a study finding that shopping-related cues have a general rewarding effect (Trotzke et al., 2014). Both genders consistently showed a relationship between perceiving a brand as attractive (cue-reactivity) and feeling an urge to buy, as well as a higher probability of purchasing the brand (craving). Thus, attractive brand logos are a salient marketing cue that might increase sales across all customer groups.

Regarding the results of *Compulsive buying tendencies on a behavioral level*, we partly confirmed H1 and fully confirmed H3. Although there was a positive relationship for women between compulsive buying tendencies and perceiving a brand logo as attractive and irresistible (cue-reactivity), our cues did not evoke a greater urge to buy or a higher probability of buying a brand (craving). Men did not show any correlation between compulsive buying tendencies and their cue-reactivity toward brand logos and craving for shopping. Many studies on cue-reactivity in compulsive buying have focused on females (Lawrence et al., 2014; Raab et al., 2011; Trotzke et al., 2021). As in our study, these investigations often reported a higher cue-reactivity toward shopping-related cues in relation to compulsive buying tendencies (Starcke et al., 2013), but in contrast to our findings they often also found a positive correlation between craving and compulsive buying tendencies (Trotzke et al., 2015; Trotzke et al., 2020). In our study, brand logos as shopping cues did not provoke cravings related to compulsive buying tendencies in either gender.

However, this aligns with the idea that addictive behaviors do not necessarily entail cravings because contemporary addiction models encompass various emotionally driven responses (e.g., cognitive biases and approach tendencies; Lawrence et al., 2014; Trotzke et al., 2014). A possible explanation is that compulsive buyers focus more strongly on the emotional and symbolic advantages (e.g., prestige) instead of functional aspects (e.g., quality) of brands (Horváth & Birgelen, 2015). Research on the meaning of brands for compulsive buyers differs. For example, studies have shown that

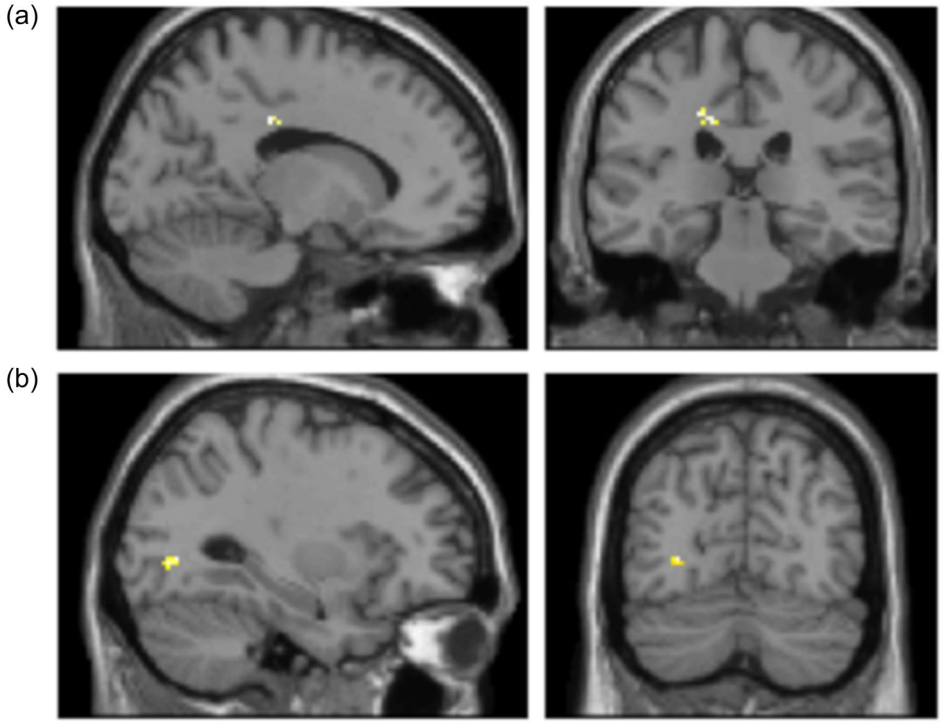

FIGURE 2 Activated regions for female participants correlating with values of CBT during the experimental phases are related to (a) left precuneus (−24, −58, 52) and (b) left middle occipital gyrus (−30, −72, 2).

compulsive buyers can have lower (Horváth & Birgelen, 2015) or higher (Lee & Workman, 2015) levels of brand attachment and brand loyalty compared with non-compulsive buyers. Japutra et al. (2019) found that brand attachment is an important mediator between self-congruence and compulsive buying. Thus, it may be that, in our study, women reacted more positively to brand logos depending on their COMPULSIVE BUYING TENDENCIES compared with men (higher cue-reactivity), but the brand logo might have been too abstract and not mentally placed them in a shopping situation (no craving).

Regarding *neural activations*, *in correlation with Compulsive buying tendencies*, the I-PACE model assumes that addictive behavior arises from an imbalance between the limbic reward-related brain system and prefrontal regions related to control. We found that attractive brand logos evoked increased activity changes in women in the middle occipital gyrus, the cingulate gyrus, the precentral gyrus, the precuneus, and the superior frontal gyrus. Conversely, in correlation with their compulsive buying tendency men exhibited higher activity changes in the hippocampus, insula, cuneus, superior and inferior frontal gyrus, putamen, caudate head, precentral gyrus, middle frontal gyrus, and precuneus. Hence, H2 and H2a are partly confirmed, and H3 is fully confirmed. However, H3a is rejected because we did not find higher activity changes in reward-related regions (e.g., ventral, dorsal striatum) in women, only higher activity changes in the dorsal striatum in men. Evidently, men reacted less strongly to attractive marketing cues on a behavioral level; their neural response revealed a more intensive reaction in reward-related brain regions versus women.

First, the increased activity changes in the precuneus and precentral gyrus *in both genders* in correlation with their Compulsive buying tendencies during exposure to attractive marketing cues could signify higher cue-reactivity. Many studies have underscored the role of the *precuneus* for cue-reactivity in substance-use addiction and addictive behavior (Schacht et al., 2013; Starcke et al., 2018; Wang et al., 2017). The precuneus is associated with memory retrieval or attentional evaluation of stimuli (Engelmann et al., 2012; Wang et al., 2017); thus, the higher activation in the precuneus could reflect attentional bias toward shopping cues in people with compulsive buying tendencies (Engelmann et al., 2012). Additionally, the precuneus is closely connected to other brain structures relevant for cue-reactivity (e.g., cingulate cortex, caudate) and is relevant for higher-order cognitive functions and attention (Cavanna & Trimble, 2006). Engelmann et al. (2012) suggested that, because of this, the precuneus might play an important role in integrating information about relevant cues processed in the visual system into brain areas important for goal-directed behavior and choice. The *precentral gyrus* has been associated with cue-reactivity in addictive behaviors and is involved in bodily voluntary motor movement (Starcke et al., 2018; Wang et al., 2017). One explanation for the higher activation in people with higher compulsive buying tendencies is that attractive brand logos lead to rapid and secure evaluation such that they pressed the button immediately.

Second, *women* exhibited increased activity changes in the *middle occipital cortex*; this has been reported in studies on cue-reactivity (Zeng et al., 2021) and is involved in the procession of both attention and reward (Hanlon et al., 2014). However, although higher activation in the occipital cortex is commonly

TABLE 5 Overview of regions with activity in correspondence to the contrasts of interest for male participants.

$GLM_{1.1}$: Attractive versus Unattractive Brand Logos (in Scanner)								
Parameter	***Region***	***Side***	***No. of voxels***	***BA***	***MNI Coordinates of peak voxel***			***T-score***
ATT versus UNATT	Inferior frontal gyrus	R	7		40	28	−12	−9.99
	Middle temporal gyrus	R	7		54	−62	12	6.11
	Middle temporal gyrus	R	36	39	46	−70	22	14.30
	Cingulate gyrus	R	6		6	−26	40	5.96
	Postcentral gyrus	L	26	3	−38	−24	46	−7.34
	Middle frontal gyrus	R	6	8	28	28	48	9.11
	Precuneus	R	26	7	14	−58	58	16.47
ATT x CBT	Hippocampus	R	18		36	−10	−14	7.16
	Insula	R	276	13	42	8	−4	9.35
	Cuneus	L	422	18	−16	−72	−10	13.64
	Superior temporal gyrus	L	21	22	−48	0	−4	9.29
	Inferior frontal gyrus	L	58		−44	34	2	8.10
	Putamen	L	77		−38	6	20	9.45
	Caudate head	L	5		−14	18	2	6.10
	Putamen	R	14		22	−6	14	7.33
	Precentral gyrus	L	6	43	−58	−6	14	5.75
	Middle frontal gyrus	L	43		−52	36	26	9.58
	Inferior frontal gyrus	R	35	9	52	12	34	7.35
	Precuneus	L	9	19	−32	−66	38	6.17
UNATT x CBT	Inferior frontal gyrus	R	24	47	34	20	−8	9.90
	Parahippocampal gyrus	R	11		26	−60	−8	6.89
	Insula	L	36	(13)	−46	2	−2	7.37
	Lingual gyrus	L	15	18	−12	−76	0	6.13
	Cuneus	R	107		12	−68	6	10.44
	Inferior frontal gyrus	R	16		50	22	4	6.66
	Posterior cingulate gyrus	L	35	30	−24	−72	6	7.84
	Putamen	L	9		−16	10	4	6.43
	Transverse temporal gyrus	L	7	42	−58	−12	14	7.43
	Postcentral gyrus	L	11	2	−40	−30	34	6.65
	Supramarginal gyrus	R	6	40	38	−48	36	6.35

Note: A positive sign in the main contrast is associated with increased activity for attractive brand logos and vice versa; a positive sign in the interaction contrast is associated with increased activity for higher values of CBT and vice versa.

reported in cue-reactivity studies, it is unclear whether these activations are because of higher reward or attentional bias (Hanlon et al., 2014). Therefore, future research should investigate the role of visual cortices in cue-reactivity in association with marketing stimuli.

Women also exhibited increased activity changes in the *(dorsal) cingulate cortex*, which—together with the precuneus—was found to differentiate addicted individuals from healthy controls during cue-exhibition (Schacht et al., 2013). The dorsal cingulate cortex also showed higher activation because of drug-related cues (e.g., cigarettes) and is associated with memory retrieval, attentional evaluation of stimuli, and the planning of motor reactions to stimuli (Engelmann et al., 2012). The dorsal cingulate cortex is part of a critical salience network for the integration of goal-directed behavior and might be important for higher attentional processing of drug-related cues (Janes et al., 2015). There is some evidence that the

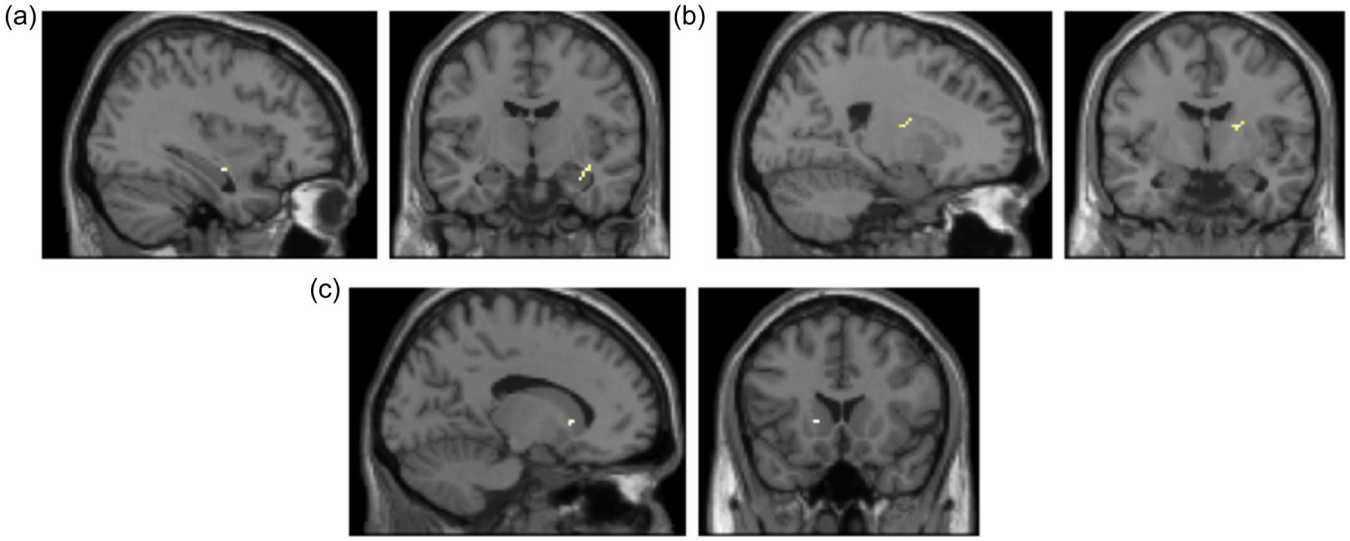

FIGURE 3 Activated regions for male participants correlated with values of CBT during the experimental phase are related to (a) right hippocampus (36, −10, −14), (b) right putamen (22, −6, 14), and (c) left caudate head (−14, 18, 2).

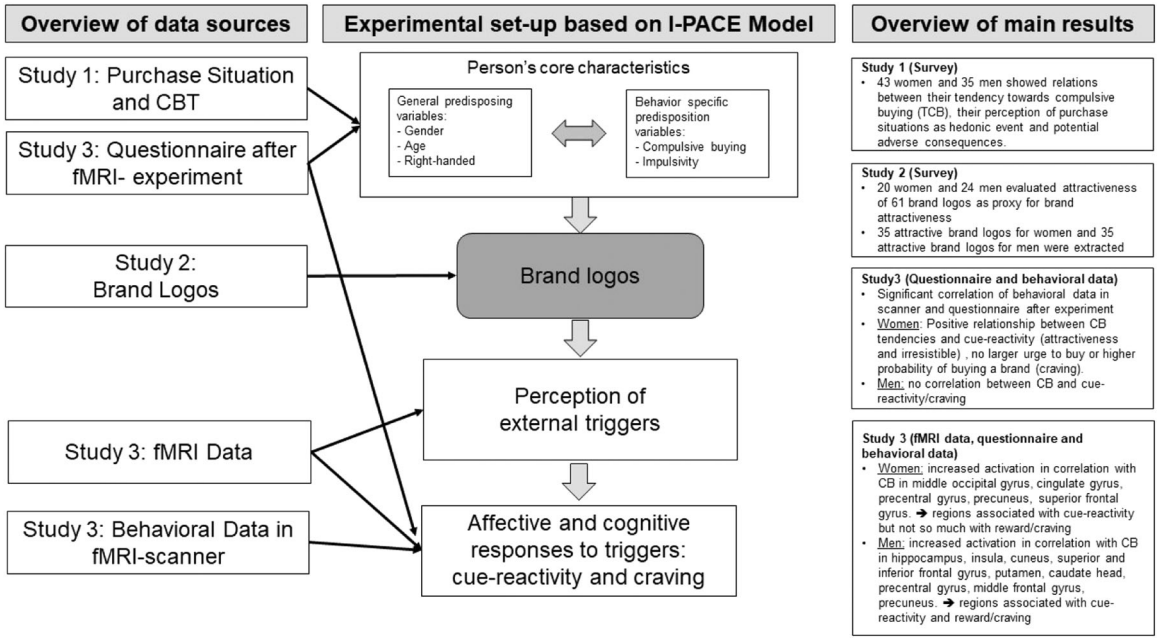

FIGURE 4 Overview of the study setup.

superior frontal cortex is also related to cue-reactivity, especially in persons deprived of their drug (e.g., smoking; Engelmann et al., 2012).

Third, *men* exhibited activity changes in brain regions often associated with the perception of rewards and emotions such as the putamen, caudate, and insula. The *caudate*, alongside the *putamen*, forms the dorsal striatum, an important structure of the reward system involved in the selection and initiation of actions (Balleine et al., 2007). It is important for decision-making because it is associated with learning about actions and their expected reward values (Balleine et al., 2007). According to I-PACE, the dorsal striatum is a fundamental structure for cue-reactivity and craving in drug addiction, especially at later stages of addiction, and is associated with anticipation and engagement in maladaptive behavior (Brand et al., 2019; Trotzke et al., 2021). It is also important for behavioral addiction (Starcke et al., 2018). Research has indicated that reward anticipation might explain why compulsive buyers cannot control their behavior. The *insula cortex* is an important brain area for many complex emotional processes and cognitively demanding tasks, as well as cue-reactivity (Janes et al., 2017). The insula is an important structure for drug addiction and feeling conscious urges after cue-exposure (Naqvi & Bechara, 2010). Regarding buying, compulsive buyers have a lower activation of the insula during price perception

(Raab et al., 2011), which might be why they lose control over their buying behavior. Our results could indicate that, in men with Compulsive buying tendencies, the insula activates a representation of the pleasurable effect of buying attractive brands. Additionally, in men we found activation in frontal regions, such as the attention-related *middle frontal cortex*, which has been associated with inhibition processing (Lorenz et al., 2013); the *hippocampus*, which is important for memory retrieval; and the *inferior frontal cortex*, which evaluates important cues (Starcke et al., 2018).

In sum, although women showed more positive cue-reactivity in relation to their compulsive buying tendencies on a behavioral level, we did not find expected activity changes regarding reward processing. One explanation could be that brand logos are perceived as attractive and, thus, rewarding for *all* women. This aligns with behavioral data showing that attractive brand logos also induced an urge and higher probability to buy the brand among all participants. However, activation in the precuneus and posterior cingulate cortex could differentiate women with Compulsive buying tendencies from women without compulsive buying tendencies (Schacht et al., 2013). Thus, women with compulsive buying tendencies might be more susceptible to attractive marketing cues because they activate brain regions associated with cue-reactivity in other addictions. For men, in contrast to H3a, exposure to brand logos yielded higher activity changes in regions related to the perception of rewards in correlation with their compulsive buying tendencies. However, on a behavioral level they did not show higher cue-reactivity. Thus, attractive marketing cues may evoke feelings of reward in men with compulsive buying tendencies; however, perhaps because of social expectations, they are better at suppressing their urge on a behavioral level.

6 | CONTRIBUTIONS AND IMPLICATIONS

6.1 | Theoretical contributions

First, by focusing on *vulnerable customer groups* and their neural activation patterns when perceiving brand logos, we extend the marketing literature on homogenous and healthy populations, providing new evidence for the relevance of "brain health" of vulnerable consumer groups for marketing research (Javor et al., 2023).

Second, our study extends research on the *relevance of brands for compulsive buyers* (Horváth & Birgelen, 2015; Lee & Workman, 2015). We showed that compulsive buyers react to brand-related cues but that this reaction does not necessarily trigger an urge to buy on a behavioral level.

Third, by investigating the *neural activation pattern of compulsive buying*, we showed that compulsive buyers are more cue-reactive, even though we could not measure a stronger cue-induced urge. These results extend the literature on classifying compulsive buying as a (behavioral) addiction (Müller et al., 2019; Trotzke et al., 2021), studies on cue-reactivity (Starcke et al., 2018; Trotzke et al., 2014, 2021), and studies that investigate the neural correlates of compulsive buying (Raab et al., 2011; Trotzke et al., 2014, 2021).

Fourth, we found *gender differences* in the neural activity changes and behavioral results. Women with Compulsive buying tendencies showed higher cue-reactivity on a behavioral level and exhibited activity changes in regions, which might differentiate addicted people from nonaddicted people during cue perception. Additionally, males showed a stronger reaction in regions related to reward. This extends the compulsive buying literature on gender difference (Mueller et al., 2011; Xu et al., 2022).

6.2 | Practical implications

The inclusion of marketing-related ethical considerations and protection of vulnerable consumer groups such as compulsive buyers might generate a trade-off with the imperative of maximizing revenues. However, to generate sustainable corporate success, marketing thinking should move away from pursuing short-term profits to providing healthier offers that improve individual lives and society (Japutra et al., 2018). For example, marketing managers could design shopping environments that help people regulate their impulses and overthink their maladaptive buying behavior. Instead of exposing potential consumers to excessive attractive marketing cues, a reduction of these stimuli could prevent potentially detrimental behavior and make consumers aware of the unhealthy consequences of overconsumption (Martin et al., 2013). This is especially important as exposure to attractive marketing cues becomes more automated with Artificial Intelligence controlling behavioral profiling (Mariani et al., 2022, 2023; Vlačić et al., 2021). If marketing managers are aware of the high prevalence and problems associated with compulsive buying, they can pursue a sustainable inclusive marketing approach and thereby build positive, long-lasting, healthy brand–customer relationships while aiding the brand's long-term success (Iyer et al., 2020).

7 | LIMITATIONS AND FUTURE RESEARCH

A limitation of our main study–from a practical standpoint - was the small sample size. Problems related to small sample sizes include the reporting of false significant findings and low statistical power (Ingre, 2013; Szucs & Ioannidis, 2020). However, small sample sizes are common in neuroscientific research, mainly because of the high costs and substantial processing and storage resources needed for fMRI data. For example, Szucs and Ioannidis (2020) reported that the over 1000 most highly cited neuroimaging studies had a median sample size of 12, with a trend in increasing sample sizes in more recent studies. Some research has also argued for smaller sample sizes in fMRI studies (Friston, 2012). Friston (2012) suggested that finding an effect in small groups shows that the effect is even stronger than finding the same result in larger samples. We were

aware of the problems that could be associated with a small sample size and, therefore, applied other means to ensure the validity of the results (i.e., less complex research design, a high number of repetitive trials within one subject, embedding existing knowledge of cue-reactivity in brain research). Nevertheless, further research should replicate studies on cue-reactivity in those with compulsive buying tendencies with a larger sample.

Furthermore, limitations and thus future research propositions from a theoretical perspective, address (1) the focus on CBT and (2) the focus on positive marketing cues. First, we focused only on self-reported compulsive buying tendency and did not include a clinical sample. Although this is common practice in studying compulsive buying (De Vries et al., 2018; Lawrence et al., 2014; Trotzke et al., 2014, 2015, 2020), it would be interesting to examine whether people who are clinically significant compulsive buyer differ more strongly in their neural activation. Additionally, a controlled experiment with pre-selected participants could be helpful to more directly assess differences between groups with perceived and diagnosed compulsive buying disorders. Regarding gender, compulsive buying is mainly described as a female problem. Future research should investigate whether men have a similar compulsive buying tendencies that must be measured differently to detect hidden implicit patterns (Koran et al., 2006). Also the inclusion of social gender, might play a role in developing compulsive buying (Grant et al., 2014) and should be addressed by future research.

Second, we focused on positive marketing cues. However, negative cues that trigger anxiety or enhance low self-esteem might explain why consumers engage in uncontrolled behavior. Here, the consumer environment can have a strong impact on their behavior, especially for people close to the addiction stage (Martin et al., 2013). This also needs to be investigated.

8 | CONCLUSION

We applied a consumer neuroscience approach to investigate how people with compulsive buying tendencies react to attractive marketing cues (brand logos). In contrast to men, there was a positive relationship for women between compulsive buying tendencies and perceiving a brand logo as attractive and irresistible (cue-reactivity). Our cues did not evoke a larger urge to buy (craving) in relation to compulsive buying tendencies in either men or women. Women exhibited activity changes in brain regions associated with cue-reactivity (e.g., in the middle occipital gyrus, the cingulate gyrus, the precentral gyrus, the precuneus, and the superior frontal gyrus), but less so in regions associated with reward processing. Conversely, in correlation with their compulsive buying tendencies, men exhibited activations in regions associated with reward processing (e.g., insula, dorsal striatum). Hence, women with compulsive buying tendencies might be more susceptible to brand logos, which can evoke neural activation related to cue-reactivity. In contrast, men may not exhibit the same level of responsiveness to cues on a behavioral level, but they displayed covert neural activation linked to rewards. Our findings underscore the importance of considering and protecting vulnerable consumer segments in marketing research.

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The authors have nothing to report.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Research data are not shared.

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APPENDIX A

Table A1

TABLE A1 Used scales to measure tendencies towards compulsive buying (TCB).

Study 1 (Ridgway et al., 2008)[a]	
1	I buy things I don't need.
2	"Much of my life centers around buying things."
3	"I buy things I did not plan to buy."
4	"Others might consider me a 'shopaholic.'"
5	"I consider myself an impulse purchaser."
Main Study (Reisch et al., 2004)	
1.	When I have money, I have to spend it.
2.	When I walk through the city center or a mall, I feel a strong urge to buy something.
3.	Often, I feel an unexplainable urge, a sudden and urgent desire, to go out and buy something.
4.	Sometimes, I see something and feel an irresistible impulse to buy it.
5.	Often, I feel that I absolutely must have something.
6.	After making a purchase, I often wonder if it was really that important.
7.	I often buy something just because it's cheap.
8.	Often, I buy something just because I have the urge to buy.
9.	I find promotional letters interesting; I often also order something.
10.	I have often bought something that I didn't end up using.
11.	I have bought things before that I actually couldn't afford.
12.	I am wasteful.
13.	Shopping is a way for me to escape the unpleasant daily routine and relax.
14.	Sometimes, I realize that something within me has driven me to go shopping.
15.	Sometimes, I feel guilty when I've purchased something.
16.	Often, I'm hesitant to show purchased items to others because they might think I'm irrational.

[a]We didn't used the item "My closet has unopened shopping bags in it." As it showed lower standardized item loadings compared to the other items used (Ridgway et al., 2008).

TABLE A2 List of brands used in main experiment.

No.	Female participants	Male participants
1	Yves Saint Laurent	Wempe
2	Versace	Rolls Royce
3	Prada	Rolex
4	Moet & Chandon	Puma
5	Louis Vuitton	Nike
6	Valentino	Porsche
7	Miu Miu	Mercedes
8	Lancome	Leica
9	Giorgio Armani	Mont Blanc
10	Givenchy	Lamborghini
11	Lagerfeld	Kenwood
12	La Prairie	Ferrari
13	Jil Sander	Calvin Klein
14	Gucci	Giorgio Armani
15	Fendi	BOSS
16	DKNY	Bentley
17	Dior	B&O
18	D&G	Apple
19	Christ	Tommy Hilfiger
20	Chloé	Sony
21	Cartier	Maybach
22	Porsche	BMW
23	BOSS	Adidas
24	Estée Lauder	Jaguar
25	Bally	Bogner
26	Chanel	Maserati
27	Escada	Loewe
28	Bogner	Moet & Chandon
29	Wempe	Ralph Lauren
30	Calvin Klein	Glashuette
31	Tommy Hilfiger	Davidoff
32	Strenesse	Brioni
33	Goldpfeil	Veuve Clicquot
34	Meissen	Diesel
35	Rolls Royce	Bose