Article details

Levallois C., Smidts A. & Wouters P. (2019), The emergence of neuromarketing investigated through online public communications (2002–2008), Business history.
Doi: 10.1080/00076791.2019.1579194

Business History

ISSN: 0007-6791 (Print) 1743-7938 (Online) Journal homepage: https://www.tandfonline.com/loi/fbsh20

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To cite this article: Clement Levallois, Ale Smidts & Paul Wouters (2019): The emergence of neuromarketing investigated through online public communications (2002–2008), Business History, DOI: 10.1080/00076791.2019.1579194

To link to this article: https://doi.org/10.1080/00076791.2019.1579194

Published online: 28 Mar 2019.

BUSINESS HISTORY
https://doi.org/10.1080/00076791.2019.1579194

The emergence of neuromarketing investigated through online public communications (2002–2008)

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ABSTRACT

'Neuromarketing' designates both a developing industry and an academic research field. This study documents the emergence of neuromarketing through the first mention of the term in traditional and new media until the stabilization of the field. Our main interest is to establish whether neuromarketing developed separately as an academic field and as an industry (with knowledge transfer from the former to the latter), or whether it was an act of co-creation. Based on a corpus gathered from a systematic search on the Web, we trace the multiple forms of engagement between academic and commercial communities, echoed but also shaped by reports in traditional and new media. We find that neuromarketing developed an identity through a set of practices and a series of debates which involved intertwined communities of academic researchers and practitioners. This result offers an alternative to the narrative of 'knowledge transfer' between academia and the industry and offers a contribution on how to use new kinds of digital sources in business history.

KEYWORDS

Neuromarketing; university-industry relations; World Wide Web; neuroeconomics; digital humanities

In the early 2000s, both an academic subfield and a new industry developed around the same theme: understanding marketing processes from the viewpoint of their connection with the consumer's underlying brain mechanisms, such as the processing of sensory inputs, memory encoding and retrieval, or the valuation of different options when presented with a choice. Neuromarketing, as it is called, is a manifestation of the growing value attributed to neuroscience in the scientific and business sphere. While the connection between academic and corporate versions of neuromarketing is likely, the nature of the link remains elusive. To what extent is the growing influence of neuroscience in academia and in the business sphere causing or influencing the other?

The pairing of neuroimaging and marketing, as a marketing events promoter wrote it, could sound 'terribly odd' (Minoque, 2003). Yet it would seem that in the late 1990s the intellectual climate was conducive to such a coupling. Marketing had already a long tradition of investigating consumer behavior as one aspect of applied psychology, putting marketing researchers in contact with the intellectual and technological innovations produced in this field (Schumann, Haugtvedt, & Davidson, 2008; Schneider & Woolgar, 2012). With cognitive neuropsychology and neuroimaging developing rapidly in the 1990s (Beaulieu, 2000; Dumit,

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2003), it was then a matter of time before marketing academics got acquainted with one of its new key technologies for brain scanning, functional magnetic resonance imaging (fMRI). In market societies where individuals are increasingly defined in terms of their identities as consumers (Thornton, 2011), it is then relatively unsurprising that neuroscientists came to investigate consumer behavior with neuroimaging techniques. Neuromarketing in academia developed in close relation to the more general research on the neuroscientific basis of decision-making, commonly referred to as neuroeconomics or decision neuroscience (Shiv et al., 2005; Glimcher, Camerer, Fehr, & Poldrack, 2008; Levallois et al., 2012). Neuroeconomists have shown some reluctance to be associated to neuromarketing in both its academic and commercial version:

> 'A related, although clearly distinct discipline that seems to be emerging alongside Neuroeconomics is Neuromarketing. Neuroeconomics is a purely academic discipline concerned with the basic mechanisms of decision-making. In contrast, Neuromarketing is a more applied field concerned with the application of brain scanning technology to the traditional goals and questions of interest of marketers, both those in academia and those in private industry. While these two disciplines are related, they are also very distinct. This is a distinction often overlooked by the popular media'. (Glimcher, 2008).

Gregory Berns, professor of neuroeconomics at Emory University and co-author of a widely cited review article on neuromarketing for *Nature Reviews Neuroscience*, also identifies a gap between neuromarketing as practiced in the industry and portrayed in the media, and academia: 'The academic community should take this topic [neuromarketing] seriously and not leave it to the neuromarketers and the op-ed page of the New York Times'. (Ariely & Berns, 2010). In a review entitled 'Branding the Brain', academics of this field similarly see a 'critical distinction' between 'consumer neuroscience' and 'neuromarketing' – the former relating to 'academic research' and the latter to 'practitioner and commercial interest in neurophysiological tools' (Plassmann, Ramsøy, & Milosavljevic, 2012, p. 19).[1] This perceived disconnect between the practices of neuromarketing in academia and in the industry is drawn more sharply by the frequent reminders issued in the academic community that neuroscientists should manifest prudence and restraint in their relations to the media and private businesses (e.g. The Lancet Neurology, 2004; Brammer, 2004; Farah, 2009). These relations would carry the risk for researchers to depart from the rigor, prudence and ingenuity which should characterize scientific investigations, and to be distracted by the profit motive, tendency to overclaim, and more lax standards of evidence reporting, which can be found in the media or businesses.[2]

Neuromarketing has been examined from the perspective of social studies of science (Schneider & Woolgar, 2012, 2015), based on an exploration of the literature and ethnographical work. These studies point to how new observations of consumers through imaging techniques actually shape the very definition of these consumers. In this study, we provide instead a historical perspective to recount the development of neuromarketing in business and academia and question their interdependence, through the examination of public documents available in the online record. The methodological framework we adopt is inscribed in the broader movement of the *digital humanities*, defined as:

> 'The research carried out [since the 1950s] in textually focused computing in the humanities […]. It remains deeply interested in text, but as advances in technology have made it first possible, then trivial to capture, manipulate, and process other media, the field has redefined itself

> to embrace the full range of multimedia. Especially since the 1990s, with the advent of the World Wide Web, digital humanities has broadened its reach, yet it has remained in touch with the goals that have animated it from the outset: using information technology to illuminate the human record, and bringing an understanding of the human record to bear on the development and use of information technology'. (Schreibman, Siemens & Unsworth, 2004, p. xxiii).

Specifically, the materials used in this study are online media from different sorts (from newspaper articles to blogs through videos and pages from commercial websites) retrieved by a systematic search on the keyword 'neuromarketing' on the World Wide Web (details below). Focusing on the public communication surrounding marketing, we depart from well-established practices in history which draw on primary sources such as archives or oral histories, and this needs a justification.

First, not relying on personal archives or interviews, one remains blind to the logic and motives driving the behavior and strategies crafted by the stakeholders involved in neuromarketing. Evidence is lacking on the resources and constraints shaping the horizons of the developers and critics of neuromarketing, and how these were negotiated, which alternatives were considered and abandoned, to arrive eventually at the representation of neuromarketing delivered publicly.[3]

Relying on the systematic harvesting of public documents from the online record does not compensate for the shortcomings mentioned above. Yet, it provides an alternative viewpoint on the historical development of neuromarketing, with its own relative advantages:

Collecting a systematic set of public documents relative to neuromarketing, without concentrating on a limited subset of stakeholders and their relations, can stimulate the exploration of new hypotheses about the historical lines of development for neuromarketing. While the accounts of neuromarketing cited above insist on the separation between university and business versions of neuromarketing, an exploration of the extensive public record can present a richer view, picturing a larger variety of stakeholders and a different sequence of events.

A second reason for considering neuromarketing through the historical record in online media is the view it offers on the rhetorical strategies at play. Rhetoric can be considered as a veil hiding the sincere or 'true' motives of the author, yet to a large extent the rhetorical dimension carries a message itself, not just in public reports but in the scientific discourse as well (Black, 1962; McCloskey, 1985). The communication act informs about which audience is targeted by the message, what kind of response the author of the message expects to elicit from this audience, and what portrait the author of the message draws of itself. For this reason, we consider public communication not as biased reports to be contrasted with more objective archival record, but part of the record itself. Considering how media representations contributed to the construction of neuromarketing requires paying special attention to the rhetorical devices at work in the corpus, which we do in this study – finding that the type of online media where the message appears (blog or institutional website, international online newspaper or scientific journal) is especially important in framing the message.

Finally, using media sources to shed light on the emergence of neuromarketing is advantageous given the young and relatively controversial history of this field. Archives are not yet available, and many key informants on the origins of the field are still active in it, which compounds the difficulty to weave their views into a coherent narrative. In contrast, as is

detailed below, the online record of publications on neuromarketing is already rich and the historical perspective – even if modest –provides an interesting value to these documents.

Hence, we consider that the public record available on neuromarketing is a worthy material to address the question of the joint or separate production of neuromarketing by academic and business communities. This research is different from, and does not replace, an archive-based study, but provides an interesting layer of interpretation nonetheless.

Created in the late 1980s and registering a staggering growth in the late 1990s, the World Wide Web presents an interesting opportunity to query large and diverse sets of documents. It has not yet been routinely used as a repository of primary sources for historical studies (Brügger, 2013; Golder & Macy, 2014; Tsatsou, 2014); however, with years passing its relevance and 'historicity' grows (Allen, 2012). In the first decade of the 21th century, access to the internet by the general public has increased dramatically: from an estimated 29% of the population of developed countries in 2001 to 81% in 2018 (International Telecommunications Union, n.d.). Content available on the Internet has also increased to reach towering figures: Technorati (a search engine for blogs) indexed 200,000 blogs in early 2003, 8 million in early 2005, and 72 million in 2007.[4] In the same period, companies also developed their presence on the Web. While studies of international scope remain sparse, it is found that as early as 1998, 218 commercial domain names (www.example.com is a domain name) were registered per 1000 companies in the United States (Zook, 2000). From 1998 to 2016, the number of domain names registered as 'dot coms' (worldwide) moved from less than 2 million to 126 million. The traces of the online publishing activity of businesses – from corporate websites to online advertising – is a valuable source to exploit for historical studies. A major obstacle to this endeavor is the transient nature of part of the Web: pages can be deleted, whole domains did disappear and cannot be retrieved directly anymore via a regular search engine. This can be mitigated by the existence of the Internet Archive's WayBack Machine, a nonprofit digital library which saved snapshots of Web pages since 1996 – harvesting 484 billion pages by 2016 (http://archive.org). While this archive is not directly searchable by keywords, it can be used to retrieve so called 'dead links' (urls pointing to deleted pages).

Method: Description of the corpus

The corpus was created by a research assistant who performed a search for the keyword 'neuromarketing' using the search engine Google to retrieve Web documents, and the Lexis Nexis database to search international newspapers and magazines. Using these two types of sources does not merely increase the volume of the corpus upon which a historical narrative can be developed. Web documents and the traditional media differ in terms of their time frames of reference, the topics they focus on, and their different standards of what makes for an authoritative discourse or statement. Their materiality differ (electronic hypertext with multimedia and underlying code versus ink on paper) and enable different types of reading modes (screen-based on multiple devices and with fragmentation and recombination for the Web, paper and page formatted for print media), suggesting that these two types of media evolve in different cognitive environments and stimulate different literacies (Hayles, 2004; Herbert-Goodall, 2015). It is however interesting to note some forms of convergence: major titles in the printed press all entertain a Web presence, which makes them discoverable through search engines and inscribes their content in Web forms of literacies.

The variety of content within these types of media (offline and online) should also be acknowledged, attenuating the differences across media types: in terms of writing style and immediacy of impact, an op-ed in the *New York Times* might be more similar to a post published by an influential blogger than to a long-form piece in the same issue of the journal.

The search was systematic, in the sense that all the results of the query have been examined.[5] We acknowledge the dependency of our results on the search engines we used, which are characterized both by evolving and non-publicly disclosed search algorithms, and by the changing perimeter of the datasets they cover. This creates selection biases that we are unable to characterize, and this also impedes the reproducibility of this research. The data collection effort remains valuable as it provides a comprehensive snapshot, susceptible to be built upon by later research.

We purposefully chose a keyword search rather than a search on the lexical field of neuromarketing to allow for a nominal definition of neuromarketing: neuromarketing is what stakeholders choose to label as such. In particular, we anticipated that a search of the type '(neuroscience OR cortex OR neuroimaging) AND (marketing OR brand OR packaging)' would have led to filter out a large number of documents making a claim to belong to 'neuromarketing' without matching this query, for instance because they discuss classic biometric approaches to marketing, not neuroimaging. Our nominalist approach avoids such an a priori. As a drawback, we risk neglecting neuroscientific approaches to marketing which do not self-refer as 'neuromarketing'. We identified such cases and address them specifically (see box). The search on the Internet used the Google search engine (different localizations have been queried, for example, Google.nl, Google.com, and Google.es). In Lexis Nexis, the search was performed on news source in the category 'international and all languages'. All search results have been opened and a full copy of each item has been archived. Meta-data was manually added in the form of tags for each person, place, organization, brand, and technology cited in the document. Pictures embedded in the html documents were also saved as separate entries. This search resulted in an archive of 1278 English language publications mentioning neuromarketing from 2002 (first document mentioning the term) to 2008.[6] As expected, the Web offered a diversity of sources and documents formats: magazine (297) and newspaper articles (99), but also blog entries (733), book reviews (38), presentations – such as pdf documents or slides uploaded on a file sharing website – (21), podcasts and radiobroadcasts (20), columns (20), or book syllabi (16).[7] From a selection of these documents, we identified themes ordered chronologically.[8]

From the BrightHouse Institute to the Pepsi-Coke experiment (2002–2004)

The first mention of the term 'neuromarketing' in English in our database appears on June 22, 2002, in a press release titled 'BrightHouse Institute For Thought Sciences Launches First Neuromarketing Research Company'.[9] Based in Atlanta, this 'institute' was a for-profit company that started operations in 2001 with 'plans to change the marketing world forever by using science to observe and understand the true drivers of consumer behavior. The Thought Sciences team uses functional magnetic resonance imaging (fMRI), a safe and non-invasive technique, to identify patterns of brain activity that reveal how a consumer is actually evaluating a product, object, or advertisement'. (PRWeb, June 2002). As a first indication of the porous frontiers between business and academia, this organization was chaired by Joey

Reiman, a marketing consultant and businessman who was also listed as a 'Senior Associate' in the Department of Psychiatry and Sciences at Emory University School of Medicine, as well as Associate Professor of Marketing in the Goizueta School of Business at Emory. The list of staff on the website of the BrightHouse Institute provides further indication that the coining of the term neuromarketing was negotiated with resources drawn from business and academia: a PhD specializing in neuroimaging, an Assistant Professor in neuroscience and specialist of addiction at the Emory University School of Medicine, and Vice-Chair for Research in the Psychiatry and Behavioral Sciences program; and two executives that graduated from the Wharton School of Management.[10] According to various news reports, the BrightHouse Institute rented fMRI scanners at an average rate of $550 to $1000 per hour from the nearby healthcare facilities of Emory University, charging from $50,000 to $250,000 for a study on product preferences involving from 12 to 30 subjects. (CBC News, 2002; Burne, 2003).

The multiple birthdates of neuromarketing

The term neuromarketing appeared in 2002 (Smidts, 2002; BrightHouse Institute), which provides a significant and convenient birthdate for the concept. While they did not use this label, activities conducted before this date had a close relationship to what is called neuromarketing today:

Pupillometry studies in the 1970s

Borrowing from contemporary developments in psychophysics, researchers in consumer behavior started measuring pupil dilation as a means to track the cognitive activity of subjects watching advertisements – 'through the eye to the brain' (Arch, 1979; Laeng, Sirois, & Gredebäck, 2012). Pupillometry is one example among many of a biometrics measure used for several decades in marketing. Other prominent techniques in this domain include galvanic skin response and eye-tracking.

EEG studies at the University of Wisconsin-Madison in the 1980s

In a series of papers, Michael Rothschild (Professor of Business) and co-authors examined the EEG response of subjects watching TV commercials (Rothschild, Thorson, Reeves, Hirsch, & Goldstein, 1986; Rothschild, Hyun, Reeves, Thorson, & Goldstein, 1988; Rothschild & Hyun, 1990), finding that after viewing the memory of the commercials 'correlated significantly with changes in the electrical patterns that occurred during viewing' (Rothschild & Hyun, 1990, p. 472).

Positron emission tomography (PET) studies at Harvard in the 1990s

A professor of Business Administration, Gerald Zaltman used 'PET scanning to evaluate consumer responses to alternative retail environments' (Kosslyn, Braun, & Zaltman, 1999). Together with Stephen Kosslyn (cognitive neuroscientist, then chair of the Department of Psychology at Harvard), they registered a patent (#6,099,319) for 'Neuroimaging as a marketing tool' in 1999. This patent was subsequently acquired by Neurofocus in 2008. Zaltman associated neuroimaging with his own interview method to elicit metaphorical thinking about products and brands – the 'Zaltman Metaphor Elicitation Technique' (Zaltman & Higie Coulter, 1995).

For more than a year, the launch of the BrightHouse Institute was sparsely covered, except for an investigative report by the Canadian TV program CBC Marketplace ('Canada's consumer watchdog') devoted to the 'science of shopping' (Kelly, 2002). We find no trace of scientific news reporting about other neuromarketing activities conducted in industry or academia until a front cover story in the magazine *Forbes* in September 2003, by journalist Melanie Wells. Her article described on-going studies conducted by integrated teams of academics and company representatives in the United States, UK (with a collaboration from Australia), and Germany. The article also highlighted the variety of technologies and use cases with descriptions of a magnetoencephalography (MEG) study on volunteers in a virtual supermarket visit (Ambler, Braeutigam, Stins, Rose, & Swithenby, 2004; Braeutigam, Stins, Rose, Swithenby, & Ambler, 2001), an fMRI study comparing preferences for different brands of cars (Erk, Spitzer, Wunderlich, Galley, & Walter, 2002), and a study using steady-state topography (SST, a form of electroencephalography, EEG) conducted on subjects watching TV series and ads (Nield, Silberstein, Rossiter, & Harris, 2001). By signaling that influential individuals and organizations – with academics in good place – had decided to become early adopters of neuromarketing, the *Forbes* paper contributed to cultivate the legitimacy of this new field.[11]

Finally, the *Forbes* article attracted early attention to an experiment in neuroscience which subsequently received a great deal of media attention. 'Neural Correlates of Behavioral Preference for Culturally Familiar Drinks' was due to be published in October 2004 in the journal *Neuron* by the team of neuroscientist Read Montague from Baylor College of Medicine (McClure et al., 2004). Here, as in other founding moments of neuromarketing, we find that academic and non-academic motives are blended: the reason for investigating 'culturally familiar drinks' was that Latané Montague, Read Montague's daughter and high school student, was working for the summer in her father's lab. Read Montague wanted to find an experiment that she could wrap her head around, and this is how they decided on investigating a commercial operation by Pepsi-Co called the "Pepsi Challenge"' (Lehrer, 2006). The Pepsi Challenge is a famous marketing promotion running since the early 1980s where consumers are asked to taste the Pepsi and Coca-Cola soft drinks, with the labels on the drinks removed. Pepsi-co claims that in a majority of cases, consumers declare a preference for the drink which turns out to be Pepsi. The study by Montague used the same set-up, with subjects sipping the drinks while lying in an fMRI scanner. It demonstrated that the subject's responses were influenced not only by the taste, but also by the knowledge of which brand they tasted. This difference could be observed in the verbal responses reported by the subjects, but also traced to the measured brain response of the experienced pleasure of drinking. This result can be interpreted as a demonstration of the 'neural signature' of the influence of brands on consumer preference. Since its publication, this research has been cited more than thirteen hundred times by other scientific publications, which is a high order. It is also by far the most often cited scientific study in our database with 148 news items (of the 1221) referring to it (Montague is also the most often cited academic in our database with 53 mentions). The media impact of this study might support the vision that a knowledge transfer occurred: the neuro-turn in academia later found an echo in society. However, the scientific experiment itself could be described as echoing a marketing operation. Here again, departing from the view of the relations between science and industry as a transfer of pure academic knowledge to the public channeled through scientific reports (e.g., Johnson & Littlefield, 2011; Wardlaw et al., 2011) is helpful in revealing cross influences between science and industry. Neuromarketing emerged through the interwoven influences of commercial and scientific cultures; the emergence of neuromarketing in academia and business appear to be intimately connected.

Involvement of academics in commercial neuromarketing: A period of controversies (2003–2007)

The major impact of the *Forbes* news story in 2003 was a progressive increase in the attention to 'neuromarketing' by other media,[12] with the effect of multiplying the narratives on neuromarketing with a less exclusive focus on the BrightHouse Institute narrative. In particular, articles published in the *New York Times Magazine* (Thompson, 2003) and in the *Financial Times* (Burne, 2003) framed neuromarketing in similar fashion to the *Forbes* story. The subsequent mentions made to the *NYT Magazine*[13] reinforced again the shaping of neuromarketing along the description first traced in *Forbes*. Hence in late 2003, neuromarketing became a clearly identifiable object of knowledge associated with a rich technological content, a diversity of powerful backers, and an international scale of operation – all characteristics suggesting that neuromarketing had secured a position of newsworthy, trending topic.

These media reports, appearing in outlets with a wide and influential audience,[14] had a large impact on the consolidation of neuromarketing as a community of actors (academics and big brands) and a set of technology and practices. Yet the first direct impact of this heightened visibility of neuromarketing was one which could have halted it abruptly.

In November 2003, Gary Ruskin, executive director of the consumer rights protection group 'Commercial Alert' (co-founded by political activist Ralph Nader), published on their website an open letter sent to James Wagner, President of Emory University[15]. The letter denounced the use of Emory's fMRI equipment by the BrightHouse Institute because these facilities where used 'not to heal, but to sell products' (Ruskin, 2003). If Emory did not put an end to its neuromarketing activities, Commercial Alert warned that 'we may ask the federal Office for Human Research Protections to investigate whether Emory University's neurological marketing research violates the principles of the Belmont Report [regulating research on human subjects]' (Ruskin, 2003). To support its case, the letter relied on the recent reporting by *Forbes* and the *NYT Magazine*, and displayed the signature of scholars affiliated with prestigious universities (Harvard and Johns Hopkins). The enlistment of academics is evocative in that the neuro-turn in marketing was advocated or challenged by alliances *mixing* academics and actors from other segments of society, and the mention of reporting in the media shows that these media popularized the neuroscientific approach to marketing, but also could be subsequently used as a red flag against it. These nuances can be overlooked when framing the issue in the simpler terms of the 'knowledge transfer', which tends to frame a unilateral flow from 'science' to 'the public', with the media forming a clear partition between the two.

While Emory University did not formally comply with Commercial Alert's demands, according to a later report in the marketing letter *Advertising Age* the campaign had nonetheless the desired effect to '[lead] to the shutting down of the group. Mr. Kilts retreated behind the walls of academia. 'All of a sudden, I was vilified', he said. 'I was the pawn of business, trying to aid business with the power of neuroscience. People were saying that you'd be sitting in front of television and secret images would control you and send you out the door to buy something' (Frazier, 2007). Beyond this particular case, the loud denunciation of improper relations between universities and commercial neuromarketing firms by Commercial Alert surely had a lasting impact on these relations by deterring some academics from collaborating with companies, in fear of receiving damaging negative publicity. This also possibly accounts for the cancellation of a conference on neuromarketing at Houston, Texas in early 2004, due to

a low number of confirmed participants (Lynch, 2004). It probably also has discouraged academics from using the term 'neuromarketing' to describe their research in this domain – preferring 'consumer neuroscience', 'decision neuroscience', or 'neuroeconomics'.

The new visibility and operation of definition of neuromarketing also had more positive consequences for the expansion of neuromarketing as an industry, here again with entrepreneurs and academic researchers being complementary inputs. Martin Lindstrom, marketing consultant and neuromarketing entrepreneur, explains how he first came to the topic:

> 'For me, it all started with a *Forbes* magazine cover story, "In Search of the Buy Button", which I picked up during a typical daylong airplane flight. The article chronicled the goings-on in a small lab in Greenwich, England, where a market researcher had joined forces with a cognitive neuroscientist to peer inside the brain of eight young women as they watched a TV show […] I was so excited by what I was reading I nearly rang the call button just so I could tell the steward.' (Lindstrom, 2008, pp. 23–24).

Not all marketing specialists expressed a similar confidence in neuromarketing. A large number of items collected around this time (2004) show marketing consultants not recommending the adoption of this new practice, or suggesting a 'wait and see' posture (Sutherland, 2004; Rice, 2004; Wolfe, 2004; James, 2004). Journalists from the general press were also reporting on a prudent tone that marketers were merely *looking for* solutions from neuroscience (Blakeslee, 2004; Lee Hotz, 2005; Page, 2006), and did not frame neuromarketing in the positive light of a scientific discovery.[16]

These tensions continued unresolved in 2005 and 2006, keeping the chatter about neuromarketing alive and contributing to its diffusion as a cultural concept traceable in professional conventions (Hoofnagle, 2006), dictionaries (Morin, 2005), new organizations (Research, 2005), course notes in universities (Hardy-Vallée, 2007), and blogs by consultants (e.g., www.neurosciencemarketing.com). In addition to numerous references to the Coke-Pepsi experiment, a number of high-profile initiatives by one group of researchers and business people continued to fuel the conversations. In April 2004, the *New York Times* (Tierney, 2004) reported on an fMRI study led by Marco Iacoboni, then Associate Professor at UCLA's Neuropsychiatric Institute and most renowned for his work on 'mirror neurons'.[17] Iacoboni's study was sponsored by the newly created company FKF Applied Research, composed of two political consultants experienced in presidential campaigns, Tom Freedman and William Knapps, and an Assistant Professor of psychiatry at UCLA, Joshua Freedman (brother of Tom). Iacoboni and Joshua Freedman's study compared the reaction of Republican and Democrat voters to different campaign commercials, in an analogical fashion to neuromarketing studies evaluating the reaction of customers to brands. This study elicited some further media attention when it was completed in Fall 2004, including a news wire by AP choosing a title making a clear reference to neuromarketing (Elias, 2004) and an article in the *Los Angeles Times* explaining the nature of the connection between neuromarketing and politics:

> 'Already, some researchers have experimented with brain scanning as a way to probe how the brain responds to political advertising. At the level of brain cells, sophisticated political arguments and party loyalties are reduced, like product preferences, to the activity of neural circuits honed by eons of evolution. Research suggests that political beliefs appear to trigger the same malleable circuits of reward, identity, desire and threat.' (Lee Hotz, 2005)

The prestigious journal *Nature Neuroscience* had a different view. Its July 2004 issue opened with an editorial listing neuromarketing initiatives dating from the BrightHouse

Institute up to Iacoboni's recent experiment in neuropolitics, warning businesses that the mechanisms of choice were still poorly understood in cognitive neuroscience, making it a risky investment to pay a large sum for fMRI studies of consumers or voters. While the tone of the editorial was overall cautious and not condemnatory, the title of the piece ('Brain scam?') made it clear that neuromarketing of this sort was of little scientific value to the journal (Brammer, 2004).[18]

The same team composed of Iacoboni and FKF Applied Research reunited in early 2006 and again in 2007 to evaluate the viewer's responses to the Super Bowl ads in 'instant science experiments'. The Super Bowl is the championship game of the American football season in the United States, and is one of the most watched TV events of the year in the US with more than 100 million viewers, leading to correspondingly very high price rates for the commercials aired in the breaks. In their study, Iacoboni and his group used the fMRIs of the UCLA Ahmanson-Lovelace Brain Mapping Center to show the Super Bowl ads to five subjects and compare patterns of the brain's activation to evaluations of the ads in self-reports. It is interesting to note that Iacoboni's mirror neurons were summoned to play a role in this experiment:

> 'Among the ads that seem relatively successful, I [Iacoboni] want to single out the Michelob ad. Above is a picture showing the brain activation associated with the ad. What is interesting is the strong response – indicated by the arrow – in"mirror neuron" areas, premotor areas active when you make an action and when you see somebody else making the same action. The activity in these areas may represent some form of empathic response. Or, given that these areas are also premotor areas for mouth movements, it may represent the simulated action of drinking a beer elicited in viewers by the ad. Whatever it is, it seems a good brain response to the ad'. (Lee Hotz, 2005).

This study conducted in 2006 evoked skeptical responses from marketing specialists and neuroscientists alike. In blogs, neuroscientists questioned the scientific standards of the experiment (conducted in just two days over five subjects) while Roger Dooley, a private entrepreneur and influential blogger on neuromarketing, found that market data contradicted the ranking of Super Bowl ads established by the experiment (Bell, 2006; Ramsøy, 2006; Dooley, 2006). In 2007, the second Super Bowl study by Iacoboni and FKF research[19] escaped criticisms but another study they conducted received a negative reception. This study was basically a rerun of their 2004 neuropolitics study, this time for the Republican and Democrat primaries in view of the 2008 presidential campaign. As for their previous studies, Iacoboni (joined by three other academics) and FKF Applied Research actively sought the largest media impact by publishing a summary of their results as an op-ed in the *New York Times* in December 2007 (Iacobini et al., 2007).[20] The accumulation of highly publicized, non-peer-reviewed studies by this group of researchers and business consultants might explain the number of criticisms raised against their latest initiative, including a letter of protest by a group of scientists addressed to the *New York Times* (Aron et al., 2007), and a second scathing editorial from *Nature* finding that the study was an effective marketing operation for FKF Applied Research, at the expense of neuroscience and political science ('Mind games', 2007).[21] Iacoboni published a response at the invitation of the 'Neuroethics & Law Blog' (started in 2005 by Adam Kolber, a professor of Law at the Brooklyn Law School). Iacoboni develops his vision of the relations between science and society:

> 'Our New York Times op-ed … provided a splendid example of how one can do civic education by using scientific constructs and rational thinking for issues that matter to people. Sadly,

> science has still a marginal role in our public discourse and this is in part due to an "ivory tower" attitude of many scientists that are afraid of mixing the "pure science" of the lab with real life issues. … I would argue that all neuro-something disciplines (neuro-economics, neuro-ethics, neuro-politics and so on) should rely heavily on the very same assumptions we adopted in our op-ed. This is necessary, if one wants to combine the tools developed and the knowledge acquired by neuroscientists to address issues that are important to our society.' (Iacobini in Kolber, 2008).

In 2007, the accumulation of criticisms of high-profile neuromarketing initiatives involving academics made Iacoboni's statement an isolated point of view. Commercial Alert, the editors of *Nature*, scientists sending protest letters to the printed media or sharing their doubts in blogs, and finally a large number of skeptical voices in a variety of online forums indicated that neuromarketing struggled to demonstrate its scientific standing, usefulness for practitioners, and ethical legitimacy – in a way not very different from the criticisms addressed to the BrightHouse Institute five years before. The co-creation of neuromarketing by academics and entrepreneurs seemed to infringe on the order of knowledge production: fundamental knowledge should be established first in academic settings and only then transposed to commercial applications. Doing all steps at once was deemed a failure: rushed and not trustworthy.

The consolidation of neuromarketing: Less headlines, more knowledge co-production (2007–…)

More recent items in our database record a decreasing number of controversies related to neuromarketing. Instead, we see a growing emphasis on collaborations between academics and the private sector without making sensationalistic headlines. Interestingly, this matched the expectations of the business community itself, which expressed the need for reliable evaluations of the promises of neuromarketing, pointing to the role of scientists in providing these.[22] Two papers stand out for their dual impact among scientists and practitioners: In January 2007, 'Neural Predictors of Purchases' by Stanford neuropsychologist Brian Knutson and co-authors published in *Neuron* reported that in a purchase experiment, 'activity from [the nucleus accumbens and the prefrontal cortex] independently predicted immediately subsequent purchases' (Knutson, Rick, Wimmer, Prelec, & Loewenstein, 2007).[23] A year later, a study by Hilke Plassmann from the California Institute of Technology and co-authors showed that by itself, the knowledge of the price of a product (in this case wine) influenced the pleasantness experienced during the consumption of this product (Plassmann, O'Doherty, Shiv, & Rangel, 2008).[24] These studies also showed that the new knowledge gained was not of theoretical interest only. Observing neural mechanisms at play, in addition to verbal or written self-reports by the subjects, appeared to increase the accuracy of predictions of subsequent purchases (Knutson et al. study), suggesting practical applications in forecasting the success of a product. Similarly in the Plassmann et al. study, the knowledge that a more expensive wine increases the blood flow in the medial orbitofrontal cortex of the individual sipping it provided a protocol for practitioners to test the effect of marketing actions and a demonstration that price is not only a pain-inducer at the purchase point (as investigated by Knutson et al.), but also a cue that consumers rely on to experience the quality of the product (a 'Veblen effect'). These key results were published in neuroscience and science journals, but found a broader audience than the community of neuroscientists. Published

in 2008, a special issue of the *Journal of Consumer Behaviour* signals that a body of knowledge has started to accumulate (Hubert & Kenning, 2008). A general survey of the field of neuroeconomics and allied fields conducted in 2010 shows that beyond marketing, many international research teams in social science, psychology and neuroscience co-contributed to the development of 'neuro-social sciences', including neuromarketing (Levallois et al., 2012).

While these scientific publications were important academic milestones, it is important to underline that they represented one source among others in the process of knowledge creation in neuromarketing. Voices with little scientific authority, but with a large and diverse audience, also shaped the knowledge landscape of neuromarketing. An example of this knowledge creation process is consultant and blogger Roger Dooley reporting on a study published in the *Proceedings of the National Academy of Sciences* (PNAS) by a team from the Section on Integrative Neuroimaging at the National Institute of Health (NIH). This study was a complex fMRI and PET experiment detailing dopamine synthesis and patterns of dopaminergic activation in young and older individuals (Dreher, Meyer-Lindenberg, Kohn, & Berman, 2008). Dooley based his blog post on a report of this study published on a portal website for professionals, 'spectographynow.com'. According to this report, the NIH study found that 'activation of dopamine-triggered brain regions differs between older and younger adults.' Dooley comments for his readers: 'In simple terms, it seems that the brain's reward system, which drives a variety of behaviors and may affect things like trying new brands, is dialed down as our brains age.' (Dooley, 2008a). This example makes two points apparent:

First, scientific results have no pre-established neuromarketing embedded meaning: a study in the neurobiology of aging making no reference to advertisements, brands or products can be cast as a statement supporting a marketing strategy. Indeed, we observe that with the growing popularity of neuromarketing, practitioners tended to reframe traditional techniques of investigation as 'neuro- techniques', even when the link with neuroscience was tenuous and indirect: eye-tracking, galvanic skin response or 'body language' (Karnell, 2008; Bradley, 2009). As a corollary, the notions and concepts discussed under the label of 'neuromarketing' could be unrelated to specific neuroscientific knowledge (understood as detailed references to brain structures and functions), and made instead general references to the role of emotions, memory, or attention in the marketing function (Bader, 2008; Branding Toronto, 2009). Second, there is a group of actors who contribute to select which scientific results and technologies are relevant to neuromarketing. Scientists themselves, but also private marketing experts as in the example above, or neuromarketing companies, all contribute to delineating the boundaries of the object 'neuromarketing'. Roger Dooley's blog, SalesBrain's social network, or the members of LinkedIn's group on neuromarketing – like many online forums – increased their audience in this period and gave momentum to neuromarketing, not merely acting as echo chambers to the studies released by academic research teams on consumer behavior but actively monitoring technological developments, sharing and evaluating practices, and commenting the entrepreneurial activities of their fellow community members.

Indeed, after 2007 entrepreneurial neuromarketing developed at a fast pace and without the negative publicity that previous initiatives had received. A reason for this might be that newly created companies learned to tone down their claims regarding the potential of neuromarketing, avoiding the inflammatory rhetoric of some of the first adopters,[25] and staying away (at least publicly) from the controversial applications of neuromarketing to politics. With the campaign of Commercial Alert against the BrightHouse Institute still in mind,

entrepreneurs also anticipated criticisms by acknowledging the possible controversial nature of neuromarketing, carving out in response the benefits it could provide to the consumers through providing products that better fit their needs.[26]

The number of neuromarketing firms increased steadily after 2007. Marketing research firms started to invest in these newly created neuromarketing labs (Karnell, 2007; Dooley, 2008b; PRNewswire, 2009; Dooley, 2009). In early 2008, the global marketing and advertising research company Nielsen took a 30% stake in Neurofocus, a start-up based in Berkeley, California specializing in EEG which had started operations in 2006 (Nielsen acquired 100% of Neurofocus in 2011). This operation was widely echoed in the press.[27] In October 2008, renowned brand specialist Martin Lindstrom published *Buyology* which presented the results of a series of proprietary studies he had directed over the previous three years. fMRI and EEG were used to conduct case studies ranging from the deterrent effect of gory pictures on cigarette packs to the relation between spirituality and attachment to the brand. This book benefited from broad media coverage – 'Buyology' and 'Lindstrom' appear to be the most frequent tags for a brand or a name in our database. The reception for *Buyology* was generally positive (it was ranked in a number of best-sellers lists), though the few commentators with a background in neuroscience were frankly critical (Lehrer, 2008; Bell, 2008). Lindstrom went on to become one of the '100 most influential people' selected by *Times* magazine in 2009 and to found the company Buyology Inc. Both Neurofocus and the *Buyology* book grew from a close association between entrepreneurs and academics, the latter enrolled as 'scientific advisors' or more directly as lead researchers of the neuromarketing studies.[28]

These partnerships between academics and entrepreneurs remained a core feature of the crystallization of neuromarketing in permanent networks and structures. The first conference using the title of neuromarketing to leave a digital trace was held in December 2008 by the Applied Neuroimaging group led by Gemma Calvert from the University of Warwick,[29] and was followed in February 2009 by a corporate event in Cracow, Poland organized by Rafal Ohme, professor in psychology and founder of the neuromarketing company 'Human Mind & Brain Applied Research Center' (HMB [now called 'Neurohm']).

Discussion

This documented overview of the development of neuromarketing stops six years after the first occurrence of the term appeared online. Fast forward to 2012, Richard Silberstein, Gemma Calvert, and Rafal Ohme became three of the board members of the newly founded 'Neuromarketing Science and Business Association' (NMSBA) with headquarters in the Netherlands, which held its first 'Neuromarketing World Forum' in February 2012 in Amsterdam[30] with subsequent conferences in Sao Paulo (2013), New York (2014), Barcelona (2015), Dubai (2016), London (2017), and Singapore (2018) indicating that the neuromarketing field has organized itself successfully. In an effort to promote what Ale Smidts denoted as 'evidence-based neuromarketing' at the NMSBA conference in February 2012,[31] the Advertising Research Foundation (an organization gathering together companies, media, agencies and universities with an interest in marketing research) released in 2011 a report of its 'Neurostandard working group', which consulted with a panel of scientific experts to evaluate eight neuromarketing companies which accepted to share the details of their procedures.[32] This initiative was paralleled by ESOMAR, a global association of marketing research professionals which consulted widely from June 2011 and released in February

2012 a guide of '36 Questions to Help Commission Neuroscience Research' (ESOMAR, 2012), in a sign that the advertising industry and marketing research in general have developed a long-term interest for neuromarketing. This is taken to the next level by the NMSBA which announced in 2016 the start of an accreditation procedure for neuromarketing companies with the goal to provide objective information to buyers of neuromarketing services on the scientific validity of the measures. In addition, they published a Code of Ethics on neuromarketing research. A search conducted in 2008 returned a list of 13 neuromarketing companies established in the United States and Europe. In 2012, this list had grown to more than 80 companies and consultancies located over five continents, and to more than 100 companies in 2016, not counting in-house neuromarketing divisions in leading market research companies.[33] In 2010, the influential review on neuromarketing by Dan Ariely and Gregory Berns published in *Nature Reviews Neuroscience* traced a roadmap for neuromarketing in business which called for more involvement by academics. It presented a balanced and critical view of the field which contributed to its academic credibility. Indeed, a steady growth of academic studies pinpoint the underlying brain process of consumer decision making and advertising effects (e.g., Klucharev, Smidts, & Fernández, 2008; Hedgcock & Rao, 2009; Stallen et al., 2010; Couwenberg et al., 2017), in an effort to demonstrate the added value of applying neuroscience methods to outstanding marketing questions. A special issue in a leading journal in the field of marketing, the *Journal of Marketing Research* (August 2015) further indicates this growth of rigorous studies in the field of neuromarketing (Camerer & Yoon, 2015). Recent academic studies focusing on predicting choice and even sales from 'neural focus groups' have also contributed to creating more faith in the validity and possibilities of neuromarketing (Berns & Moore, 2012; Falk, Berkman, & Lieberman, 2012; Boksem & Smidts, 2015; Venkatraman et al., 2015; Genevsky & Knutson, 2015; Barnett & Cerf, 2017). Recent reviews summarize the added value of neuroscience insights and methods for marketing in addition to pointing out the main challenges and opportunities (e.g., Smidts et al., 2014; Plassmann et al., 2015; Spence, 2016; Hsu, 2017). That neuromarketing is becoming of age in academia is furthermore indicated by the increasing number of top business schools that employ faculty specializing in neuromarketing, and who are teaching the topic to business students and business executives.[34] Occasionally though, neuromarketing as practiced in business still raises major outcry and discomfort by academics. It was most evidently illustrated by the letter to the editor of the *New York Times* signed by leading neuroscientists in response to unjustified claims made by Lindstrom in an Op-Ed on 'being in love with one's Iphone' (Lindstrom, 2011; Poldrack, 2011). The opacity of industry practices also continues to raise ethical concerns (Stanton et al., 2017). On the other hand, while difficult to document empirically, it also seems that the general public has become more accustomed to fMRI and brain studies and how they are applied outside the medical field. In this respect, the take-off of neuromarketing is in phase with the larger movement of the increasing importance of neuroscience and the brain in contemporary culture (Abi-Rached & Rose, 2010; Thornton, 2011).

Reflecting on this decade, we can re-examine the question stated in the introduction to this study. Is the record showing a relationship between the emergence of neuromarketing in academia and in the industry – or have the two unfolded independently? We show that each key episode in the first years of neuromarketing reveals a tight integration: scientists intervene as co-creator, employees, advisors to, or petitioners against neuromarketing firms; in turn, neuromarketing entrepreneurs actively sought to enlist academics in their commercial activities. The first occurrence of the term, in relation to the creation of the BrightHouse

Institute, is illustrative: this neuromarketing company was created by an entrepreneur hiring neuroscientists and businessmen with academic credentials, and providing commercial services while using brain scanners located in a university hospital.

This alliance of scientists and private entrepreneurs proved at first unstable: the credibility of neuromarketing as a legitimate site for knowledge production was regularly questioned by academics, private businesses, and consumer representatives. This deficit in credibility was caused by the relative weakness of the scientific body of knowledge in neuromarketing at this time and by an intense presence in the media about the promises and threats of this new field, contributing to inflate expectations but also doubts about the capacity for the field to deliver (Borup et al., 2006). From 2007 onwards, key scientific publications in neuromarketing and a less over-claiming media coverage assuaged tensions in the field. Academics and business persons launched studies and created companies at a faster pace, eventually developing neuromarketing into an organized, global branch of marketing studies.

Historians have provided a detailed narrative on the transformations of the role of a scientist in contemporary societies, from the emergence of the 'industrial scientist' in the twentieth century (Liebenau, 1984) to the development of a political economy of scientific entrepreneurship since the 1970s (Shapin, 2008), which is today in full bloom – especially in biotechnologies (Kleinman, 2003; Mirowski, 2011). This literature points to the fact that scientific knowledge is increasingly produced outside of traditional academic structures, by stakeholders who identify themselves as entrepreneurs or private knowledge workers, not primarily as academic scientists anymore. These actors have partly taken the place of R&D departments of large corporations which tend to outsource a larger share of their R&D effort, at least in the pharma industry (Rafols et al., 2014). The traces of this knowledge creation activity are likely to be found in scientific news coverage in the print media (Hicks & Wang, 2013), but also in patents, industry reports, promotional materials, consultancy presentations, and the reactions they elicit in the form of consumer group statements, TV shows, and other forms of social commentaries (Allgaier et al., 2013). Since the 1990s and 2000s, these documents take increasingly a digital form, challenging our historiographical practices (Jensen, 2015) with the development of new datasets, methods of query and analysis of large corpora. Business history will benefit from integrating new types of archival sources, originating from different fields of practice and reflecting different methodological approaches to business history (Walton, 2010; Kobrak & Schneider, 2011). In future work, it remains to explore how 'offline' archival and unpublished material can be articulated with these digital documents – we suspect that the mere reconciliation of offline and large volumes of online sources will be a methodological challenge.

In substantive terms, it can be expected that primary sources such as archives and interviews on the one hand, and digital traces deriving from the acts of publication communication on the other hand, will play complementary roles in the writing of rich historical narratives. While digital traces can help ascertain topics, a list of stakeholders and their relations, a chronology of events and a map of the sites of knowledge production (as was attempted here), primary sources bring light on the *motives* of the agents involved in the field under consideration, help find explanations and a causal order: transforming a sequence of events into a rich history. For the present this study, beyond tracing the public exchanges surrounding this emerging field, offers a reconsideration of the modes of knowledge (co-) production in academia and business, and a methodological contribution to defining the role of digital artifacts in historical research.

Acknowledgements

We thank Nicoline Beun for assistance in data collection and anonymous reviewers for their helpful comments. Funding for this research comes from the Erasmus Research Institute of Management, the Virtual Knowledge Studio, and the Open Research Area programme from the Netherlands Organization for Scientific Research (NWO) (NESSHI 464-10-029). All remaining errors are ours.

Notes

1. Others offer a much more positive view on the connections between neuromarketing in academia and business, and suggest an agenda to foster and widen these relations (Lee, Broderick, & Chamberlain, 2007; Senior & Lee, 2008).
2. Criticism of the crossing of boundaries between academia and practice is not specific to the case of neuroscience and marketing, it have also been evidenced in organizational and management research (Caswill & Wensley, 2012).
3. Based on archival research, we contributed elsewhere to fleshing out key episodes in the history of the relations between economics and the life sciences in the post-World War II period. See Levallois (2009, 2010, 2011).
4. More recent data is not available through a credible source, as Technorati stopped indexing blogs.
5. The research assistant spent a day per week, for a year (2009), on this task. As of June 2016, Google returns an indicative 467,000 results to the search on 'neuromarketing', and more than four million results in 2018. These figures are however approximations which are typically vastly over estimated (http://webapps.stackexchange.com/questions/16436/what-is-the-real-number-of-results-in-google-images-search). As referenced *infra*, less than 4000 items were retrieved. The detailed report on the methodology or data collection is available here: https://figshare.com/articles/Neuromarketing_db_Methodology_report/867663
6. The search included results in different languages (for a total of 3591 items), but only results in English are reported here. Partial results from 2009 are also included in the database but are not considered in this study.
7. A number of categories with just a few documents are not reported here. See the report attached to the database for the complete list. The number of documents in the archived dataset is marginally higher because we added a few items when checking the data sources in the preparation of this study (Google and Lexis Nexis search engines span larger collections of documents since the initial data collection has taken place).
8. We read each document individually except when they originated from the same source (for example, several dozens of posts written by the same blogger), in which case we read only a sample of them. The dataset is available publicly: https://figshare.com/articles/Bibliography_of_neuromarketing_occurrences_on_the_web_2002-2008/7485536
9. The same year, Ale Smidts independently coined the term neuromarketing in his publication 'Looking into the brain: On the prospects of neuromarketing' (ERIM Inaugural Address Series: http://repub.eur.nl/res/pub/308/) which was published as his inaugural address as Professor of Marketing at the Rotterdam School of Management in October 2002. The publication is in Dutch but contains an English abstract defining Neuromarketing. This publication is the first academic piece on the new field of neuromarketing that we have found, not only defining the field but also discussing its prospects.
10. The site has gone offline, but it can be visited as it looked in the summer 2002 at this address: http://wayback.archive.org/web/20020401000000*/http://www.thoughtsciences.com/aboutus.htm
11. Renowned British biologist and neuroscientist Steven Rose from Open University was cited as a co-leader of the neuromarketing study on shopping experience. The inventor of steady-state topography, Richard Silberstein from Swinburne University of Technology in Melbourne, Australia, was also cited as a provider of the technology serving in the TV ads study conducted

in collaboration with a prominent advertising professor John Rossiter. DaimlerChrysler is mentioned as the backer of a study conducted by Walter Henrik, psychiatrist at the University of Ulm, Germany and 'General Motors, Ford of Europe, and Camelot, the UK's national lottery operator' were listed as interested in neuromarketing.

12. We counted 11 subsequent mentions of the *Forbes* article. While this number might appear low, it should be remembered that in 2003 the online social media (such as blogs), which are a large source of news sharing, were just starting to develop. It should also be noted that any mention of the *Forbes* article not also mentioning the term 'neuromarketing' would not have been returned by our query.
13. We counted 15 subsequent mentions of the *NYT* article.
14. This is of course the case of *Forbes* and the *NYT Magazine*, but not only. Specialist blogs are also an influential vector of opinions for targeted audiences. For example, Zack Lynch, who runs a widely read blog on topics related to the 'neurosociety', seems to have discovered neuromarketing through the NYT article of Oct. 26, 2003 – and he reported on it two days later on his blog.
15. See also the Center for Cognitive Liberty and Ethics (CCLE) which expressed a similar concern about neuromarketing, with the nuance that they doubted its real powers: 'Our current position (Spring 2004) is that although the label smacks of creepy invasive advertising, in reality it's not much different than using focus groups to polish product features or marketing. […] As for consumers, we presently believe that the hype around neuromarketing is much larger than its actual power to steer consumer behavior.' (Center for Cognitive Liberty & Ethics, 2004).
16. It is at this point interesting to note the absence of articles from popular science journals referring to neuromarketing until relatively late: for the American press, the first reference to neuromarketing appears in *Scientific American* only in 2005 (and the second time in 2009, followed by a rapid increase in the frequency of mentions), while *Popular Science* does not evoke neuromarketing until 2010.
17. 'Mirror neurons' is a proposition that some neurons have the property to fire when an individual acts, and when the individual watches another individual performing the same action.
18. This does not mean that *Nature* and other publishing groups were not interested in the application of neurophysiological techniques to similar issues – but within the control of peer-review publications (Amodio, Jost, Master, & Yee, 2007; Ballew & Todorov, 2007; Fowler & Schreiber, 2008).
19. The press release for this study represents a fine example of the interleaving of resources, objects and people from academia and private businesses in the enactment of the neuro-turn in marketing: http://www.prnewswire.com/news-releases/super-bowl-xli-ads-to-be-ranked-by-fmri-brain-scans-54069502.html.
20. See also the accompanying slideshow: http://www.nytimes.com/slideshow/2007/11/11/opinion/20071111_BRAIN_index.html.
21. Other criticisms include pieces in the *Los Angeles Time*, the *Guardian* 'Bad Science' column, *Slate*, *Ars Technica*, NeuroscienceMarketing.com, MindHacks.com , the Neuroethics and Law blog (with an invited post by neuroethicist Marta Farah), and BrainEthics.
22. 'Would-be neuromarketers are willing to take any scrap of data and run with it, often without a solid basis for doing so. Where else would a researcher stick a tiny number of subjects in an fMRI scanner and declare "Super Bowl ad winners"? … What the field really needs is rigorous research that establishes a clear link between specific observations of brain activity and an ultimate purchase. It's not enough to find that one ad lights up an area of the brain more than another ad – that may be suggestive, but it's not proof. The sooner such research is conducted and published, both neuroeconomics and neuromarketing will be taken a lot more seriously, and we'll see businesses investing real money in private studies.' (Dooley, 2007).
23. The Knutson et al. paper is mentioned 12 times in our database. It received 31 citations in the academic literature in the three years following its publication, and was featured as a 'research highlight' in *Nature Reviews Neuroscience* (Welberg, 2007).
24. This paper received 30 citations in the three years following its publication, and appears nine times in our database.

25. Adam Koval, company executive of the Brighthouse Institute, was reported as having said: '[Neuromarketing] will actually result in higher product sales or in brand preference or in getting customers to behave the way they want them to behave' (Kelly, 2002). This rhetoric has been abandoned in public media but similar examples can still be found in the promotional material of neuromarketing companies (e.g., this video by Sales Brain in 2011: http://youtu.be/rcH9WQ6s4Ow).
26. An example of an elaborate defence of neuromarketing appeared early on in the blog of a professor of economics from George Mason University (Cowen, 2003).
27. Eleven items in our database mention this event, including an article in the *Financial Times* (Chaffin, 2008).
28. Lindstrom conducted his study in partnership with Gemma Calvert who held the Chair in Applied Neuroimaging at the University of Warwick (and co-founder of her own neuromarketing firm, Neurosense) and Richard Silberstein, Professor at Swinburne University (also co-founder of Neuro-Insight). Neurofocus was advised since 2006 by Robert Knight, the Evan Rauch Professor of Neuroscience and Director of the Helen Wills Neuroscience Institute at UC Berkeley, and since 2010 by Eric Kandel, Nobel Prize for Medicine for his research on the physiological basis of memory storage in neurons.
29. http://www2.warwick.ac.uk/fac/sci/wmg/research/neuroimaging/. An 'inaugural Australian Neuromarketing Symposium' was also held at Swinburne University (Melbourne) in February 2007. Max Sutherland, a marketing professional and fine observer of neuromarketing, delivered a speech which can still be found online (Sutherland, 2007).
30. http://www.neuromarketingworldforum.com/. Martin de Munnik, Partner and CMO of Neurensics (specializing in fMRI neuromarketing) took the initiative to found the NMSBA.
31. A statement reiterated in an interview preparing the International Conference on Neuromarketing on May 31, 2012 at Erasmus University Rotterdam: https://vimeo.com/40278247
32. The report was not released publicly but a draft is made available by the ARF: https://thearf-org-aux-assets.s3.amazonaws.com/research/NeuroStandards_WhitePaper_Oct262011_Pre-Production_Version.pdf. According to this draft the working group was cautiously positive about neuromarketing and concluded that further work was needed to establish standards and validate results.
33. List established in 2009: http://neuromanagement.wordpress.com/resources/. List in 2012: https://web.archive.org/web/20130309103242/http://neurorelay.com/2012/05/08/neuromarketing-companies-worldwide. List in 2016: http://www.nmsba.com/neuromarketing-companies.
34. Neuromarketing is taught in marketing departments at Erasmus University, Berkeley, INSEAD, U of Michigan, Wharton School, Stanford, Temple University, Kellogg, University of Minnesota, and Tel Aviv University.

Disclosure statement

No potential conflict of interest was reported by the author

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Clement Levallois is associate professor of digital culture and chaired Segeco professor in data valuation at emlyon business school. He is a co-director of the MSc in digital marketing and data science and is a member of the faculty group in "Operations, Data and Artificial Intelligence" at emlyon. He has researched and published on the recent history of economics and biology, before making contributions in computational methods applied to social sciences.

Ale Smidts is a professor of marketing research and director of the Erasmus Center for Neuroeconomics at the Rotterdam School of Management, Erasmus University (RSM). At RSM he teaches neuromarketing at the bachelor, master and executive level. He and his research team have published on topics such as the neural processes underlying social conformity, celebrity effects in advertising, the neural

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