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Attention in Business Press to the Diffusion of Attention Technologies, 1990–2017

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Organizations in the digital networked media environment must increasingly rely on data about audiences' allocation of their attention to obtain positive returns on their marketing budgets; provide better and more personalized services; or achieve more successful outcomes of health, political, or other campaigns or interventions. Thus, a variety of attention technologies (tracking, storage, and analytics) and an attention brokerage industry have developed over time. These developments are grounded in concepts of the information and knowledge economy, information economics, media advertising models, the attention economy, and diffusion of innovations theory. After this contextualization, the study analyzes how the business press represents the attributes associated with the diffusion of these attention technologies (relative advantage, compatibility, complexity, trialability, communicability, uncertainty, and reinvention), and new subdimensions of each, and by promoting or adopting company, over time (1990–2017).

Keywords: attention technologies, information economy, media marketing models, content analysis, diffusion of innovations

The continuing development and diffusion of digital networked media have generated extensive amounts and kinds of usage data, requiring the development and diffusion of *attention technologies* to track, store, and analyze those data. As with most new information and communication technologies, there is a tendency for the press, the public, and even researchers to treat these as novel and unique phenomena. Yet, attention technologies are grounded in several interrelated historic, technological, social, and economic developments. The growing value of user data is another manifestation of the

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information or knowledge economy. The economics of information make it difficult to sell information or content to online consumers, so sites seek resources through the media advertising model by generating attention from its users and selling that to third parties. This process represents an attention economy that has developed into a major media and attention technology sector. Yet, as with other innovations, there has been considerable uncertainty surrounding them, so that potential adopters and related stakeholders seek, provide, and attend to information about attention technologies through relevant media. Diffusion of innovations theory provides propositions and concepts for assessing how attributes of those technologies are communicated through the business press over time. Thus, this study first provides background context leading to the industry and types of attention technologies, and then analyzes how the business press has communicated their attributes over time.

The Information or Knowledge Economy

Many developed countries have become information or knowledge societies, whereby cognitive activities, symbol analysis, and information resources have replaced agriculture and manufacturing as the primary economic sectors. Machlup's (1962) analysis of the U.S. economy identified a sector primarily devoted to information activities necessary to produce physical goods and services. Porat (1971) reanalyzed Machlup's data to define the key components of the growing information society. Bell (1973) explained the postindustrial economy, whereby knowledge becomes the primary resource, allowing freedom from constraints of labor, land, and machines (for more historical foundations, see also Beniger, 1989; Headrick, 2002). The basis of wealth is shifting to the collection, storage, management, analysis, and application of data and information (Daley, 2015). This shift is also a manifestation of the rise of information capitalism and the exploitation of knowledge and creative labor (Castells, 2000; Curtin & Sanson, 2016; Fuchs, 2010). Attention technologies are (just) one more component of the information society.

The Economics of Information

A crucial requirement for a free market is "perfect information" (Smith, 1776), whereby anyone can obtain free and accurate information about products or services when needed, so that prices represent complete information about product values, which is necessary for market efficiency. But information as product, and about products, does not exhibit the same economic characteristics as material goods (see Table 1). This difference creates challenges for traditional material-based economics (Lamberton, 2003; Stigler, 1961), especially for organizations devoted to information and content, such as in the digital media industry (Zelenkauskaite, 2016). For example, it is difficult to value, sell, and protect online digital information, so content producers generally turn to other business models.

Table 1. Economic Characteristics of Information.

- Indivisibility of use (once shared, information cannot be easily separated)
- Nonexcludability (more than one person can "have" the same information)
- Inappropriability (difficult to own all of the benefits or profits from the information)
- Possibility of being a public good, which, because its value may not be fully appropriable by its creator, often results in underinvestment in R&D or creation
- Independence of scale of production (the same amount of information might be applied to small or large processes)
- Ability to create economies of scale and scope
- Marginal storage, retrieval, and distribution costs, which are much lower per unit than initial creation costs
- Changing value over time separately and in combination with other information
- Need to assess the value of information in order to decide whether to purchase, which means obtaining (at least some of) that information beforehand
- Difficulty in assessing the value of information
- Explicit (easily shared, documented, routinized, and programmed) and tacit (difficult to explain, share, document, or formalize, thus requiring iterative interpersonal relationships and accrued experience) forms
- Difficult to control distribution, use, and value (though trademarks, patents, licensing, royalties, etc., which are attempts to privatize its full value)
- Once information is digitized and networked, the content may take a variety of forms across diverse devices, often fragmenting ownership and payment

The Media Advertising Model and Its Discontents

Revenue from the global media entertainment industry as a whole (movies, home video, Internet subscription video-on-demand services, Internet advertising, music, TV advertising, video games, Internet access, book publishing, magazine, newspaper, radio, out-of-home advertising) was expected to reach $2.2 trillion worldwide in 2016 ($759 billion for the U.S. market; PricewaterhouseCoopers, 2017). Several models have developed to financially support this massive media industry. Until recently, the basic business models for funding the creation and distribution of content included direct payment (subscription, individual purchase including pay per view and tickets), advertising, and subsidies or nonprofit support.

In the advertising model, what most consumers traditionally refer to as a "medium" (radio, television or cable network, newspaper, and now the Internet) is an intermediary linking audience attention to advertisements (to sell products and services, and to inform the public) presented during exposure to the medium's ostensible content (Weisberg, 2016; Wu, 2016)—that is, a "two-sided platform." In this general audience commodification approach, media provide aggregated human attention (a form of unpaid audience work) to advertisers in return for money and other resources that support content production and distribution (McGuigan & Manzerolle, 2014; Smythe, 1981; Webster, 2014). The traditional media have used familiar measures of audience attention, such as circulation, subscriptions, Nielsen or Arbitron ratings, best-seller or top-hits lists, and so on, as the bases for charging advertisers (Napoli, 2011; Webster, Phalen, & Lichty, 2013). There are also many information sources attempting to generate interest in program content itself, through the use of advertisements about media content, reviews, awards shows, user "tags," hyperlinks, and recommender systems, among others.

Furthermore, crowd-sourcing, open-source programming and publishing, remixing, prosumers, and other creative labor sources provide content for free (Benkler, 2006; Curtin & Sanson, 2016; Jenkins, 2006; Rifkin, 2015; Shirky, 2010), although such content may lead to later integration into the marketplace as commercial products or fame. To illustrate the sheer volume of such content production, in 2014, in every minute Facebook users shared almost 2.5 million pieces of content, YouTube users uploaded 72 hours of new content, Twitter spawned 277,000 tweets, Instagram users posted 216,000 photos, and Google received more than 4 million search queries (Gunelius, 2016, p. 1). As the marginal storage and transmission costs for specific digital content approach zero, traditional physical constraints on content creation, inventory, access, and display disappear, and more content is provided for free; the traditional media models and ways of measuring audience attention are threatened and changing (Biswas, 2004; Napoli, 2011, Chapter 2; Rifkin, 2015). Thus, attracting and tracking audience attention in this swirling context are necessities, challenges, and opportunities, with much uncertainty about which data, methods, and technologies to use.

The Attention Economy

Central Concepts of the Attention Economy

Who pays attention to what has pervasive implications throughout all levels of society and industry (Downs, 1972; Taylor, 2015). Wu (2016) notes the long history of commercial attempts to attract and commodify people's attention, from the penny press in the 1830s and Parisian posters or patent medicine ads in the late 19th century, to newspapers and radio and television ads, on through celebrity tweets and Facebook news. Advertisers and other communicators (what Wu calls "attention merchants") devote extensive expertise, effort, and expense attempting to locate, attract, and analyze a specific audience's attention. These interrelated issues are the focus of the *attention economy* (Davenport & Beck, 2001; Franck, 1998; Goldhaber, 1997), based on the commoditization of this attention through all media, but digital media in particular (as attention data are already digitized and collected, and mobile personal media are pervasive). As there is increasingly more content than any one person can process, individuals must allocate or ration their limited attention (Simon, 1971), which is thus a rare and valuable resource. Therefore, the attention economy presumes that, rather than audiences consuming information, information

consumes audience attention (Davenport & Beck, 2001); Goldhaber (1997) argues that attention, rather than information, is what flows through the Internet. Indeed, audience commodification, through attention technologies, is the central model of Internet economics.

For example, Facebook's central identity is both a social media site as well as an advertiser and surveillance agency, emphasizing monetization of usage, through collecting user data and integrating them with consumer credit information (called "onboarding") to sell to advertising companies (and other entities), which can then target very specific groups with very personalized messages or individualized context-specific pricing (Bucher, 2012; Lanchester, 2017; Wu, 2016). Even physical retail stores employ a wide variety of strategies and technologies to capture customer behavior and usage data (Turow, 2018).

Critiques of the Attention Economy

Of course, different stakeholders have varying views of these developments. Concerns include surveillance, privacy, ownership, and control (Becker, 2014; "Fuel of the Future," 2017; Gandy, 1993; Hintz, Dencik, & Wahl-Jorgensen, 2017; Weisberg, 2016); declines in traditional and regional media (Taylor, 2015); manipulating search engine results and fake clicks; integrating multiple consumer databases (Lanchester, 2017; Wu, 2016); obscure algorithms (Gillespie & Seaver, 2016; Mittelstadt, Allo, Taddeo, Wachter, & Floridi, 2016; Shorey & Howard, 2016); journalistic practices and news bias (Fengler & Ruß-Mohl, 2008); biased data from nonrepresentative users (Napoli, 2011, Chapter 3); the rise of unpaid and precarious creative labor (Curtin & Sanson, 2016); overloading audiences with ads (Taylor, 2015); and triaging inequalities across narrowly targeted audiences offline and online (Gandy, 1993; Turow, 2018). Users have little access to or control over this information (Crain, 2018; Zelenkauskaite, 2016), although consumers may soon begin to take charge of (some of) their own information, using personal data clouds and intermediary data stores (Becker, 2014). From this perspective, the attention economy becomes a complex sociotechnical–financial infrastructure (Crogan & Kinsley, 2012; Wu, 2016).

Attention Technologies

To coordinate these processes, an extensive intermediary attention industry has developed (Halpern, 2016; Marwick, 2014; Turow, 2012; Weisberg, 2016; Wu, 2016), extending the traditional two-sided media platform to a "three-sided platform." This intermediary market provides, for example, automated online auctioning to advertisers for both instantaneous and scheduled access to users' attention within their current viewing, clicking, searching, or posting context; keyword advertising with pricing proportional to location alongside the right side of the search page; Google's AdSense; algorithms that match ads in real-time to users' search phrases; cookies that track return visits to sites; analysis of data from users' past behavior to predict current usage and information preference; and promotion of social influence advertising through a participant's personal network ("Fuel of the Future," 2017; Halpern, 2016; Marwick, 2012; Turow, 2012; Webster, 2014; Wu, 2016). Some of the largest companies engaged in tracking include AddThis, Adnxs, Doubleclick, Facebook, Google, Quantserve, Scorecard Research, Twitter, and Yieldmanager (Geary, 2012). This data brokerage economy was estimated to be $200 billion in 2014 (Crain, 2018). Google and Facebook are pretty successful in their application of attention technologies: Of

the total $60 billion digital ad revenue in 2015, 50% went to Google and 13% to Facebook, and these two firms accounted for about 90% of all the revenue growth that year (Ingram, 2017).

All of these approaches, services, and markets require sophisticated and interrelated attention technologies, which we categorize into tracking, storage, and analytics technologies. *Data-tracking technologies* gather information about the consumers' characteristics (e.g., in their profile or past purchases) and online behavior (e.g., time spent viewing a website; which links they click; what search terms they use; what they tweet or post; what topics are trending; and how they feel about a product, service, or topic; Hemann & Burbary, 2013; Turow, 2018). *Data storage technologies* manage extensive and complex demographic, sales, online behavior, and sentiment data to integrate with other data sets (commercial, public, governmental), license or sell to third parties, and serve the analytics stage (Daley, 2015; "Fuel of the Future," 2017; Turow, 2012). *Data analytics technologies* organize, integrate, mine, compute, and visualize metrics and usage patterns to more effectively design and place ads and other messages and gain competitive advantage (Hemann & Burbary, 2013). These attention technologies also provide the basis for algorithmic generation of digital identities through shaping the news that users are exposed to, the categories users are assigned to, and inferences about users' behavior and relationships (Cheney-Lippold, 2017). More positively, some have suggested these be called *listening* or *engagement* technologies, as such information is also used to understand how one's products or arguments are positioned, what industry or social topics are trending, how customers and competitors discuss a topic, how potential voters respond to candidates and political campaigns, in what ways patients participate in online health interventions, how to optimize search engine results, and how to develop and tailor relevant content (Hemann & Burbary, 2013). Also, user data are valuable for mitigating risk, verifying identities, and aiding law and counterterrorism efforts (Crain, 2018).

Diffusion of Innovations Theory and Innovation Attributes

In the attention economy, the (potential) value of the displayed content depends on relevant audiences attending to that information. As the number, types, complexity, newness of, and thus uncertainty about, attention technologies increase, potential adopters require, and the relevant media provide, communication about these innovations and their implications. However, there is little analysis of how the business press represents these attention technologies (for a more general exception, see Swanson's 2012 discussion of "IT innovation waves").

Diffusion of innovations (DOI) theory provides a conceptual foundation for such analyses. "Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers, 2003, p. 5), culminating in outcomes such as adoption, rejection, or reinvention. An innovation is a product, process, service, or idea that is perceived as new at the time by a given audience. The adoption process and innovation outcomes are fraught with uncertainty and potential risk. Therefore, adoption decisions are influenced by how media and interpersonal sources portray, and how potential adopters perceive, attributes of the innovation, so that potential adopters can understand its positive and negative aspects (Gatignon & Robertson, 1993; Rice, 2017).

Communication of the following central attributes may be by neutral sources such as the press, as well as by stakeholders such as promoting and adopting organizations. *Relative advantage* is the ratio of benefits to disadvantages relative to current practice. *Compatibility* is the extent to which the innovation is consistent with existing needs, experiences, values and norms, and systems, although transformative approaches may require rejecting current (legacy) systems and organizational cultures altogether (Mullan, 2017). *Complexity* is how difficult the innovation is to understand and use, influenced by context such as existing organizational expertise and capabilities. *Trialability* reflects how easily the innovation can be tried out on a preliminary basis, such as by demonstrations and beta applications, or by being able to use selected components. *Communicability* is the extent to which aspects of the innovation can be easily communicated or exposed to potential adopters.

Two other attributes are particularly relevant: uncertainty and reinvention. If there is much *uncertainty* or risk about the investment, maturity, or outcome (e.g., return on investment) of an innovation, it is less likely to be adopted (Greenhalgh, Robert, Macfarlane, Bate, & Kyriakidou, 2004). *Reinvention* is "adaptation after adoption" (Rice & Rogers, 1980), such as when an organization reconfigures the innovation to fit local needs or contexts, develops uses for which it was not initially intended, or tailors it to integrate into the current technological infrastructure.

Research Questions and Hypotheses

This study analyzes the extent to which the business press represented various attributes of attention technologies between 1990 and 2017 through the following research questions and hypotheses.

RQ1: *How are attention technologies and their attributes represented in the business press overall and over time?*

RQ2: *How are selected attributes associated with each other? We might expect that attributes that are conceptually related to each other, and share similar valence, would be more likely to be represented about a given attention technology as an additional way to reduce uncertainty about the innovation. Thus,*

H1a: *Positive relative advantage is positively associated with positive compatibility with strategy. This is likely because DOI underscores the relative, perceived nature of an innovation's advantage. Thus, "advantage" would be relative to how well the innovation fits a potential adopter's strategy.*

H1b: *Lower financial uncertainty is positively associated with positive compatibility with strategy. It seems unlikely that communication about a successfully diffusing innovation would convey compatibility as involving high financial uncertainty.*

H1c: *Positive compatibility with technology is positively associated with lower technology uncertainty. Integration and implementation of a new attention technology are complex challenges,*

generating uncertainty, which can be reduced by perceptions of its compatibility with current procedures and systems.

H1d: Positive technological compatibility is positively associated with lower complexity. The less complex, the fewer constraints on interoperability of new technology with current practices and standards.

H1e: Lower complexity is positively associated with lower technological uncertainty. Easier understanding and learning about an attention technology should reduce uncertainty about it.

H2: Mentions of positive aspects of attributes of attention technologies will be more frequently associated with organizations that are promoting the technologies than with organizations that are adopting them. Companies promoting attention technologies (with goals of increased reputation and market share) will attempt to reduce negative uncertainty by highlighting positive aspects. Adopting companies are more likely to experience and thus communicate about negative aspects.

RQ3: What major insights emerge from the content analysis of the business press's coverage of attention technologies and their attributes over time?

Method

Sample

We searched the Business Source Complete Database, which covers business journals about an extensive range of subjects. The search entry was ["Marketing" AND ("data tracking" OR "data storage" OR "data analytics")]. The sample was further narrowed to the period from 1990 to 2017 as there were very few mentions of data storage technologies before 1990 and none of tracking or analytics until 1992. The publication type "trade publications" was selected, as it provides timely coverage of information regarding business and professional interests and concerns. Finally, only "full text" articles were selected, so as to find mentions of our terms throughout the article. We downloaded the resulting 834 articles.

Coding

First, we used the DOI definitions and resources such as *Harvard Business Review* and the Business Source Complete Database to develop an initial a priori coding framework of definitions of each type and attribute of attention technology. We also allowed for emergent codes derived from the research literature and the articles in the industry/business context. The unit of analysis was the entire article. The codebook is available at
http://www.comm.ucsb.edu/faculty/rrice/RiceHoffmanIJOCAttentionTechnologiesCodebook.pdf

Manifest Content

For each article we entered an identification number, and the article title, publication venue, publication date, and number of words.

Relevance

An article was relevant if it mentioned at least one of the *a priori* instances of the three attention technologies. If not, coders marked "0" and proceeded to the next article. If a term for one of the technologies appeared that was not on the a priori list for that technology, we coded it as "other," entered the term, and also coded the article as relevant.

Attention Technologies

A priori or initial instances of tracking technologies included cookies, customized coupons, event-driven marketing, geofencing, geolocation, IP tracking, transactional purchasing data (OLTP), and other. Storage technologies included cloud computing, database-general, database-relational, data center, data marts, data volumes, and other. Analytics technologies included behavioral, clickstream, predictive, stream, value-based marketing, and other.

Attributes

Based on the literature and initial readings of the articles, we identified a variety of additional subcategories for the attributes, and distinguished these further by their valence (positive/negative or high/low).

Relative advantage (positive/negative). This attribute was referenced by such words as *improving* (positive) or *reducing* (negative) value creation, customer acquisition, competitive advantage, and improvements over current or traditional approaches for managing attention data.

***Compatibility (positive/negative)*.** We added three subcategories of compatibility. *Compatibility with culture:* Organizational culture is one context for considering compatibility of a new attention technology. In the business context, organizational compatibility with culture may include having (positive) or needing to develop (negative) appropriate roles such as chief technology marketing officer, individuals with appropriate skills and expertise to use the technology, or organizational capabilities matching new trends in attention technologies. *Compatibility with strategy:* This attribute was indicated when articles mentioned factors such as appropriate allocation of resources, integrating digital media more effectively into their broad marketing plan, and so on. *Compatibility with strategy positive*: This was conceptualized as ease of allocation of resources, or mention that the technology supports an organizational mission or market niche. *Compatibility with strategy negative:* This attribute was indicated by mention of a misalignment of budgets and resources, or the technology's not matching an organization's mission or market. *Compatibility with technology positive:* This was indicated through easy integration, migration, or easy implementation with existing systems. *Compatibility with technology negative:* This was indicated

through mention of the need for specialized coding, new systems, new hardware or software, and an overall lack of integration with current systems.

Complexity (high/low). *Complexity high* was indexed by mention of a high learning curve, challenge in implementation, need for consultants, or how much previous knowledge is needed to use the technology. *Complexity low* was indicated by ease of use or simplicity or easy-to-understand reports and processes.

Trialability (positive/negative). *Trialability positive* was any reference of success in beta tests and demonstrations, and the ability to try various components of the innovation before making the full adoption decision. *Trialability negative* was any reference to difficulties during demonstrations or beta tests, or mentioning "turnkey" systems or the need for full transition or large-scale implementation.

Communicability (positive/negative). *Communicability positive* was indicated by any reference to communication (through conferences, blog posts, webinars, trade shows, sales team visits, advertisements, trade publications, interviews with or articles by industry leaders and adopters, etc.) about the success or positive aspects about the technology. *Communicability negative* was indexed by difficulties in communicating about the technology, acquiring sufficient information, or gathering an audience/viewership for the technology.

Uncertainty (high/low). We identified three subcategories of uncertainty. *Uncertainty: Financial* included any reference to financial uncertainty (e.g., "difficult" to estimate return on investment, financial costs, budgeting concerns, etc.). *Uncertainty financial high* was indicated by more and *uncertainty financial low* was indicated by less risk regarding financial aspects. *Uncertainty: Policy/legal* was operationalized as any reference to (high or low) uncertainty about the potential legal ramifications or sanctions pertaining to data mining and analytics, such as intrusion into consumer privacy, emerging privacy laws, or patent issues. *Uncertainty: Technological* was indexed by a reference to (high or low) uncertainty relating to the technology's capabilities or integration with current systems.

Reinvention (adoption or attribute; positive/negative). *Reinvention as adoption type* was indicated by mentions of organizations adjusting the innovation to fit their needs, such as discussing how an organization discovered new uses for the technology it adopted, or implemented the innovation in ways that were not originally advertised or intended (positive), or were not able to do so (negative). *Reinvention as attribute* was indicated by any mention of marketing or promoting the technologies as easily adaptable, adjustable, customizable, or reconfigurable to fit the needs of an organization (positive) or not (negative).

Reliability Tests

The research team read the first full version of the codebook (based on iterations of a priori and some early emergent coding) to ensure that all members had a thorough understanding of the operationalizations of the technologies and attributes. The team then read and discussed three articles together to ensure understanding of the codes. We adjusted the codebook based on any disagreements, as

well as on emergent aspects appearing in the articles. We then coded three new articles separately and reconvened to discuss our codes, and made a few small adjustments.

After initially coding and discussing 20 articles, we decided to code for the presence or absence of only the first mention of any of the three technology types, and then the associated first mention of each of the possible attributes associated with that first-mentioned technology. The articles were relatively short (*M* = 1,004 words), so they tended to focus on just one example of any of the three technologies, and when there were multiple examples, the first-mentioned instance of each of the three technologies tended to be the focal point of the article. We applied and discussed this approach in a set of 10 shared articles.

Two members then each coded a set of 20 articles to assess initial intercoder reliability, using the I_r reliability measure, suitable for dichotomous categories (Perreault & Leigh, 1989). This yielded high reliabilities (mean I_r = 0.97), except for compatibility with culture (positive) and with technology (positive), both of which still had high values of I_r = 0.90. The coders discussed the discrepancies in these two codes, coded another 10 articles, reaching consensus and slightly revising the codebook. The two coders were then assigned their own sets of 200 different articles. After that, to assess possible coding drift, we conducted another reliability test, using the first set of 20 articles and the second set of 10 articles. All codes had high reliability (mean I_r = 1.0). The two coders were then each assigned half the remainder of the articles, saving the last 34 articles for a final reliability drift test, which again demonstrated high reliabilities (mean I_r = 0.98).

Results

The following analyses are based on 577 relevant articles (66.8% of the original 834).

Coverage Overall and Over Time (RQ1)

Table 2 presents the descriptive statistics for all measures.

Table 2. Descriptive Statistics.

Variable	*M*	*SD*
Article length (words)	1,050.2	878.0
Company role		
Adopting	0.23	0.420
Promoting	0.60	0.489
First-mentioned technology		
Tracking	0.12	0.321
Storage	0.42	0.494
Analytics	0.45	0.498
Relative advantage		
Positive	0.58	0.494
Negative	0.01	0.110
Compatibility		
Culture positive	0.16	0.365
Culture negative	0.05	0.226
Strategy positive	0.35	0.478
Strategy negative	0.06	0.236
Technology positive	0.37	0.483
Technology negative	0.06	0.232
Complexity		
Low	0.22	0.417
High	0.15	0.356
Trialability		
Positive	0.01	0.117
Negative	0.00	0.042
Communicability		
Positive	0.16	0.370
Negative	0.01	0.102
Uncertainty		
Financial low	0.08	0.268
Financial high	0.10	0.306
Policy/legal low	0.05	0.211
Policy/legal high	0.12	0.321
Technology low	0.05	0.211
Technology high	0.11	0.310
Reinvention		
Attribute	0.04	0.204
Adoption	0.03	0.183

Note. *N* = 577 articles. Except for article length, values are means and standard deviations of the percentage occurrence in the relevant articles.

Storage and analytics technologies were covered about equally (42% and 45%, respectively), with tracking discussed less (12%). Some attributes were mentioned fairly often: relative advantage (positive), 58%; compatibility culture (positive), 16%; compatibility strategy (positive), 35%; and compatibility technology (positive), 37%; both low (22%) and high (15%) complexity; communicability (positive), 16%; uncertainty financial (high), 10%; and policy/legal (high), 12%. Trialability and reinvention were hardly mentioned.

Table 3 lists how frequently specific attention technologies were mentioned.

Table 3. Percentage Occurrence in Articles of Specific First-Mentioned Attention Technologies.

Technology	%	Technology	%	Technology	%
Tracking		Storage		Analytics	
Cookies	2.1	Cloud computing	5.6	Behavioral	3.9
Customized cookies	0.8	Database general	8.9	Clickstream	0.8
Event-driven marketing	0.8	Database relational	0.5	Predictive	3.5
Geofencing	0.0	Data center	2.0	Stream	0.2
Geolocation	0.8	Data matrix	0.5	Value-based marketing	2.1
IP address	0.5	Data volumes	0.8		
OLTP	1.2				
Other		Other		Other	
Data tracking	2.4	Data storage	7.7	Data analytics	18.2
		Database management system	2.1	Big data analytics	2.3
		Data warehouse	2.0	Web analytics	2.0
Remaining other	3.8	Remaining other	12.6		
Brand tracking, offline data collection, search engine optimization, etc.		Enterprise content management, smart grids, customer relationship manager, etc.			

Note. *N* = 577 articles. In coding, the specific type of each "other" occurrence was noted. The most frequent of those were then coded and listed as a specific "other." The remaining are grouped as "remaining other."

Table 4 shows mean differences in attributes by attention technology.

Table 4. Mean Differences in Attributes by Attention Technology and by Company Role.

	Attention technology				Company role		
Attribute	Tracking	Storage	Analytics	*F* ratio	Adopting	Promoting	*t* ratio
Company role							
Adopting	0.24_a	0.16_{ab}	0.29_b	6.38**	–	–	–
Promoting	0.58	0.66	0.57	2.51	–	–	–
First-mentioned technology							
Tracking	–	–	–	–	0.11	0.11	0.10
Storage	–	–	–	–	0.30_a	0.46_b	–3.40***
Analytics	–	–	–	–	0.58_a	0.42_b	3.14**
Relative advantage							
Positive	0.61_a	0.48_b	0.67_a	9.35***	0.66	0.54	2.47**
Negative	0.00	0.02	0.03	1.63	0.02	0.01	0.08
Compatibility							
Culture positive	0.07_a	0.13_{ab}	0.21_b	4.87**	0.18	0.14	1.08
Culture negative	0.01_a	0.02_a	0.09_b	6.90***	0.03	0.05	–0.98
Strategy positive	0.33	0.30	0.41	2.91*	0.40	0.34	1.06
Strategy negative	0.03	0.06	0.07	0.76	0.08	0.04	1.14
Technology positive	0.18_a	0.51_b	0.29_a	21.44***	0.40	0.38	0.53
Technology negative	0.00_a	0.10_b	0.03_a	7.18***	0.06	0.03	1.56
Complexity							
Low	0.04_a	0.32_b	0.18_c	14.57***	0.15_a	0.25_b	–2.54**
High	0.15	0.11	0.19	3.36*	0.15	0.13	0.76
Trialability							
Positive	0.01	0.02	0.01	0.75	0.05_a	0.01_b	2.13**
Negative	0.01_a	0.00_b	0.00_b	3.78*	0.00	0.00	–0.61
Communicability							
Positive	0.25_a	0.13_b	0.17_{ab}	2.95*	0.15	0.17	–0.50
Negative	0.04_a	0.00_b	0.01_b	5.14**	0.02	0.01	–0.33
Uncertainty							
Financial low	0.07	0.10	0.06	1.19	0.05	0.09	–1.69
Financial high	0.18_b	0.09_a	0.10_a	2.36	0.11_a	0.08_b	–2.03**
Policy/legal low	0.01_a	0.09_b	0.02_a	7.28***	0.02_a	0.06_b	–2.83**
Policy/legal high	0.13_a	0.31_b	0.05_a	18.82***	0.09	0.10	–0.29
Technology low	0.07	0.05	0.03	1.11	0.04	0.04	–0.24
Technology high	0.07	0.13	0.10	1.05	0.09	0.09	–0.00
Reinvention							
Adoption	0.00	0.05	0.03	1.59	0.05	0.03	0.95
Attribute	0.01	0.07	0.03	2.59	0.00_a	0.05_b	–4.48***
n	67	243	259	569	131	349	480

Note. Cell values are mean percentages. Overall multivariate Wilks' Lambda = 0.677, $F(46, 1086) = 4.98$, $p < .001$. Pairwise comparisons apply Duncan's post hoc means test and harmonic mean. Means with different subscripts are significantly different at $p < .05$, two-sided significance. Appropriate *t* ratios are based on Levene's equality of variances test.

*$p < .05$. **$p < .01$. ***$p < .001$.

Table 5 applies binary logistic regression to identify the unique contributions of company role, year of publication, and those attributes with at least 10% coverage.

Table 5. Binary Logistic Regressions Explaining Attention Technologies.

	Tracking				Storage				Analytics			
Variable	*B*	*SE*	Wald	Exp(*B*)	*B*	*SE*	Wald	Exp(*B*)	*B*	*SE*	Wald	Exp(*B*)
Company role (0 = adopt, 1 = promote)	0.00	0.35	0.00	1.00	0.55*	0.26	4.55	1.73	−0.47*	0.25	3.71	0.62
Year published	−0.07*	0.03	5.51	0.94	−0.16***	0.02	51.44	0.85	0.19***	0.02	64.64	1.21
Relative advantage positive	0.59	0.36	2.65	1.80	−0.51*	0.23	4.85	0.60	0.35	0.24	2.16	1.41
Compatibility												
Culture positive	−0.87	0.57	2.34	0.42	−0.42	0.31	1.76	0.66	0.67*	0.31	4.72	1.95
Strategy positive	0.14	0.33	0.17	1.15	−0.33	0.23	1.95	0.72	0.24	0.23	1.07	1.27
Technology positive	−0.73	0.38	3.63	0.48	0.98***	0.23	17.61	2.67	−0.71***	0.24	8.77	0.49
Complexity												
Low	−1.25*	0.63	3.95	0.29	0.39	0.26	2.13	1.47	−0.10	0.27	0.14	0.91
High	0.59	0.42	1.99	1.81	−0.69	0.36	3.67	0.50	0.31	0.33	0.90	1.37
Communicability positive	0.72*	0.35	4.19	2.04	−0.50	0.31	2.67	0.61	−0.06	0.30	0.05	0.94
Uncertainty												
Financial high	0.67	0.48	1.96	1.95	−0.17	0.40	0.18	0.85	−0.19	0.40	0.22	0.83
Policy/legal high	1.44***	0.42	11.52	4.20	0.67	0.37	3.19	1.95	−1.63***	0.41	15.81	0.20
Technology high	−0.76	0.59	1.65	0.47	0.84*	0.39	4.71	2.31	−0.34	0.40	0.70	0.72
Constant	−1.29	0.69	3.51	0.28	2.22	0.52	18.02	9.19	−3.37	0.56	36.46	0.03
χ^2 (*df* = 12)	44.8***				134.6***				139.7***			
−2 log likelihood	292.9				517.5				523.3			
Nagelkerke R^2	.18				.33				.34			
Correctly classified (%)	89.0				73.3				73.8			

Note. *N* = 490. Table includes only attributes with at least 10% overall coverage.

*p < .05. **p < .01. ***p < .001.

Tracking technologies were characterized by earlier coverage, more high policy/legal uncertainty, more positive communicability, and less low complexity (explaining 18% of the variance in absence or presence of coverage). Storage technologies were associated with more promoting companies, earlier coverage, more positive technical compatibility, more high technological uncertainty, and less positive relative advantage (33% variance explained). And analytics technologies were represented as related to adopting companies, later coverage, more positive culture compatibility, less positive technological uncertainty, and less high policy/legal uncertainty (33% variance explained).

Coverage of tracking technologies was not significantly associated ($r = -.06$) with successive three-year publication dates (we aggregated over three-year periods because of the low percentages within year, especially for early years), whereas storage was negatively correlated ($r = -.36$, $p < .001$) and analytics positively correlated ($r = .40$, $p < .001$). Figure 1 displays these basic trends in coverage of attention technologies.

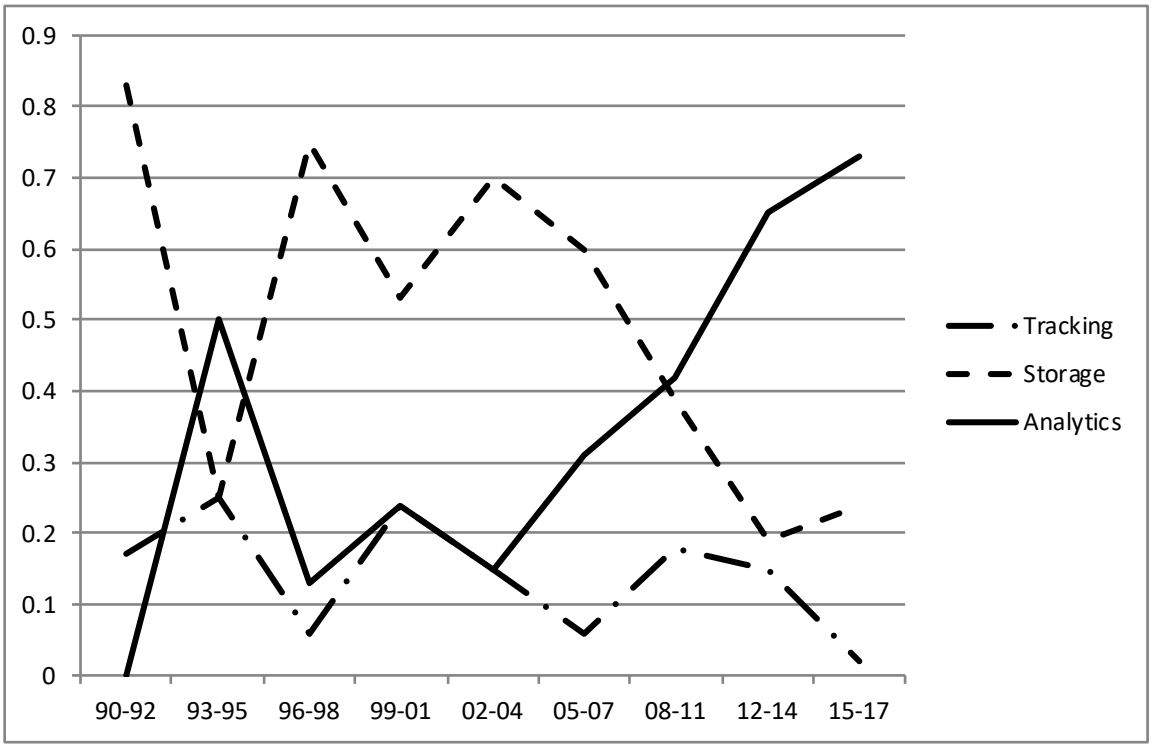

Figure 1. Percentage coverage of the attention technologies, 1990–2017, by three-year periods;* n *articles = 6, 4, 16, 17, 81, 124, 90, 150, 89 (last three-year sequence includes only part of 2017).

Associations Among Attributes (RQ2): Hypotheses (H1a–H1e, H2)

H1a–H1e

Because we measured positive and negative or low and high valence of each attribute, we could test each hypothesis in two ways: first by assessing the correlation (Spearman) between the stated valenced attributes (e.g., positive compatibility with strategy, and lower financial uncertainty), and second by the correlation between the opposite pair of valenced attributes (e.g., negative compatibility with strategy, and higher financial uncertainty). All five hypotheses were supported by both correlations. Compatibility strategy was associated with relative advantage (H1a: positive/positive $r = .25$; negative/negative $r = .17$) and with uncertainty financial (H1b: positive/low $r = .11$; negative/high $r = .15$); compatibility technology was associated with uncertainty technology (H1c: positive/low $r = .05$; negative/high $r = .18$) and with complexity (H1d: low/low $r = .25$; high/high $r = .11$); and complexity was associated with uncertainty technology (H1e: low/low $r = .14$; high/high $r = .17$); ps $< .01$, except $r = .05$, *n.s*.

H2

When identified in the article, the company role was primarily a promoter rather than an adopter (60% vs. 23%; see Table 2). Table 4 shows that the business press coverage of communication by promoting companies tended to be somewhat more positive, with significantly higher percentages than adopting companies for storage technology, low complexity, and low policy/legal uncertainty, but significantly lower percentages for analytics, positive trialability, and high financial uncertainty.

Insights (RQ3)

We returned to the articles and our results to identify several general insights about the attention economy in general and several key attributes of attention technologies in particular.

Attention Economy

Upsurge in content production: With the dramatic increase in content production, the Internet has become saturated with content trying to capture audiences' attention, requiring firms to compete constantly for that scarce attention. *Need to share:* In the private sector, data are typically siloed within organizational units, as certain departments claim certain data types. However, over the coming years, organizations will see a "democratization" of data in which relevant users and departments are inundated with many more data from other organizational users and units: "Think of all the social media data feeds, web search logs, documents being created and stored; all this unstructured data is existing somewhere and growing exponentially" (Kho, 2014; Article 737).

Change Over Time

Tracking technologies seem to have continued to develop over time as new media devices diffused, receiving a fairly stable amount of coverage. Coverage of data storage declined primarily

because of enterprises adopting these technologies rapidly over the course of the 1990s. This created an industry standard, meaning that it was no longer an innovation and thus not as relevant for business press coverage about a fast-changing industry. On the other hand, with the increases in data storage, companies struggled to derive actionable insights from the increasingly overwhelming amount of data. This caused a pressing need for analytics and visualization tools, generating increased coverage throughout the early and middle 2000s.

Relative Advantage

Customer experience: A consistent relative advantage these technologies offer to companies is a quality customer experience through tailored and relevant content and support services: "Customers expect a consistent experience and they expect a company to know who they are from device to device and from touch point to touch point. You can only do that with technology" (CIO, 2016; Article 463).

Compatibility With Culture

Emergence of new c-level executive roles: The articles indicated a growing need for creating a shared chief information officer and chief marketing officer role, sometimes referring to this new role as chief technology marketing officer. *Increased communication across departments:* Research efforts indicated the pressing need for a cohesive environment between the information technology and marketing departments to drive effective decision making using data analytics:

> That's where IT and marketing have to be best friends. My new tribe is the IT department-data scientists, very analytical and their skill set has to change because it is not all about surveys and databases anymore. And then you have marketers who are very creative and, actually, the two can work well together but they are such different tribes at the moment, so the challenge is bringing them together. (Roberts, 2016; Article 436)

Mergers and acquisitions: In terms of compatibility with culture, the importance and variety of attention technologies have prompted numerous mergers and acquisitions, with hopes of facilitating increases in market share, economies of scale and scope, and integration across technologies: "I believe we will start seeing a large M&A movement within enterprises, where many large companies will start to buy niche media companies where there is a gap in content and/or audience" (Kho, 2014; Article 737). For example, Oracle acquired more than 230 companies during the time period of this study, with recent attention technology examples including digital advertising measurement, cloud computing security, and media Web-tracking technology (https://en.wikipedia.org/wiki/List_of_acquisitions_by_Oracle).

Emergence of new skills in marketing departments: Coverage was generally positive about some of the areas requiring new expertise to match the technology requirements (compatibility: culture [positive], 16%, especially for analytics, 21%; uncertainty: technology [low], 5%; and complexity [low],

22%, significantly higher for storage). However, there were also some concerns about compatibility: culture (negative; 5%, significantly higher for analytics); uncertainty: technology (high, 11%), and complexity (high, 15%). Several articles indicated that there is a growing need for marketing professionals to possess attention technology skills. The emergence of these attention technologies has directly forced companies to gain new skills (or hire those with them) in order to evaluate, adopt, and implement them. As some articles noted how current education curricula do not include these skills, new online training programs and the emergence of a master's degree in data analytics programs are intended to fill these gaps.

Compatibility With Strategy

Budgeting: The emergence of data-tracking, analytics, and storage technologies is fundamentally changing the way marketing budgets are formed as more funding is allocated toward new technologies: "Technology is not just changing consumer behavior; it is changing the composition of marketing budgets" (James, 2016; Article 449). *Affordability:* In the early 1990s, these technologies were only compatible with larger firms' budgets. Over time, database marketing platforms are becoming more affordable to small- and middle-tier firms. Nonetheless, many companies still question whether they can afford attention software, technology, and services.

Compatibility With Technology

Emergence of big data: The diffusion of the term *big data* represents the vast upsurge in data being produced and analyzed. But without understanding and application of the appropriate metrics, companies struggle to find actionable data. *Lack of proper metrics:* The industry continues to develop numerous metrics, such as impression, click, conversion, like, share, tweet, and so forth, but there is a pressing need for firms to focus on metrics that contribute to effective decision making and more long-term goals (see also Hemann & Burbary, 2013):

> As analytic tools gain in popularity, we increasingly see many companies measuring individual campaigns with great precision but not doing as good of a job measuring the longer-term items that accumulate over multiple campaigns. Many are also neglecting to think about the impact that their actions are having on customer failure over time. (Hess, 2010; Article 541)

Uncertainty About Policy/Legal Issues

Although the intended and direct effects of these attention technologies are portrayed in the business press as largely positive, an indirect consequence of the diffusion of tracking and storage technologies is that customers have become somewhat more aware of how many user data companies are collecting and how they are using those data. Thus, we see noticeable coverage of policy/legal (high) issues for tracking (13%) and especially storage (31%) technologies. This is associated with increased public discourse concerning privacy implications for the average consumer, and has contributed to discussions about revising consumer privacy rights regulations. The actual analytic technologies,

generally known and understood only within the industry, have not generated as much policy/legal coverage (5%, although not significantly different from tracking). These issues are particularly salient for the health care, security, finance, and insurance industries, and government agencies, as they tend to track pertinent personal information about clients, leading to increased legal, societal, and even national security implications: "Recent high visibility security breaches in the insurance, retail and government sectors provide a cautionary tale about keeping transactional and static data secure" (Donovan, 2015; Article 478).

Discussion

Contributions

The study contributes to the DOI literature and attention technologies literature in threeways. First, few studies have measured how attributes are associated with innovations in the media as opposed to individuals' perceptions. Second, it identifies, reliably operationalizes, and analyzes new subcategories of attributes including compatibility with culture, strategy, and technology; financial, technological, and policy/legal uncertainty; and reinvention as an attribute; as well as considering positive/negative or high/low valence of each. Thus, we introduce a far more detailed and comprehensive approach to the central innovation attributes typically used in diffusion of innovations research. Third, it contributes to the study of the particular innovation of attention technologies by distinguishing their three different components, and by characterizing them through how the business press portrays attention paid by the industry to those components and their attributes over time. Discussions and analyses of the use and implications of attention technologies may benefit from these three contributions, for instance, by rejecting the notion that perceptions of the attributes of such technologies are necessarily stable over time or objective (DOI theory emphasizes the influence of perceptions of attributes) by paying attention to which stakeholder is evaluating which attribute (press, promoter, adopter).

Research Implications

A more nuanced approach would test for the hypothesized associations among attributes within each of the three attention technologies and the time periods rather than overall. For example, would financial uncertainty be differentially associated with strategy compatibility for the different attention technologies, and for earlier versus later periods of business press coverage? Press coverage in the earlier stages, or about the more abstract analytics technology, may reflect more initial uncertainty about financial returns.

Future studies could expand the scope of this research by including the industry and size of companies mentioned in the articles, as these might be associated with emphasis on different attention technologies or attributes across the diffusion process. For example, some industries might be more concerned about legal/policy uncertainty and technological uncertainty attributes than other industries (such as health care industries because of the Health Insurance Portability and Accountability Act of 1996).

The DOI model could be extended by considering temporal sequencing of the extent of coverage of the perceived attributes. Perhaps, later in the diffusion process, there is more discussion of relative advantage because that perception is contingent on prior and established technological and legal compatibility.

The study found little media coverage of reinvention and trialability of these attention technologies. Diffusion studies in general underemphasize the reinvention process, and organizations tend to view reinvention as a negative diversion from the desired implementation (Rice & Rogers, 1980; Rogers, 2003), so this concept needs greater emphasis. For some technologies, the associated interdependencies and standards may make trialability either difficult or only partially informative. These gaps could be explained through conducting interviews with business leaders and journalists to provide a clearer context for the representation, and assessment, of reinvention and trialability.

Limitations

We analyzed the full population of business press articles meeting our criteria, but there were of course other media venues communicating about these attention technologies during the time period. Especially interesting would be to analyze attention technology trade show materials, and advertisements from the vendor companies themselves, to see how some attributes are emphasized over others. However, these are heavily promotional and limited in scope, whereas professional media articles are likely to provide more timely, diverse, neutral, and critical perspectives, better reflecting the over-time innovation communication process. On the other hand, general newspapers or magazines are not likely to cover such industry- and technology-specific topics. Another limitation of this study, as with most content analysis studies, is that we can not assess the effect of the business press's representation of the three attention technologies and their attributes on the rate of adoption of these technologies in the industry or by specific organizations. In this context, coverage probably both reflects and influences the rate of adoption.

Conclusion

This study grounds an understanding of the representation of the attributes of attention technologies (tracking, storage, and analytics technologies), as represented in the business press, in prior work on the information and knowledge economy, economics of information, the attention economy, media advertising models, and DOI theory. With continuing changes in the nature of media in the digital, networked environment, stakeholders and researchers need to pay more attention to the media coverage, attributes, diffusion, use, and implications of attention technologies.

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