Title

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 in order to obtain positive returns on their marketing budgets, to provide better and more personalized services, or to archive 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, this study then 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, from 1990 to 2017) over time, and by promoting or adopting company.

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

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The continuing development and diffusion of digital networked media has generated extensive amounts and kinds of usage data, requiring the development and diffusion of *attention technologies* to track, store, and analyze it. 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 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 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 up 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 US 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 post-industrial 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 collecting, 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 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)
• non-excludability (more than one person can "have" the same information)

- inappropriability (difficult to own all 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. 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 VOD services, Internet advertising, music, TV advertising, video game, Internet access, book publishing, magazine, newspaper, radio, out-of-home advertising) is expected to reach $2.2 trillion worldwide in 2016 ($759 billion for the U.S. market) (PWC, 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 non-profit 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, 2014; 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 that supports 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, etc., as the bases for charging advertisers (Napoli, 2011; Webster, Phalen, & Lichty, 2013). There are also many information sources attempting to generate interest in the program content itself, through the use of advertisements about the media content, reviews, awards shows, user "tags", hyperlinks, recommender systems, etc.

Further, crowd-sourcing, open-source programming and publishing, re-mixing, prosumers, and other creative labor sources provide content for free (Benkler, 2006; Curtin & Sanson, 2016; Shirky, 2010; Jenkins, 2006; Rifkin, 2015) (though 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 over 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 is a necessity, challenge, and opportunity, 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 is already digitized and collected, and mobile personal media are pervasive). As there is increasingly more content than any

one person can process, the individual must allocate or ration their limited attention (Simon, 1971), which is thus a rare and valuable resource. Thus the attention economy presumes that, rather than audiences consuming information, information consumes audience attention (Davenport & Beck, 2001); Goldhaber (1997) argued 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 usage data and integrating it with consumer credit information (called "onboarding") to sell to advertising companies, 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 their own information, using personal data clouds and intermediary data stores (Becker, 2014). From this perspective, the attention economy becomes a complex socio-technical-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 a 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, 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 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 (such as in their profile or past purchases) and online behavior (such as 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 this extensive and complex demographic, sales, online behavior, and sentiment data, to integrate with other datasets (commercial, public, governmental), to license or sell to third parties, and to serve the analytics stage (Daley, 2015; "Fuel of the future," 2017; Turow, 2012). *Data analytics* technologies organize, integrate, mine, and compute and visualize summary metrics and usage patterns to more effectively design and place ads, and gain competitive advantage (Hemann & Burbary, 2013). These attention technologies also provide the basis for algorithmic generation of digital identities, through shaping the news we are exposed to, the categories we are assigned to, and inferences about our 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 are discussing a topic, how potential voters respond to candidates and political campaigns, in what ways patients are participating in online health interventions, how to optimize search engine results, and how to develop and tailor relevant content (Hermann & Burbary, 2013). Also, user data are valuable for mitigating risk, verifying identities, and aiding law and counter-terrorism efforts (Crain, 2018).

Diffusion of Innovations Theory and Innovation Attributes

In the attention economy, the (potential) value of the displayed content depends upon 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," culminating in outcomes such as adoption, rejection, or reinvention (Rogers, 2003, p. 5). 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 & Roberston, 1993).

Communication of the following central attributes may be by both 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, though 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 (such as 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 represents 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 is a complex challenge, 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 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 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 (listed below). 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* 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 sub-categories for the attributes, and distinguished these further by their valence (positive/negative, or high/low).

Relative advantage (positive, negative). This attribute is 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* is indicated when articles mention factors such as "appropriate allocation of resources," "integrating digital media more effectively into their broad marketing plan," etc. Compatibility with strategy positive is conceptualized as an ease of allocation of resources, or mention that the technology supports an organizational mission or market niche. Compatibility with strategy negative may be 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.* Compatibility with technology positive might be indicated through easy integration, migration, or easy implementation with existing systems. Compatibility with technology negative might be 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 is indexed by mention of a high learning curve, a challenge in implementation, a need for consultants, or how much previous knowledge is needed in order to utilize the technology. Complexity low is indicated by ease of use or simplicity, or easy to understand reports and processes.

Trialability (positive, negative). Trialability positive is any reference of success in beta tests and demonstrations, and of the ability to try out various components of the innovation before making the full adoption decision. Trialability negative is any reference of 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 is 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 is 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* includes any reference to financial uncertainty (for example "difficult" to estimate return on investment, financial costs, budgeting concerns, etc.). Uncertainty financial high is indicated by more, and low less, risk regarding financial aspects. *Uncertainty: Policy/Legal* is 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 of consumer privacy, emerging privacy laws, or patent issues. *Uncertainty: Technological* is 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* is indicated by mentions of organizations adjusting the innovation to fit their needs, such as discussing how an organization discovered new uses for the technology they 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* is 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 they 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. However, the articles are relatively short (*M* = 1004 words) so tend to focus on just one example of any of the three technologies, and when there are multiple examples, the first-mentioned instance of each of the three technologies tends 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 inter-coder reliability, using the I_r reliability measure, suitable for dichotomous categories (Perreault & Leigh, 1989). This yielded high reliabilities (mean I_r = .97) except for Compatibility with culture (pos.) and with technology (pos.), both still with high values of Ir = .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 Ir = 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 Ir = .98).

Results

The following analyses are based on relevant articles (*N* = 577, 66.5% of the 868).

Coverage Overall and over Time (RQ1)

Table 2 presents the descriptive statistics for all measures. Companies mentioned in the articles were primarily vendors or promoters (60%).Storage and analytics technologies were covered about equally (42%, 45%), with tracking less discussed (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 2. Descriptive Statistics

Articles		
Variable	***M***	***SD***
Article Length (words)	1050.2	878.0
Company Role:		
Adopting	.23	.420
Promoting	.60	.489
1st Mention Technology:		
Tracking	.12	.321
Storage	.42	.494
Analytics	.45	.498
Relative Advantage:		
Positive	.58	.494
Negative	.01	.110
Compatibility:		
Culture Positive	.16	.365
Culture Negative	.05	.226
Strategy Positive	.35	.478
Strategy Negative	.06	.236
Tech Positive	.37	.483
Tech Negative	.06	.232
Complexity:		
Low	.22	.417
High	.15	.356
Trialability:		
Positive	.01	.117
Negative	.00	.042
Communicability:		
Positive	.16	.370
Negative	.01	.102
Uncertainty:		
Financial Low	.08	.268
Financial High	.10	.306
Policy/Legal Low	.05	.211
Policy/Legal High	.12	.321
Tech Low	.05	.211
Tech High	.11	.310
Reinvention:		

Attribute	.04	.204
Adoption	.03	.183

N = 577

Note: Except for article length, values are mean and standard deviation of the percentage occurrence in the relevant articles.

Table 3 lists how frequently specific attention technologies were mentioned.

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

Tracking	**Pct.**	**Storage**	**Pct.**	**Analytics**	**Pct.**
Cookies	2.1%	Cloud computing	5.6%	Behavioral	3.9%
Customized cookies	.8	Database general	8.9	Clickstream	.8
Event-driven marketing	.8	Database relational	.5	Predictive	3.5
Geofencing	.0	Data center	2.0	Stream	.2
Geolocation	.8	Data matrix	.5	Value-based marketing	2.1
IP address	.5	Data volumes	.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: Brand tracking, Offline data collection, Search engine optimization, etc.	3.8	Remaining Other: Enterprise content management, Smart grids, Customer relationship manager, etc.	12.6		

N = 577 articles

Note: In coding, the specific type of each "Other" occurrence was noted. The most frequent of those are listed as a specific "Other". The remaining are grouped as "Remaining Other".

Table 4 shows and tests for mean differences in attributes by attention technology. Tracking and analytics technologies were associated with more positive relative advantage than were storage technologies. Analytics technologies were portrayed with more comments about compatibility with organizational culture (both positive and negative), but, along with tracking, less compatibility with technology (both positive and negative). Storage technologies were presented as more complex, with tracking the least. Tracking was also seen as more communicable, with storage the least, and as having high financial uncertainty but low levels of low policy/legal uncertainty, and middle levels of high policy/legal uncertainty.

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

	Attention technology				**Company role**		
Attribute	**Track-ing**	**Stor-age**	**Analy-tics**	***F*-ratio**	**Adopt-ing**	**Promot-ing**	***t*-ratio**
Company Role:							
Adopting	.24a	.16ab	.29b	6.38 **	--	--	--
Promoting	.58	.66	.57	2.51	--	--	--
1st Mention Tech:							
Tracking	--	--	--	--	.11	.11	.10
Storage	--	--	--	--	.30a	.46b	-3.40 ***
Analytics	--	--	--	--	.58a	.42b	3.14 **
Relative Advantage:							
Positive	.61a	.48b	.67a	9.35 ***	.66	.54	2.47 **
Negative	.00	.02	.03	1.63	.02	.01	.08
Compatibility:							
Culture Pos.	.07a	.13ab	.21b	4.87 **	.18	.14	1.08
Culture Neg.	.01a	.02a	.09b	6.90 ***	.03	.05	-.98
Strategy Pos.	.33	.30	.41	2.91 *	.40	.34	1.06
Strategy Neg.	.03	.06	.07	0.76	.08	.04	1.14
Tech Pos.	.18a	.51b	.29a	21.44 ***	.40	.38	.53
Tech Neg.	.00a	.10b	.03a	7.18 ***	.06	.03	1.56
Complexity:							
Low	.04a	.32b	.18c	14.57 ***	.15a	.25b	-2.54 **
High	.15	.11	.19	3.36 *	.15	.13	.76
Trialability:							
Positive	.01	.02	.01	0.75	.05a	.01b	2.13 **
Negative	.01a	.00b	.00b	3.78 *	.00	.00	-.61
Communicability:							

Positive	.25a	.13b	.17ab	2.95 *	.15	.17	-.50
Negative	.04a	.00b	.01b	5.14 **	.02	.01	-.33
Uncertainty:							
Financial Low	.07	.10	.06	1.19	.05	.09	-1.69
Financial High	.18b	.09a	.10a	2.36	.11a	.08b	-2.03 **
Policy/Legal Low	.01a	.09b	.02a	7.28 ***	.02a	.06b	-2.83 **
Policy/Legal High	.13a	.31b	.05a	18.82 ***	.09	.10	-.29
Tech Low	.07	.05	.03	1.11	.04	.04	-.24
Tech High	.07	.13	.10	1.05	.09	.09	-.00
Reinvention:							
Adoption	.00	.05	.03	1.59	.05	.03	.95
Attribute	.01	.07	.03	2.59	.00a	.05b	-4.48 ***
N	67	243	259	569	131	349	480

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

Note: Cell values are mean percentage. Overall multivariate Wilks' Lambda = .677, F(46,1086) = 4.98, p <.001. Pairwise comparisons apply Duncan's post hoc means test and harmonic mean. a, b, c: Means with different letters are significantly different, p <.05 two-sided significance Appropriate t-ratio based on Levene's equality of variances test.

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. *Tracking* technologies are 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 are 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 are 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).

Table 5. Binary Logistic Regressions Explaining Attention Technologies

	Tracking				**Storage**				**Analytics**			
Variables	**B**	**S.E.**	**Wald**	**Exp(B)**	**B**	**S.E.**	**Wald**	**Exp(B)**	**B**	**S.E.**	**Wald**	**Exp(B)**
Company role (0 Adopt, 1 Promote)	.00	.35	.00	1.00	.55*	.26	4.55	1.73	-.47*	.25	3.71	.62

YearPub	-.07*	.03	5.51	.94	-.16***	.02	51.44	.85	.19***	.02	64.64	1.21
Rel Adv. Positive	.59	.36	2.65	1.80	-.51*	.23	4.85	.60	.35	.24	2.16	1.41
Compat: Culture Pos.	-.87	.57	2.34	.42	-.42	.31	1.76	.66	.67*	.31	4.72	1.95
Strategy Pos.	.14	.33	.17	1.15	-.33	.23	1.95	.72	.24	.23	1.07	1.27
Tech Pos.	-.73	.38	3.63	.48	.98***	.23	17.61	2.67	-.71***	.24	8.77	.49
Complex: Low	-1.25*	.63	3.95	.29	.39	.26	2.13	1.47	-.10	.27	.14	.91
High	.59	.42	1.99	1.81	-.69	.36	3.67	.50	.31	.33	.90	1.37
Comm: Positive	.72*	.35	4.19	2.04	-.50	.31	2.67	.61	-.06	.30	.05	.94
Uncert: Financial High	.67	.48	1.96	1.95	-.17	.40	.18	.85	-.19	.40	.22	.83
Policy/ Legal High	1.44***	.42	11.52	4.20	.67	.37	3.19	1.95	-1.63***	.41	15.81	.20
Tech High	-.76	.59	1.65	.47	.84*	.39	4.71	2.31	-.34	.40	.70	.72
Constant	-1.29	.69	3.51	.28	2.22	.52	18.02	9.19	-3.37	.56	36.46	.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%

N = 490; * *p* < .05; ** *p* < .01; *** *p* < .001
Note: includes only attributes with at least 10% overall coverage

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), while 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.

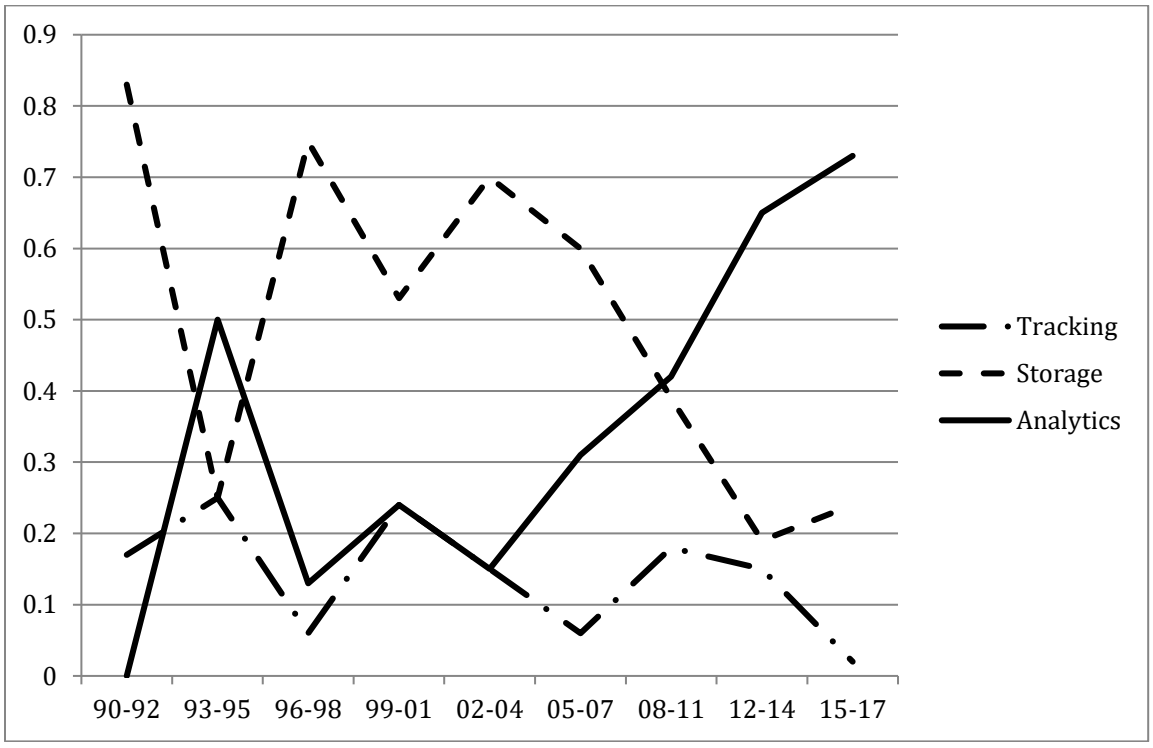

Figure 1. Percent coverage of the attention technologies, 1990–2017, by three-year periods.

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

H2. When identified, the company role was primarily a promoter rather than an adopter (60% vs 23%; 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 the audience's attention, requiring firms to compete constantly for that scarce attention. *Need to Share*: In the private sector, data is 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 much 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" (Article #737).

Change over time. Tracking technologies seem to have continued developing over time as new media devices diffused, receiving a fairly stable amount of coverage. Coverage of data storage declined primarily due to enterprises adopting these technologies rapidly over the course of the 1990s. This created an industry standard, meaning 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" (#463).

Compatibility with culture. *Emergence of New C-Level Executive Roles:* The articles indicate 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 indicate 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" (#436). *Mergers and Acquisitions***:** In terms of compatibility with culture, the importance and variety of attention technologies have prompted numerous mergers and acquisitions to facilitate 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" (#737). For example, Oracle acquired over 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 is 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 are 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 Master's 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 towards new technologies. "Technology is not just changing consumer behavior; it is changing the composition of marketing budgets" (#449).

Affordability: In the early 90s 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. *The 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, etc., 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" (#541).

Uncertainty about policy/legal issues. *Policy/Legal Uncertainty, Especially in Some Industries:* 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 much user data companies are collecting and how they are using that 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%, though not significantly different from tracking). These issues are particularly salient for the healthcare, security, and insurance industries, 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" (#478).

Discussion

Contributions

The study contributes to the DOI literature and attention technologies literature in four ways. 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 characterizing them by 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 such distinctions, 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 associations among attributes within each of the three attention technologies, rather than overall. For example, would financial uncertainty be differentially associated with strategy compatibility for the different attention technologies, and for earlier vs. later periods of business press coverage? Press coverage in the earlier stages, or about the more abstract analytics technology, may reflect more 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 Diffusion of Innovations 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

While we analyzed the full population of business press articles meeting our criteria, there were of course other media venue 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, while 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 cannot 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 diffusion of innovations 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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