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Dissemination of Erroneous Research Findings and Subsequent Retraction in High-Circulation Newspapers: A Case Study of Alleged MDMA-Induced Dopaminergic Neurotoxicity in Primates

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ABSTRACT

Ensuring the public is informed of retractions has proven difficult for the scientific community. While it is possible that newspapers focus differential attention on publication of scientific articles and their subsequent retractions, this topic has received minimal attention from researchers. To learn more, we analyzed newspaper coverage of the high-profile 2002 article *Severe dopaminergic neurotoxicity in primates after a common recreational dose regimen of MDMA ("ecstasy")* and its retraction in a case study. We searched the 50 largest American newspapers with available online archives for stories about the article's publication and retraction. Of the 50 newspapers, 26 (52%) covered the article's publication and 20 (40%) its retraction. Six of the 50 newspapers (12%) published stories on the article's retraction without covering its initial publication. Of the 26 newspapers covering the article's publication, only 14 (54%) covered its retraction. Stories about the retraction were balanced, but shorter than those on the article's publication and often lacking in context and detail. While the decrease in coverage of the article's retraction was moderate among the entire sample, the much lower retraction coverage in newspapers that had already covered the article's publication is concerning and emphasizes the need for increased media coverage of retractions.

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Introduction

Newspapers have long been recognized as essential agents for disseminating public health information (Evans 1916). However, due to journalists' limited training in critically appraising scientific studies, the difficulty of distilling complicated science into easily digestible stories, and financial incentives for publications to garner as many readers as possible, media reports of research findings are frequently prone to exaggeration and error (Schwitzer 2014; Sharpe, Di Pietro, and Illes 2016). This inaccuracy distorts the public's scientific knowledge, leading many to question the credibility of the scientific enterprise if they later find the truth about a scientific study differs from what was reported. Unsurprisingly, most scientists are concerned about poor media coverage of research findings (Ashwell 2016).

Further complicating the media's coverage of scientific research is the fact that contradictory findings are common in the scientific process due to differences in study design and improvements in research methods. Unfortunately, the media preferentially cover initial research findings in a particular scientific domain, but rarely report when they have been disconfirmed by subsequent studies (Dumas-Mallet et al. 2017). Another challenging area for the media is the retraction of research findings. Retraction is necessary in the pursuit of knowledge, and despite its rarity, its rate is greatly accelerating (Hesselmann et al. 2017). Scientific articles can be retracted for a variety of reasons, including revelations of substantial errors, plagiarism, fake peer review (Gao and Zhou 2017), and scientific misconduct. Data on how newspapers and other media handle retractions of these articles are scant, though one study revealed newspapers cover only 6% of retracted articles (Rada 2007).

Studies published in well-known journals often receive significant media coverage. However, if their findings are later retracted, the media's focus on the topic has often already waned (Rada 2005). This is unfortunate because, given the potential effects of misinformation on the public's understanding of scientific topics, it is imperative that news of retractions be as widely disseminated as possible.

The 2003 retraction of the article *Severe dopaminergic neurotoxicity in primates after a common recreational*

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dose regimen of MDMA ("ecstasy") (Ricaurte et al. 2002) provides a useful example for the study of retraction dissemination in newspapers given its high-profile nature. Though many years have passed since the article's retraction, we believe it is worth studying today since its publication may have influenced the passage of anti-drug legislation targeting recreational MDMA use and slowed efforts to gain Food and Drug Administration (FDA) approval for MDMA-assisted psychotherapy as a treatment for Posttraumatic Stress Disorder (PTSD).

In September 2002, George Ricaurte, Una McCann and associates at Johns Hopkins University published their findings in the journal *Science* (Ricaurte et al. 2002). Their article described a National Institute on Drug Abuse (NIDA)-funded study in which MDMA was administered to 10 non-human primates in order to model human MDMA use and assess its effects on the brain. Imaging studies subsequently demonstrated severe dopaminergic neurotoxicity and less severe serotonergic neurotoxicity within the brains of the primates and, surprisingly, two of them died. While previous research had demonstrated evidence of MDMA serotonergic neurotoxicity in animals (Green, Cross, and Goodwin 1995), the finding of dopaminergic neurotoxicity was novel and raised questions about previously unknown long-term consequences of recreational MDMA use, such as the possibility of developing parkinsonism.

Upon the article's publication, the *Johns Hopkins Gazette* announced university researchers had found that doses of MDMA "similar to those that young adults typically take during all-night dance parties cause extensive damage to brain dopamine neurons in nonhuman primates" (Stockton 2002). The American Association for the Advancement of Science (AAAS), which publishes *Science*, also issued a press release entitled, "Ecstasy Thought to Cause Brain Damage According to Study Published in *Science*" (Wren 2002). The press release concluded with a warning from Alan Leshner, chief executive officer of AAAS at the time and former director of NIDA, who stated, "Using Ecstasy is like playing Russian roulette with your brain function" (Wren 2002).

The study received widespread media attention, with the *New York Times* writing "the amount of the drug Ecstasy that some recreational users take in a single night may cause permanent brain damage" (McNeil 2002). However, its findings were met with strong criticism from some in the scientific community, including the Multidisciplinary Association for Psychedelic Studies (MAPS) (Multidisciplinary Association for Psychedelic Studies 2002; Mithoefer, Jerome, and Doblin 2003). Ricaurte et al. defended the study (G. Ricaurte et al. 2003a), arguing their results differed from those of previous studies because they had administered MDMA using a novel protocol.

In September 2003, one year after the article's publication, *Science* issued a retraction, with Ricaurte and colleagues writing they had discovered that methamphetamine, rather than MDMA, had been used to treat all but one study animal due to a labeling error (G. A. Ricaurte et al. 2003b). MAPS subsequently asked NIDA for an investigation into all work conducted by Ricaurte and associates since the mislabeled MDMA had been received (Doblin 2003).

Although numerous questions were raised after the retraction and considerable taxpayer dollars were lost to the mix-up, NIDA never issued a report on the matter. However, in January 2004, it cooperated with a Freedom of Information Act request submitted by MAPS and released documents that detailed projects affected by the mistake and indicated another research article would be retracted (Ricaurte 2004).

Calling for an independent inquiry, Colin Blakemore, chairman of the British Association for the Advancement of Science, questioned whether prohibitionist politics had influenced the development of the sensational press releases associated with the study (Drug Policy Alliance 2003). An editorial published in *Nature* also observed that the initial publication of the article "was subjected to far more US media coverage than this month's retraction" (Nature Editorial Board 2003). It also discussed how the publicizing of the study's erroneous findings may have influenced the passage of the Illicit Drug Anti-Proliferation Act by Congress, which deterred nightclub owners from taking harm reduction efforts to protect patrons using MDMA recreationally. MAPS also later revealed that an MDMA-assisted psychotherapy trial in Spain was shut down and efforts to gain approval for one in the United States were hampered after the study's publication (Multidisciplinary Association for Psychedelic Studies 2003).

Given the considerable media attention surrounding the publication of the article by Ricaurte et al and its retraction, as well as the study's possible decelerating effect on MDMA-assisted psychotherapy research progress, we conducted a case study to assess whether there was differential newspaper coverage of the publication of the article and its retraction. We also hoped to provide an example of newspaper coverage of a high-profile retraction in 2003, which could prove useful to investigators seeking historical comparisons in the future.

Methods

Drawing from a list of American newspaper circulation sizes (Infoplease 2007), we searched the archives of the

50 largest newspapers for which online archival access was available, either through the subscription-based website Newspapers.com or individual newspaper websites [Table 1]. Some newspapers lacked available online archives, requiring that we descend the list of largest newspapers to number 64 in rank.

Searches were conducted for reports about the publication of the initial article in 2002 and its retraction in 2003. Search terms included combinations of "MDMA," "ecstasy," "Ricaurte," "monkey," "dopamine," "Johns Hopkins," and "retraction." If stories were not elicited by these combinations of search terms, all articles including either "MDMA" or "ecstasy" from September to November 2002 and September to November 2003 were manually searched to ensure no relevant reports were missed.

Table 1. Newspapers investigated for relevant articles (in descending order of circulation).

	Newspaper name
1	New York Times
2	Wall Street Journal
3	Los Angeles Times
4	New York Post
5	New York Daily News
6	Chicago Tribune
7	Washington Post
8	Houston Chronicle
9	Arizona Republic
10	San Francisco Chronicle
11	Boston Globe
12	Atlanta Journal Constitution
13	Philadelphia Inquirer
14	Star Tribune (Minneapolis-St. Paul, MN)
15	Plain Dealer (Cleveland, OH)
16	Detroit News/Free Press
17	St. Petersburg Times
18	Oregonian (Portland, OR)
19	Orange County Register (Anaheim, CA)
20	Sacramento Bee
21	St. Louis Post Dispatch
22	Miami Herald
23	Indianapolis Star
24	Kansas City Star
25	Denver Post
26	San Antonio Express News
27	Baltimore Sun
28	San Jose Mercury News
29	Tampa Tribune
30	Orlando Sentinel
31	South Florida Sun Sentinel (Fort Lauderdale, FL)
32	Courier Journal (Louisville, KY)
33	Daily Oklahoman (Oklahoma City, OK)
34	Observer (Charlotte, NC)
35	Pittsburg Post-Gazette
36	Fort Worth Star Telegram
37	Cincinnati Enquirer Post
38	Richmond Times Dispatch
39	Omaha World Herald
40	Virginian-Pilot (Norfolk, VA)
41	Democrat-Gazette (Little Rock, AR)
42	Buffalo News
43	Raleigh News and Observer
44	Hartford Courant
45	Palm Beach Post
46	Tennessean (Nashville, TN)
47	Austin American-Statesman
48	The Record (Hackensack, NJ)
49	Contra Costa Times (Contra Costa County, CA)
50	Fresno Bee

Data were analyzed using Stata version 15 by StataCorp (College Station, Texas), with statistical significance set at $p < .05$. We calculated the proportion of newspapers covering the initial article publication and the retraction, as well as word counts for the stories. For stories about the article retraction, we performed a content analysis. We then used Fisher's exact test, two tailed to determine whether there were differences in the prevalence of various components of reporting between stories in newspapers covering only the retraction and stories in newspapers covering both the article's initial publication and its retraction. Simple logistic regression was used to assess the relationship between newspaper circulation size and coverage of the study's initial publication and its retraction.

Results

Of the 50 newspapers evaluated, 26 (52%), published a report on the initial article publication and 20 (40%) published one on its retraction. Six of the 50 newspapers (12%) covered the article's retraction without publishing a story on its initial publication. Notably, of the 26 newspapers that published a story on the initial article's publication, only 14 (54%) published one on its retraction. There was no association between circulation size and coverage of the study's initial publication ($p = .25$) or its retraction ($p = .84$).

The mean word count of reports covering the initial article's publication was 482 ± 303 words, ranging from 69 to 1260, compared to 396 ± 193 words for reports on the retraction, which ranged from 86 to 837. For newspapers covering both events, mean word count of stories covering the initial study publication was 550 ± 271 and ranged from 188 to 1260, while mean word count for stories about the retraction was 386 ± 205, ranging from 86 to 837. For newspapers covering only the initial article publication, mean article length was 404 ± 331 words, ranging from 69 to 1038. For newspapers covering only the retraction, articles were 420 ±177, ranging from 124 to 652.

The content analysis of articles written about the study retraction revealed several reporting components, some of which were common to many or all of the articles. All articles informed readers that the initial study findings had suggested one night's MDMA use could cause brain damage or parkinsonism and that there had been a mix-up of study compounds that rendered the initially reported results erroneous, while 70% (14) reported there had been longstanding controversy

over MDMA research in the scientific community. These and other components of newspaper stories covering the study retraction, as well as other coverage metrics, are detailed in Table 2. No statistically significant difference in prevalence of any of these components was detected when comparing articles in newspapers covering only the retraction and articles in newspapers covering both the article's initial publication and its retraction.

Discussion

Our results indicate that publication of the initial article by Ricaurte et al in 2002 was covered by a majority of America's largest newspapers, while its 2003 retraction received a lesser but still significant amount of coverage. This case may be unique, since most retracted articles receive no media coverage at all (Rada 2007). Previous research has shown that only retracted articles accompanied by a press release from the publishing journal or another involved entity are covered by newspapers (Rada 2007). Given this study's publication in the high profile journal *Science* and the fact that the initial article and its retraction were both accompanied by press releases (Smith 2003; Walgate 2003), it is not surprising that media coverage was broad.

Among all newspapers in our data set, the difference in coverage of the initial article and its retraction was moderate when compared to that found in another case study (Rada 2005). This smaller differential may have been due to the high-profile nature of this particular retraction, which likely led some newspapers to cover it, though they had not covered the article's publication. Notably, the differential was particularly pronounced in the subset of newspapers that ran stories on the initial article's publication. Nearly half of them did not report the retraction, despite having already exposed their readers to misinformation, which is concerning.

The dramatic press release issued by AAAS to accompany the initial article may have driven greater newspaper coverage of the article's publication than of its retraction. Journalists rely heavily upon press releases when reporting on scientific publications, and press release quality influences quality of associated newspaper stories (Schwartz et al. 2012). Unfortunately, press releases frequently omit important facts and often do not acknowledge study limitations (Schwartz et al. 2012), increasing the likelihood of media sensationalism.

Table 2. Prevalence of reporting components identified in content analysis of retraction stories.

Article content component	All newspapers covering retraction (N=20), *n*(%)	Newspapers covering initial publication and retraction (N=14), *n*(%)	Newspapers covering only retraction (N=6), *n*(%)	*P*[a]
Initial study findings had suggested one night's MDMA use could cause brain damage or parkinsonism	20 (100)	14 (100)	6 (100)	-
There was mix-up of study compounds, so initially reported results erroneous	20 (100)	14 (100)	6 (100)	-
There has been longstanding controversy over MDMA research in scientific community	14 (70)	9 (64)	5 (83)	0.61
Study findings had been criticized by some scientists	13 (65)	8 (57)	5 (83)	0.35
Animals died during the study	11 (55)	6 (43)	5 (83)	0.16
Ricaurte lab alleged supplier of investigational compounds was responsible for mix-up	11 (55)	8 (57)	3 (50)	1.00
Dr. McCann stated her regrets about the study error	8 (40)	6 (43)	2 (33)	1.00
Earlier research showed possible serotonergic neuronal damage by MDMA	7 (35)	4 (29)	3 (50)	0.61
Allegations by some that study's initially reported findings were politically driven	7 (35)	5 (36)	2 (33)	1.00
Research was funded by National Institute on Drug Abuse/US government	5 (25)	3 (21)	2 (33)	0.61
Quote from a critic of original study	4 (20)	2 (14)	2 (33)	0.55
Ricaurte lab stated earlier findings on MDMA were not affected by mistake	4 (20)	4 (29)	0 (0)	0.27
Report from Johns Hopkins University that Dr. Ricaurte remained faculty in good standing	4 (20)	1 (7)	3 (50)	0.06
Dr. McCann stated she still had concerns about MDMA after retraction	4 (20)	3 (21)	1 (17)	1.00
Dr. Ricaurte stated his lab did not verify composition of compounds used in studies	4 (20)	2 (14)	2 (33)	0.55
Dr. Ricaurte denied allegations of political influence on research	3 (15)	2 (14)	1 (17)	1.00
Statement that Alan Leshner had defended original study's findings	2 (10)	1 (7)	1 (17)	0.52

[a]The difference in component prevalence between newspapers covering both initial article publication and retraction and newspapers covering only retraction was analyzed using Fisher's exact test, two tailed.

In this case, the initial AAAS press release contained sensational elements, such as its closing line, "Using Ecstasy is like playing Russian roulette with your brain function," (Wren 2002) which may have helped intensify media coverage of the article's publication. Regrettably, AAAS was unable to provide the authors with a copy of the press release accompanying the article's retraction, and we were also unable to locate one elsewhere. Therefore, we cannot comment on how its contents may have influenced coverage of the article's retraction.

There is also evidence indicating more extensive media coverage of medical issues that have higher rates of mortality (Adelman and Verbrugge 2000), a factor which may have also contributed to increased coverage of the original article's publication. While the initial article reported findings purportedly linking MDMA use with extreme morbidity through increased risk of parkinsonism, which would have likely increased press interest, the retraction's severing of this link may have dissuaded newspapers from covering it. Additionally, the article's retraction did not fit with the era's predominant media narrative of MDMA being an extremely dangerous substance (Ahrens 2013), further disincentivizing the use of highly sought after newspaper space to report on it. Finally, it must also be noted that AAAS "issued the retraction late in the afternoon on Friday 5 September, resulting in low-key media coverage" (Nature Editorial Board 2003).

Among the entire sample, as well as in newspapers that covered both the article's publication and its retraction, there was a wide range of word counts for both stories, though, on average, stories about the retraction were shorter. Our content analysis of stories covering the article's retraction revealed balanced reporting. All retraction stories indicated that the study's initially reported findings suggested a possible link between one night's MDMA use and subsequent "brain damage" or parkinsonism and that the article was retracted because it had mistakenly employed methamphetamine rather than MDMA. Most stories also mentioned that the original study findings were published amid a longstanding scientific debate on the risks and clinical utility of MDMA and that some scientists had been skeptical of them even before the article's retraction. However, many stories provided minimal details on historical context and lacked other information that may have aided readers in better understanding why the retraction was important, such as quotes from Drs. Ricuarte and McCann or critics of the original study's publication, discussion of allegations made by some of possible study bias due to political influence, and references to earlier research suggesting possible damage to serotonergic neurons following recreational MDMA use.

While societal concerns about illicit MDMA use persist, media coverage of MDMA has become more positive (Philipps 2018) as research findings supporting its therapeutic use have mounted in recent years (Mithoefer et al. 2019, 2018). Despite the challenges of gaining regulatory approval following publication of Ricaurte et al's mistaken findings (Morris 2003), MAPS is currently sponsoring Phase 3 trials of MDMA-assisted psychotherapy for PTSD. Debate continues about the safety profile of MDMA, including whether possible serotonergic damage associated with recreational MDMA use is generalizable to pharmaceutical grade MDMA (Doblin et al. 2014; Parrott 2013, 2014), as well as the existence of possible long-term neurocognitive deficits secondary to MDMA consumption (Fisk et al. 2011; Halpern et al. 2004, 2011; Krebs et al. 2009; Lyvers 2011; Lyvers and Hasking 2004; Parrott 2011). However, evidence of MDMA-induced dopaminergic toxicity in humans has not materialized since the retraction of Ricaurte et al and regulatory agencies around the world have determined that MDMA's potential therapeutic benefits outweigh its risks in research settings (Doblin et al. 2014).

Study limitations include an inability to both access archives for all of the 50 largest US newspapers and review the AAAS press release accompanying the article retraction notice. We were also unable to analyze where stories were located within newspapers, an important factor influencing the scope of their dissemination.

As possible FDA approval of MDMA draws closers, the media must consider whether their sensational coverage of the erroneous findings by Ricaurte and associates may have helped slow the development of a promising psychiatric treatment. This example highlights not only the importance of restraint in high-stakes medical journalism but also the media's critical, though often overlooked, role in setting the record straight when errors in the scientific enterprise inevitably come to light.

Data availability statement

Those interested in obtaining our data can contact Dr. Barnett for a copy.

Disclosure statement

- Dr. Barnett has received no funding from pharmaceutical companies or organizations involved in MDMA therapeutic research.
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