Published in final edited form as:

AJOB Prim Res. 2014 January 1; 5(1): 44–55. doi:10.1080/21507716.2013.811315.

Focusing on Cause or Cure?:

Priorities and Stakeholder Presence in Childhood Psychiatry Research

Lauren C. Milner, PhD and

Center for the Integration of Research on Genetics and Ethics (CIRGE), Stanford Center for Biomedical Ethics, Stanford University, 1215 Welch Road, Modular A, Stanford, CA 94305

Mildred K. Cho, PhD

Center for the Integration of Research on Genetics and Ethics (CIRGE), Stanford Center for Biomedical Ethics, Stanford University, 1215 Welch Road, Modular A, Stanford, CA 94305, Tel: (650) 725-7993, micho@stanford.edu

Abstract

Background—Biomedical research is influenced by many factors, including the involvement of stakeholder groups invested in research outcomes. Stakeholder involvement in research efforts raise questions of justice as their specific interests and motivations play a role in directing research resources that ultimately produce knowledge shaping how different conditions (and affected individuals) are understood and treated by society. This issue is highly relevant to child psychiatry research where diagnostic criteria and treatment strategies are often controversial. Biological similarities and stakeholder differences between attention deficit hyperactivity disorder (ADHD) and autism spectrum disorder (ASD) provide an opportunity to explore this issue by comparing research foci and stakeholder involvement in these conditions.

Methods—A subset of ADHD and ASD research articles published between 1970–2010 were randomly selected from the PubMed database and coded for research focus, funding source(s), and author-reported conflicts of interest (COIs). Chi-square analyses were performed to identify differences between and within ADHD and ASD research across time.

Results—The proportion of ADHD research dedicated to basic, description, and treatment research was roughly similar and remained stable over time, while ASD research showed a significant increase in basic research over the past decade. Government was the primary research funder for both conditions, but for-profit funders were a notable presence in ADHD research, while joint-funding efforts between non-profit and government funders were a notable presence in ASD research. Lastly, COIs were noted more frequently in ADHD than in ASD research.

Conclusions—Our study shows significant differences in research foci and funding sources between the conditions, and identifies the specific involvement of for-profit and non-profit groups in ADHD and ASD, respectively. Our findings highlight the relationship between stakeholders outside the research community and research trajectories and suggest that examinations of these relationships must be included in broader considerations of biomedical research ethics.

corresponding author: Tel: (650) 723-8628, lcmilner@stanford.edu.

Author Contributions: LCM provided the conception and design of the study, collected and analyzed the data, and drafted the manuscript. MKC contributed significantly to the conception and design of the study and edited the manuscript.

Competing Interests: None declared.

Ethical Approval: Not required.

Keywords

autistic spectrum disorder; attention deficit disorder with hyperactivity; quantitative research; social science

INTRODUCTION

Biomedical research is not an isolated process, but a social practice composed of different actors, relationships, and dynamics that combine to advance biomedical knowledge for a medical condition. Particularly influential in these endeavors are groups outside of the research community who invest, and are invested in, research outcomes (i.e., stakeholders) (Caron-Flinterman et al., 2007; Gordan et al. 2011; Hoffmaster 2001; Mitchell et al. 1997). Stakeholders often influence the direction of research advancement through funding and advocacy efforts (Collyar 2008; Landy et al. 2012; Pavitt 2001; Perkmann and Walsh 2009; Sharp and Landy 2010) and by translating research results to broader publics (Pickersgill 2011). Through their actions, stakeholders may play a significant role in shaping accepted knowledge about medical conditions as well as how different conditions (and individuals affected by these conditions) are perceived and treated outside of the research community. The influence of particular stakeholders in different areas of medical research speaks to the issue of justice as the interests of particular groups can direct resources towards specific lines of research that, in turn, influence how different medical conditions are defined and prioritized by the medical community and the broader public, as well as how medical and social service resources are allocated to affected individuals.

Child psychiatry is a field in which different stakeholders may have a considerable impact on research directions informing general knowledge. The etiological and diagnostic complexity, as well as the socially contentious nature, of psychiatric conditions suggests that prioritizing specific types of research will directly influence broader social understanding of these conditions, such as whether a condition is viewed as biologically- or environmentally-based; whether the condition should be treated or prevented; and the extent to which the condition is considered a public health concern (Kawa et al. 2012; Singh and Rose 2009). Prioritization of specific types of research will also directly affect children with these conditions, as general knowledge derived from research findings may strongly influence their concepts of personal identity (Singh 2005; Wisdom et al. 2008) and acceptance or stigmatization by others (Hinshaw and Stier 2008; Martin et al. 2007; Pescosolido et al. 2008, 2010; Schomerus et al. 2012). The exceptional challenges arising from research in child psychiatry warrant a close examination of both research trajectories and research stakeholders in this field.

Attention deficit hyperactivity disorder (ADHD) and autism spectrum disorder (ASD) provide a unique opportunity to examine and compare research trajectories and stakeholders, as these conditions may benefit from similar research trajectories, but have divergent social histories and unique stakeholder groups that may play a significant role in shaping research differently for each condition. In this study, we compare ADHD and ASD research foci and funding sources over time as one approach to examining the relationship between child psychiatry research trajectories and stakeholder groups that may influence research progress for each condition.

ADHD and ASD: Research Similarities and Stakeholder Differences

Evidence of overlaps in biological, behavioral, and epidemiological aspects of ADHD and ASD (Gargaro et al. 2011; Reiersen 2011) highlight the potential benefits of similar research trajectories for these conditions. In addition to mounting evidence for neurological

(Bradshaw et al. 2000; Durston et al. 2009; Takarae et al. 2007) and genetic overlap (Albayrak et al. 2008; Nijmeijer et al. 2010; Ronald and Hoekstra 2011; Rommelse et al. 2010), there is also overlap in symptomatology (Nijmeijer et al. 2009; Ozonoff et al. 1999; Sergeant et al. 2002; St. Pourcain et al. 2011) such that prescribing ADHD medications for attention and impulsivity problems has become common practice for children with ASD (Aman et al. 2008; Canitano and Scandurra 2011; Handen et al. 2000; Zeiner et al. 2011). The biological and behavioral overlap between ADHD and ASD suggests that similar types of research may have tangible benefits on diagnostic and treatment practices for both conditions (Rommelse et al. 2011).

The benefits of similar research trajectories are also suggested by multiple clinical and social characteristics shared by ADHD and ASD. At the individual level, both conditions present in childhood; are disproportionately expressed in males (Baron-Cohen et al. 2011; Ramtekka et al. 2010); are highly comorbid with other physical and mental health conditions (Kuhlthau et al. 2010; Montalbano and Roccella 2009; Wehmeier et al. 2010); and produce functional impairments that persist long into adulthood (Billstedt et al. 2011; Rosler et al. 2010). At the population level, prevalence rates for both ADHD and ASD have risen dramatically over the past decade (CDC 2009, 2010) and have been a growing focus of public concern. Both ADHD and ASD have been described as “epidemics” or “crises” in pediatric public health (Liu et al. 2010; Newschaffer and Curran 2003; Perrin et al. 2007; van den Hazel et al. 2006) and generated controversies garnering widespread media attention (Barkley 2002; Guillaume et al. 2008; Holton et al. 2012; Timimi et al. 2004). ADHD and ASD are also growing foci within the research community, as evidenced by a five-fold increase in published articles for both conditions over the past two decades (Bishop 2010). Despite increased attention from the research community and public alike, the complexity of etiological factors contributing to ADHD and/or ASD development has prevented facile identification and treatment strategies, making it likely that both will remain medical research priorities for the near future.

Still, the research trajectories are influenced by the dramatic differences ADHD and ASD exhibit in clinical and social aspects, including, but not limited to, condition severity, impact of the condition on physical and/or psychological health, the affected individual’s ability to function successfully in various social environments, and public perceptions of condition etiologies and therapies (McLeod et al. 2007; Mercer et al. 2006). In particular, the different timelines of ADHD and ASD classification as psychiatric conditions (1968 and 1980, respectively) may underlie differences in research trajectories. However, we argue that the availability of pharmaceutical treatment (and involvement of the pharmaceutical industry) for ADHD and the rise of a powerful advocacy movement for ASD stand out as unique social factors that may impact research trajectories for each condition. Because these stakeholder groups have both a clear history of involvement in research efforts and a clear interest in promoting specific types of research, we believe that they in particular may influence ADHD and ASD research progress, and that the presence and priorities of these stakeholders can be observed in the research produced for both conditions over time.

The history of ADHD has been primarily defined by the availability of pharmacological drugs used to treat the condition and controversies resulting from prescribing these drugs to affected children (Diller 1998; Mayes et al. 2009; Neufeld and Foy 2006). Over 30 years before ADHD was officially classified as a mental health condition, Dr. Charles Bradley reported stimulants as an effective treatment to calm “hyperactive” behavior and increase scholastic perform in children (Bradley 1937). The introduction of Ritalin in the 1950s, followed by FDA approval for its use to treat ADHD in 1961, established pharmaceutical treatments as the primary intervention for ADHD (Breggin 2001; Mayes and Rafalovich, 2007). However, the past two decades have been especially contentious because of the sharp

rise in ADHD diagnoses and associated growth in consumption of stimulant medications, both in the United States and internationally (Singh 2008). The dramatic growth of stimulant consumption has generated billions of dollars in profit for pharmaceutical companies (Furman 2008; Lang et al. 2010; Scheffler et al. 2007), giving them a pronounced stake in ADHD research. The presence of a powerful stakeholder group with strong financial interests in ADHD remaining a (pharmacologically) treatable condition undoubtedly plays an important role in shaping ADHD research trajectories.

In contrast, the history of ASD has largely been defined by the presence of parent-led advocacy groups promoting research and services for the condition. First described by Leo Kanner in 1943, ASD was initially considered a rare childhood disorder (Deisinger 2011), largely invisible to the research community because of a popular theory that the condition arose from “refrigerator parents” failing to provide adequate affection or making an emotional bond with their children (Bettleheim 1967). The stigmatization of parents of children with ASD prompted the formation of ASD advocacy groups in the 1960s, many of which stressed the possibility of a biological cause of ASD and advocated for more research, support services, and education for the condition (Silverman 2012; Silverman and Brosco 2007). The growing influence of these groups, especially since the late-1990s, has been remarkable. In addition to directly funding research, ASD advocacy groups have also fostered collaborations between different research groups by establishing and controlling ASD databases and tissue banks (Fischbach and Lord 2010; Lajonchere et al. 2010). ASD advocacy groups are also largely responsible for growing public awareness surrounding the condition (Chamak 2008) and remain a driving force behind ASD federal funding efforts (CAA 2005). ASD advocacy groups and other non-profit organizations have quickly become significant contributors to ASD research efforts, and their relationships with the research community continue to flourish, suggesting that the presence of advocacy and non-profit groups will play an important role in shaping ASD research trajectories.

However apparent, the presence of stakeholders in ASD or ADHD research has yet to be systematically examined or compared with research trajectories for either condition. Here, we provide such an examination by comparing research foci (i.e., trajectories) and funding sources (i.e., stakeholders) between a set of randomly selected ADHD and ASD articles over the past four decades.

METHODS

For this study, searches were performed in the PubMed database using database-supplied MeSH terms for ADHD and ASD and limited to every 5th year from January 1, 1970 through December 31, 2010. For each year selected, 10-53% of the total number articles were selected using a random number generator (random.org) and coded for research focus, funding source(s), author-reported conflicts of interest, and country of origin. (See Table 1 for article selection details and Supplementary Table 1 for country of origin details.) Searches were limited to articles written in English. Articles included in this analysis met the following criteria: (1) ADHD or ASD was the primary topic of the article and (2) the article reported the results of an original empirical study.

Major article foci were coded as follows: *basic* (articles reporting neuroscience, genetic, environmental, or other etiological data); *description* (articles reporting prevalence, diagnosis, behaviors, and comorbidity data); *treatment* (articles reporting pharmacological or behavioral therapy data); and *other* (articles reporting outcome or social science data). Funding sources were coded into four main categories: *government* (federal or state funder); *industry* (pharmaceutical, biotechnology, or other corporate funder); *non-profit* (advocacy group or private research foundation funder); and *mixed* (non-profit or for-profit plus

government funder). Conflicts of interest (COIs) were recorded when articles explicated declared an author's financial involvement with a pharmaceutical or biotechnology organization (or explicitly stated that authors did not have any COIs). All articles were coded by the primary researcher (L.M.) with a second coder sampling 30% of the articles for code reliability. Inter-rater agreement was determined using Cohen's kappa coefficient.

All analyses were carried out using SPSS® statistical software. Pearson's chi-square test contingency tables were used to compare proportions of research foci and funding within conditions (across decades) and between conditions (within decades). Fisher's exact test was used in comparisons where expected frequencies < 5 for a specific cell or when $n < 120$ for all cells. All statistically significant differences ($\alpha = 0.05$) observed were followed up with specific pairwise comparisons with a Bonferroni correction ($\alpha = 0.05/n$ comparisons) to determine which foci or funder differences were driving the statistically significant results observed.

RESULTS

A total of 1448 articles (816 ADHD, 632 ASD) were coded by the primary author. A randomly selected subset of articles ($n = 450$) was independently coded by a second researcher; high interrater reliability was shown for all categories (kappas = .89 [basic]; .86 [description]; .91 [treatment]; .80 [other]). Initial analyses performed between decades detected only two significant differences: a significant increase in the proportion of ADHD articles focusing on description research between 1980 to 1990 (28.0% to 41.8% of sample; χ^2 (d.f. = 1) = 10.9; $p = 0.012$) and a significant increase in the proportion of ASD articles focusing on basic research from 2000-2010 (41.9% to 56.8% of sample; χ^2 (1) = 8.0; $p = 0.046$). Because no other significant differences were observed between decades pre- and post-2000, ADHD and ASD articles were grouped into two time periods (1970-1999 and 2000-2010) for subsequent analyses.

Additionally, two significant differences were observed between US-based and international research articles in the 2000-2010 ADHD sample, with US-based articles reporting more treatment-based research than international articles (28.0% of US articles and 19.9% of international articles [χ^2 (1) = 19.8; $p < 0.001$]) and more for-profit funding than international articles (16% of US articles and 7% of international articles; [χ^2 (1) = 11.1; $p = 0.01$]). However, no significant differences were observed between US-based and international articles for ASD or for other research foci or funders for ADHD in the 1970-99 sample. Because the differences observed did not change the overall results reported below, US and international articles were grouped together for each condition in subsequent analyses.

Research Foci

Pearson's chi-square analyses revealed a significant change in the proportion of ASD research foci between the two time periods examined (χ^2 (3) = 15.5; $p = 0.001$; Supplementary Figure 1). Follow-up analyses showed that this difference was driven entirely by a significant increase in the proportion of basic ASD research across time (from 33.9% in 1970-1999 to 50.2% in 2000-2010; χ^2 (1) = 15.8; $p < 0.001$), with corresponding decreases in proportion of articles dedicated to both description (from 41.0% in 1970-1999 to 31.3% in 2000-2010) and treatment research (from 16.5% in 1970-1999 to 10.9% in 2000-2010). No significant changes in research foci proportions were observed in ADHD articles across time (χ^2 (3) = 5.2; $p = 0.16$).

Significant differences were observed between ADHD and ASD research foci for both 1970-1999 (χ^2 (3) = 12.2; $p = 0.007$) and 2000-2010 (χ^2 (3) = 73.9; $p < 0.001$; Figure 1). In

1970-99, the differences in research foci were driven by the research category of treatment (29.4% of ADHD articles and 16.5% of ASD articles; $\chi^2(1) = 11.5$; $p = 0.001$). In 2000-2010, the differences in research foci were driven by basic (25.0% of ADHD articles and 50.2% of ASD articles; $\chi^2(1) = 64.2$; $p < 0.001$); treatment (23.9% of ADHD articles and 10.9% of ASD articles; $\chi^2(1) = 25.8$; $p < 0.001$); and other categories (13.8% of ADHD articles and 7.5% of ASD articles; $\chi^2(1) = 9.4$; $p = 0.002$). Overall, differences between the proportions of ADHD and ASD research dedicated to treatment were expected due to the availability of multiple pharmaceutical treatments for ADHD.

This finding was further supported by differences between ADHD and ASD articles with respect to the type of treatment being researched; in ADHD articles, the majority of treatment research was dedicated to pharmaceutical treatments, whereas behavioral treatments comprised the majority of treatment research for ASD (82.6% and 61.1% of treatment research, respectively; $\chi^2(1) = 75.1$; $p < 0.001$). One unexpected finding was the substantial proportion of basic-focused research in ASD articles over the past decade, especially as compared ADHD articles, which showed research more evenly distributed between basic, description, and treatment research.

Research Funders

Significant differences were also observed in funders of ADHD and ASD research, both between conditions and within conditions across time (Supplementary Figure 2). Initial analyses were driven by significant reductions in “not reported” funders between 1970-1999 and 2000-2010 (from roughly 51% to 23% for both ADHD and ASD articles). For this reason, we performed subsequent analyses using only articles with reported funders. Within these articles, ADHD articles showed significant changes in funders over time ($\chi^2(3) = 16.4$; $p = 0.001$). Follow-up analyses revealed that this difference was driven by a significant reduction in non-profit funders (13.0% in 1970-1999 to 4.6% in 2000-2010; $\chi^2(1) = 11.5$; $p = 0.001$). Significant changes in funders were not observed over time in the ASD sample ($\chi^2(3) = 6.4$; $p = 0.1$).

Significant differences were also observed between funders of ADHD and ASD research for both 1970-1999 ($\chi^2(3) = 8.1$; $p = 0.044$) and 2000-2010 ($\chi^2(3) = 60.7$; $p < 0.001$; Figure 2). In 1970-1999, “mixed” funding groups were cited in more ASD articles than ADHD articles, although this difference did not reach statistical significance. In the period from 2000-2010, multiple differences were observed, with ADHD articles citing significantly more government (65.9% in ADHD and 53.9% in ASD; $\chi^2(1) = 10.7$; $p = 0.001$) and for-profit funding sources (12.0% in ADHD and 1.3% in ASD; $\chi^2(1) = 29.7$; $p < 0.001$) than ASD articles, and ASD articles citing significantly more non-profit (4.6% in ADHD and 10.3% in ASD; $\chi^2(1) = 9.3$; $p = 0.003$) and “mixed” funding sources (17.5% in ADHD and 34.5% in ASD; $\chi^2(1) = 27.4$; $p < 0.001$) than ADHD articles.

Further examination of the “mixed” funders revealed additional differences between ADHD and ASD articles. “Mixed” funders of ADHD research were composed primarily of government and non-profit sources (72.2%), government and for-profit sources (20.0%), or a combination of all three sources (7.8%). In contrast, “mixed” funders of ASD research were overwhelming composed of government and non-profit sources (92.5%), with few government/for-profit or all three funding sources reported (7.5%). Overall, these differences show that government and for-profit sources primarily fund ADHD research, while non-profit funders primarily fund ASD research, acting as either a sole funder or co-funder (usually with government) of ASD research projects.

To gain a better understanding of research priorities for different types of funders for both conditions, we examined research foci by funder for all articles explicitly noting a funder

(1970-2010; Figure 3). In the ADHD sample, government, non-profit and mixed funders exhibited similar research foci by providing the most funding to basic and description research (between 25-35% of funding), followed by treatment (around 20%) and other research (10-20% of funding). As expected, research focus was significantly different in for-profit funded research compared to the other funders ($\chi^2(3) = 83.5; p < 0.0001$), with the majority of for-profit funding focused on treatment (~70%), followed by description research (~20%), and then basic and other research. In ASD research, both government and non-profit funders showed highly similar research foci by funding primarily basic research (~45%), followed by description (~35%), treatment (~15%), and other research (~5%). However, the “mixed” funders showed a notably different funding pattern than government and non-profit funders ($\chi^2(3) = 20.5; p = 0.002$), focusing heavily on basic research (~70%) and less on description (~22%), treatment (6%), or other research (~2%). For-profit research patterns were also unique, but for-profit funding was negligible for ASD articles (total $n = 5$ articles), so analyses were not performed for this group.

Author-Reported Conflicts of Interest

Lastly, we examined financial conflicts of interest (COIs) declared by the first and last authors from 2000-2010 (before 2000, fewer than 1% of COIs were reported) and found significant differences in both the number of authors reporting COIs (Figure 4) and in the number of COIs reported by authors. From 2000-2010, the majority of ADHD and ASD articles did not report COIs (63.6% and 59.2% of articles, respectively). However, significant differences were still observed; 9.7% of ADHD authors reported one or more COIs, while only 1.6% of ASD authors reported one or more COIs ($\chi^2(1) = 69.8, p < 0.0001$). Additionally, there were differences in the type and number of COIs reported between authors of ADHD and ASD articles. The majority of COIs in ADHD research related to financial relationships with the pharmaceutical industry (e.g., Abbott, AstraZeneca, Ortho-McNeil, Shire, etc.), and many authors noted having COIs with multiple pharmaceutical companies (ranging from 1-28 companies). In contrast, the COIs reported in ASD articles related to ownership of either an ASD-related patent or investment in a biotechnology company marketing ASD diagnostic tools, and all authors listed only one COI in ASD research. Finally, as expected, the focus of research differed between articles with author-reported COIs and those declaring no COIs (or articles not reporting COIs) for both ADHD ($\chi^2(3) = 22.1; p < 0.0001$) and ASD ($\chi^2(3) = 8.1; p = 0.04$). While treatment was the primary focus of ADHD and ASD articles with reported COIs (45.8% and 37.5% of articles, respectively), basic and description research were the focus of ADHD and ASD articles not reporting or declaring no COIs (65.2% and 82.2% of articles, respectively). Taken together, these results show that authors with reported COIs are more involved in treatment research than other types of research.

DISCUSSION

In general, the results of our analysis draw attention to the shifts in focus and funding for ASD research over the past decade, as well as differences in research trajectories and stakeholders between ADHD and ASD research across time. Although a causal relationship between research focus and research funder cannot be established here, our analysis supports the idea that stakeholder groups outside of the research community have a discernable presence in research production and through this involvement may influence research trajectories. The most apparent differences between ADHD and ASD research trajectories appear in the proportion of basic and treatment research dedicated to each condition. The fact that ADHD research is more evenly-distributed between basic, description, and treatment research, and ASD is focused primarily on basic (i.e., etiological) research may not be surprising. ASD has only recently become a common condition, and there are

currently no pharmacological interventions for the core symptoms of ASD. However, a critical examination of research efforts is warranted given that the focus of such efforts play a primary role in shaping what we “know” about these conditions more broadly.

For example, while both ADHD and ASD are considered highly heritable disorders, research efforts to date have failed to find clear genetic, metabolic, or neurological markers highly predictive of either condition (Singh and Rose 2009). Interpretations of this failure differ between conditions. While many argue that the lack of biological markers for ADHD suggest that it is a socially-constructed condition that is used to “medicalize” and pharmacologically control deviant behavior (Conrad 1975 2007; Searight and McLaren 1998; Timimi and Taylor 2004), the lack of biological markers for ASD are attributed to the highly complex biology and dearth of scientific knowledge surrounding ASD (Momeni et al. 2012). Put another way, biological research into ADHD is often cited as evidence of its *validity* as a psychiatric condition (e.g., “All of the major medical associations and government health agencies recognize ADHD as a genuine disorder because the scientific evidence indicating it is so overwhelming.” [Barkley et al. 2002, 89]). In contrast, biological research into ASD is used as an *explanation* for the condition and an avenue towards better diagnostic methods and treatments (e.g., “There is widespread hope that the discovery of valid biomarkers for autism will both reveal the causes of autism and enable earlier and more targeted methods for diagnosis and intervention.” [Walsh et al. 2011, 603]). Promoting different lines of research may add to these narratives (i.e., ADHD as a contested condition, ASD as a poorly understood condition) by providing a disproportionate amount of “evidence” for particular aspects of the conditions, such as the biological aspects of ASD or the treatment aspects of ADHD. In the end, the types of research produced for ADHD and ASD will help to determine broader social acceptance and treatment of both conditions, as well as dictate how medical and social services resources are allocated for affected individuals, making continued examination of ADHD and ASD research foci warranted.

The results of this analysis also draw attention to the presence of for-profit stakeholders (i.e., pharmaceutical industry) in ADHD research and the presence of non-profit stakeholders in ASD research. The relationship between the pharmaceutical industry and ADHD research (especially in the United States) is clearly observed in this analysis, evidenced both by research funding and by author-reported COIs. Although clear, evidence of this relationship is nothing new. In fact, a sizeable body of literature describes (and often criticizes) this relationship (Angell 2008; Bailey et al. 2011; Campbell et al. 2007) and for good reason; the involvement of industry can significantly bias research. For example, much evidence has shown clinical drug trials are more likely to report favorable outcomes when funded by pharmaceutical companies (Cho and Bero 1996; McHenry and Jureidini 2008; Perkmann and Walsh 2009; Sismondo 2008; Tugaraza and Poole 2007), outcomes which could create imbalanced information that influences prescribing practices for conditions such as ADHD.

Another cause for concern in ADHD is industry sponsorship of advocacy groups. Children and Adults with Attention Deficit Hyperactivity Disorder (CHADD), one of the largest advocacy groups for ADHD, has been criticized for taking donations from the pharmaceutical industry, a conflict of interest that may influence their support of stimulant medications to treat the condition (Timimi 2008). Although CHADD is not directly involved in research funding, this group plays an important role in research by disseminating research findings (for example, see www.help4adhd.org), thus serving as an interface between the research community and the broader public. The complex relationship between the pharmaceutical industry, the research community, and ADHD advocacy groups most certainly influences broader understanding of ADHD as a medically manageable condition, one in which current research is less focused on identifying a cause than on promoting a cure.

Less conspicuous but equally compelling is the relationship between non-profit funders (generally advocacy groups and private foundations), government funders, and basic research for ASD. As previously noted, non-profit stakeholders have become a prominent presence in ASD research. Most apparent in the United States is Autism Speaks, the largest advocacy group for ASD, and the Simons Foundation (SF), a non-profit organization that has contributed hundreds of millions of dollars over the past five years to basic research on ASD (OARC 2012a). Both Autism Speaks and SF contribute to research through large-scale funding initiatives (Silverman and Brosco 2007) and sponsorship of gene (Fischbach and Lord 2010; Lajonchere 2010), tissue (Autism Speaks 2005a), treatment (Autism Speaks 2005b), and cell (SFARI 2010) banks. Non-profit organizations often control access to their databanks, effectively making themselves independent research organizations by maintaining strict control over the type of research being performed using their samples (Andrews 2005; Terry et al. 2007). The results of our analysis, as well as the funding portfolios and resource sharing strategies of these groups, show that they are heavily invested in identifying causal factors for ASD, and their significant financial investments suggest that basic research will remain a (if not the) primary focus of ASD research.

In addition to funding research, non-profit organizations also influence research through their participation in federal funding for ASD. The most compelling example of this collaboration is the Interagency Autism Coordinating Committee (IACC), a committee created to advise federal funding research initiatives and to track the progress of research being funded under the Combat Autism Act (CAA) of 2006, which allocated over one billion dollars to ASD research and services (CAA, 2005). IACC is intentionally collaborative, with representatives from both federal funding agencies and the public, many from autism advocacy and non-profit organizations. To date, IACC reports are consistent with our analysis in that the majority (50-60%) of funding is dedicated to research investigating causal factors of ASD, while social and outcome studies are the smallest focus of funding (OARC et al. 2012b). The heavy emphasis on basic research (especially pertaining to genetic and neuroscience research) was a focus of government-funded ASD research prior to enactment of CAA (Singh et al. 2007, 2009). However, the rise in collaborative efforts between federal research agencies and non-profit organizations observed both in our analysis and elsewhere (e.g., National Database on Autism Research; Lee 2011) suggests that together these stakeholders are the primary actors setting ASD research priorities.

Although progressive, this collaboration is not without controversy. One noted issue is the limited role of the ASD self-advocacy community in research decisions, a community that is overtly critical of the current ASD research agenda (Durbin-Westby 2010; Ne'eman 2010). Unlike government and non-profit stakeholders, self-advocates consistently state that too many resources are focused on finding a "cure" for ASD, something they find unsatisfactory both because most do not consider their condition something that needs to be "cured" (Reynolds 2012) and because it detracts from resources that should be directed towards services for ASD individuals (Robertson 2010). Research and service priorities promoted by the self-advocacy community have yet to become apparent in ASD research trajectories, an issue that may become negligible as the community becomes a more organized and influential research stakeholder group.

A second consideration for ASD research is the potential of for-profit stakeholder involvement in future research efforts. Practically undetectable in our analysis, for-profit stakeholders may become more involved in future ASD research efforts for a number of reasons. First, pharmacological treatments are becoming increasingly common for symptoms associated ASD, such as hyperactivity (Posey et al 2007), anxiousness (Wink et al. 2010), depression (Hurwitz et al. 2012), irritability (Elbe and Lalani 2012), and

aggression (Dove et al. 2012). Second, over 150 clinical trials are underway to address ASD core and peripheral symptoms (www.clinicaltrials.gov), suggesting that numerous drug treatments are on the horizon for ASD. The rising prevalence rates and public visibility of ASD suggests that successful pharmacological treatments could be hugely profitable. Drug companies are starting to take note; over the past few years, many pharmaceutical companies have begun to develop drugs that target ASD and have taken a larger role in sponsoring clinical trials (Hughes 2010).

Additionally, the novel nature of many of these therapies will necessitate large-scale clinical trials, prompting significant changes in ASD research foci and increased visibility of for-profit groups in ASD research efforts. Whether the rise of a for-profit presence in ASD research will spark controversy over using pharmacological treatments in children (as it has for ADHD research) remains to be seen, but the impact that this type of stakeholder has on ASD research should remain under intense scrutiny as more pharmacological treatment options become available.

Our study has a number of limitations, including analyses influenced by limitations inherent in our selection of database (PubMed), articles, and coding strategies. A comparison of ADHD and ASD literature in PubMed, Web of Science, and Ovid databases showed similar article numbers across time (data not shown). However, limitations in PubMed classifications of ADHD and ASD search terms (i.e., PubMed “MeSH” terms) or in the number of articles sampled (10-53% of the literature reported) may have influenced our findings. The sample was randomly selected to maximize the probability that it was representative of the literature produced, but was limited to research published and indexed in PubMed, and thus may be subject to publication bias (Dickersin et al. 1987; Easterbrook et al. 1991). Additionally, there is evidence that industry-sponsored studies are less likely to be published than research funded by other sources (Lexchin 2003), making it possible that our study underestimates industry-sponsored research for both ADHD and ASD.

Finally, it is important to recognize the limitations inherent in any examinations of social influences on research within a context as complex as that of child psychiatry research. We chose to examine the association between research foci and research funders because the data are easily accessible and quantifiable. However, as noted in the introduction, the diagnostic history of each condition, as well as many other condition-specific factors, may have a significant impact on research trajectories. Future studies should attempt to identify and study additional condition-specific aspects that impact research in this field.

Despite these limitations, our results reveal clear differences in research foci over time (research trajectories) and funding sources (research stakeholders) between ADHD and ASD. Our analysis suggests the involvement and interests of stakeholder groups outside of the research community may play an important role in shaping research directions for these conditions, which may result in broader social and ethical consequences. Continued examination of the motivations and contributions of these groups toward research endeavors will be critical to foster a more comprehensive understanding of the broader context in which child psychiatry research advances as well as to make informed decisions about how to direct research efforts in the future.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

The authors would like to thank Catherine Nygen for assisting in analysis and David Magnus, Sally Tobin, Inna Shafer and Nanibaa' Garrison for helpful comments on the manuscript.

Funding: This work is sponsored by a grant from NHGRI (P50 HG003389).

References

- Albayrak O, Friedel S, Schimmelmann BG, Hinney A, Hebebrand J. Genetic aspects in attention-deficit/hyperactivity disorder. *Journal of Neural Transmission*. 2008; 115(2):305–15. [PubMed: 18200432]
- Aman MG, Farmer CA, Hollway J, Arnold LE. Treatment of inattention, overactivity, and impulsiveness in autism spectrum disorders. *Child and Adolescent Psychiatric Clinics in North America*. 2008; 17(4):713–38.
- Andrews LB. Harnessing the benefits of biobanks. *Journal of Law and Medical Ethics*. 2005; 33(1): 22–30.
- Angell M. Industry-sponsored clinical research: a broken system. *JAMA: the Journal of the American Medical Association*. 2008; 300(9):1069–71. [PubMed: 18768418]
- Autism Speaks. Autism Tissue Bank. 2005a. Retrieved from <http://www.autismtissueprogram.org/site/c.nIKUL7MQIsG/b.5183271/k.BD86/Home.htm>
- Autism Speaks. Autism Treatment Network and Autism Clinical Trials Network. 2005b. Retrieved from <http://www.autismspeaks.org/science/resources-programs>
- Bailey CS, Fehlings MG, Rampersaud YR, Hall H, Wai EK, Fisher CG. Industry and evidence-based medicine: Believable or conflicted? A systematic review of the surgical literature. *Canadian Journal of Surgery*. 2011; 54(5):321–6.
- Barkley RA, Cook EH, Diamond A, et al. International Consensus Statement on ADHD. *Clinical Child and Family Psychology Review*. 2002; 5(2):89–111. [PubMed: 12093014]
- Baron-Cohen S, Lombardo MV, Auyeung B, Ashwin E, Chakrabarti B, Knickmeyer R. Why are autism spectrum conditions more prevalent in males? *PLoS Biology*. 2011; 9(6):e1001081. [PubMed: 21695109]
- Bettleheim, S. *The Empty Fortress: Infantile Autism and the Birth of the Self*. The Free Press; New York, NY: 1967.
- Billstedt E, Gillberg IC, Gillberg C. Aspects of quality of life in adults diagnosed with autism in childhood: a population-based study. *Autism*. 2011; 15(1):7–20. [PubMed: 20923888]
- Bishop DV. Which neurodevelopmental disorders get researched and why? *PLoS One*. 2010; 5(11):e15112. [PubMed: 21152085]
- Bradley C. The behavior of children receiving benzedrine. *The American Journal of Psychiatry*. 1937; 94:577–585.
- Bradshaw JL, Sheppard DM. The neurodevelopmental frontostriatal disorders: evolutionary adaptiveness and anomalous lateralization. *Brain Language*. 2000; 73(2):297–320. [PubMed: 10856179]
- Breggin PR. Questioning the treatment for ADHD. *Science*. 2001; 291(5504):595. [PubMed: 11229399]
- CAA. S. 843--109th Congress: Combating Autism Act of 2006. [GovTrack.us](http://www.govtrack.us/congress/bill.xpd?bill=s109-843) (database of federal legislation). 2005. [GovTrack.us](http://www.govtrack.us/congress/bill.xpd?bill=s109-843) Retrieved from <http://www.govtrack.us/congress/bill.xpd?bill=s109-843>
- Campbell EG, Weissman JS, Ehringhaus S, et al. Institutional academic industry relationships. *JAMA : the Journal of the American Medical Association*. 2007; 298(15):1779–86. [PubMed: 17940234]
- Canitano R, Scandurra V. Psychopharmacology in autism: an update. *Progress in Neuropsychopharmacology and Biological Psychiatry*. 2011; 35(1):18–28.

- Caron-Flinterman JF, Broerse JEW, Bunders JFG. Patient Partnership in Decision-Making on Biomedical Research: Changing the Network. *Science, Technology & Human Values*. 2007; 32(3):339–368.
- CDC. Prevalence of autism spectrum disorders - Autism and Developmental Disabilities Monitoring Network, United States, 2006. *Morbidity and Mortality Weekly Report*. 2009; 58(10):1–20. [PubMed: 19145219]
- CDC. Increasing prevalence of parent-reported attention-deficit/hyperactivity disorder among children --- United States, 2003 and 2007. *Morbidity and Mortality Weekly Report*. 2010; 59(44):1439–43. [PubMed: 21063274]
- Chamak B. Autism and social movements: French parents' associations and international autistic individuals' organizations. *Sociology of Health & Illness*. 2008; 30(1):76–96. [PubMed: 18254834]
- Cho MK, Bero LA. The quality of drug studies published in symposium proceedings. *Annals of Internal Medicine*. 1996; 124:485–489. [PubMed: 8602706]
- Collyar D. An essential partnership: patient advocates and cooperative groups. *Seminars in Oncology*. 2008; 35(5):553–5. [PubMed: 18929153]
- Conrad, P. *Identifying Hyperactive Children: The Medicalization of Deviant Behavior*. Ashgate Publishing Co.; Burlington, VT: 1975.
- Conrad, P. *The Medicalization of Society*. Johns Hopkins University Press; Baltimore, MD: 2007.
- Deisinger, JA. History of autism spectrum disorders. In: Rotatori, AF.; Obiakor, FE.; Bakken, JP., editors. *History of Special Education*. Vol. 21. Emerald Group Publishing Limited; Bingley, UK: 2011. p. 237-267.
- Dickersin K, Chan S, Chalmers TC. Publication bias and clinical trials. *Controlled Clinical Trials*. 1987; 8(4):343–53. [PubMed: 3442991]
- Diller, LH. *Running on Ritalin: A Physician Reflects on Children, Society, and Performance in a Pill*. Bantam Books; New York, NY: 1998.
- Dove D, Warren Z, McPheeters ML, Taylor JL, Sathe NA, Veenstra-VanderWeele J. Medications for adolescents and young adults with autism spectrum disorders: a systematic review. *Pediatrics*. 2012; 130(4):717–26. [PubMed: 23008452]
- Durbin-Westby PC. “Public Law 109-416 Is Not Just about Scientific Research”: Speaking Truth to Power at Interagency Autism Coordinating Committee Meetings. *Disability Studies Quarterly*. 2010; 30(1) online only. Retrieved from <http://dsq-sds.org/article/view/1070/1245>.
- Durston S, de Zeeuw P, Staal WG. Imaging genetics in ADHD: a focus on cognitive control. *Neuroscience and Biobehavioral Reviews*. 2009; 33(5):674–89. [PubMed: 18789356]
- Easterbrook PJ, Berlin JA, Gopalan R, Matthews DR. Publication bias in clinical research. *Lancet*. 1991; 337(8746):867–872. [PubMed: 1672966]
- Elbe D, Lalani Z. Review of the pharmacotherapy of irritability of autism. *Journal of the Canadian Academy of Child and Adolescent Psychiatry*. 2012; 21(2):130–46. [PubMed: 22548111]
- Fischbach GD, Lord C. The Simons Simplex Collection: a resource for identification of autism genetic risk factors. *Neuron*. 2010; 68(2):192–5. [PubMed: 20955926]
- Furman LM. Attention-deficit hyperactivity disorder (ADHD): Does new research support old concepts? *Journal of Child Neurology*. 2008; 23(7):775–84. [PubMed: 18658077]
- Gargaro BA, Rinehart NJ, Bradshaw JL, Tonge BJ, Sheppard DM. Autism and ADHD: how far have we come in the comorbidity debate? *Neuroscience Biobehavioral Reviews*. 2011; 35(5):1081–8. [PubMed: 21093480]
- Gordan JB, Levine RJ, Mazure CM, Rubin PE, Schaller BR, Young JL. Social contexts influence ethical considerations of research. *American Journal of Bioethics*. 2011; 11(5):24–30.
- Guillaume L, Bath PA. A content analysis of mass media sources in relation to the MMR vaccine scare. *Health Informatics Journal*. 2008; 14(4):323–34. [PubMed: 19008281]
- Handen BL, Johnson CR, Lubetsky M. Efficacy of methylphenidate among children with autism and symptoms of attention-deficit hyperactivity disorder. *Journal of Autism and Developmental Disorders*. 2000; 30(3):245–55. [PubMed: 11055460]

- Hinshaw SP, Stier A. Stigma as related to mental disorders. *Annual Review of Clinical Psychology*. 2008; 4:367–93.
- Hoffmaster, BC., editor. *Bioethics in Social Context*. Temple University Press; Philadelphia, PA: 2001.
- Holton A, Weberling B, Clarke CE, Smith MJ. The Blame Frame: Media Attribution of Culpability About the MMR-Autism Vaccination Scare. *Health Communication*. 2012; 27(7):690–701. epub ahead of print. [PubMed: 22236220]
- Hughes, V. Pharma companies set their sights on autism. Jun 29. 2012 Retrieved from <http://sfari.org/news-and-opinion/news/2010/pharma-companies-set-their-sights-on-autism>
- Hurwitz R, Blackmore R, Hazell P, Williams K, Woolfenden S. Tricyclic antidepressants for autism spectrum disorders (ASD) in children and adolescents. *Cochrane database of Systematic Reviews*. 2012; 3 epub ahead of print. doi: 10.1002/14651858.CD008372.pub2.
- Kawa S, Giordano J. A brief historicity of the Diagnostic and Statistical Manual of Mental Disorders: Issues and implications for the future of psychiatric canon and practice. *Philosophy, Ethics and Humanities in Medicine*. 2012; 7(1):2.
- Kuhlthau K, Orlich F, Hall TA, et al. Health-Related Quality of Life in children with autism spectrum disorders: results from the autism treatment network. *Journal of Autism Developmental Disorders*. 2010; 40(6):721–9. [PubMed: 20033762]
- Lajonchere CM. Changing the landscape of autism research: the autism genetic resource exchange. *Neuron*. 2010; 68(2):187–91. [PubMed: 20955925]
- Landy DC, Brinich MA, Colten ME, Horn EJ, Terry SF, Sharp RR. How disease advocacy organizations participate in clinical research: A survey of genetic organizations. *Genetics in Medicine*. 2012; 14(2):223–8. [PubMed: 22261756]
- Lang HC, Scheffler RM, Hu TW. The discrepancy in attention deficit hyperactivity disorder (ADHD) medications diffusion: 1994–2003--a global pharmaceutical data analysis. *Health Policy*. 2010; 97(1):71–8. [PubMed: 20382439]
- Lee, K. NDAR federation creates largest source of autism research data to date. *NIH News*. Dec 12. 2011 Retrieved from <http://www.nih.gov/news/health/dec2011/nimh-12.htm>
- Lexchin J, Bero LA, Djulbegovic B, Clark O. Pharmaceutical industry sponsorship and research outcome and quality: systematic review. *British Medical Journal*. 2003; 326:1167–70. [PubMed: 12775614]
- Liu KY, King M, Bearman PS. Social influence and the autism epidemic. *American Journal of Sociology*. 2010; 115(5):1387–434.
- Mayes R, Rafalovich A. Suffer the restless children: the evolution of ADHD and paediatric stimulant use 1900–80. *History of Psychiatry*. 2007; 18(4):435–457. [PubMed: 18590022]
- Mayes, R.; Bagwell, C.; Erkulwater, J. *Medicating Children: ADHD and Pediatric Mental Health*. Harvard University Press; Boston, MA: 2009.
- Martin JK, Pescosolido BA, Olafsdottir S, McLeod JD. The construction of fear: Americans' preferences for social distance from children and adolescents with mental health problems. *Journal of Health and Social Behavior*. 2007; 48(1):50–67. [PubMed: 17476923]
- McHenry LB, Jureidini JN. Industry-sponsored ghostwriting in clinical trial reporting: a case study. *Accountability in Research*. 2008; 15(3):152–67. [PubMed: 18792536]
- McLeod JD, Fettes DL, Jensen PS, Pescosolido BA, Martin JK. Public knowledge, beliefs, and treatment preferences concerning attention-deficit hyperactivity disorder. *Psychiatric Services*. 2007; 58(5):626–31. [PubMed: 17463342]
- Mercer L, Creighton S, Holden JJ, Lewis ME. Parental perspectives on the causes of an autism spectrum disorder in their children. *Journal of Genetic Counseling*. 2006; 15(1):41–50. [PubMed: 16547798]
- Mitchell RK, Agle BR, Wood DJ. Toward a theory of stakeholder identification and salience: defining of who and what really counts. *Academy of Management Review*. 1997; 22(4):853–86.
- Momeni N, Bergquist J, Brudin L, et al. A novel blood-based biomarker for detection of autism spectrum disorders. *Translational Psychiatry*. 2012; 2:e91. F. [PubMed: 22832856]
- Montalbano R, Roccella M. The quality of life of children with pervasive developmental disorders. *Minerva Pediatrica*. 2009; 61(4):361–70. [PubMed: 19752845]

- Ne'eman A. The Future (and the Past) of Autism Advocacy, Or Why the ASA's Magazine, *The Advocate*, Wouldn't Publish This Piece. *Disability Studies Quarterly*. 2010; 30(1) online only. Retrieved from <http://dsq-sds.org/article/view/1059/1244>.
- Neufeld P, Foy M. Historical reflections on the ascendancy of ADHD in North America, c. 1980-c. 2005. *British Journal of Educational Studies*. 2006; 54(4):449–470.
- Newschaffer CJ, Curran LK. Autism: an emerging public health problem. *Public Health Report*. 2003; 118(5):393–9.
- Nijmeijer JS, Hoekstra PJ, Minderaa RB, et al. PDD symptoms in ADHD, an independent familial trait? *Journal of Abnormal Child Psychology*. 2009; 37(3):443–53. [PubMed: 19051006]
- Nijmeijer JS, Arias-Vasquez A, Rommelse NN, Altink ME, Anney RJ, Asherson P, et al. Identifying loci for the overlap between attention-deficit/hyperactivity disorder and autism spectrum disorder using a genome-wide QTL linkage approach. *Journal of the American Academy of Child and Adolescent Psychiatry*. 2010; 49(7):675–85. [PubMed: 20610137]
- Office of Autism Research Coordination (OARC). National Institute of Mental Health & Acclaro Research Solutions, Inc.. Interagency Autism Coordinating Committee (IACC). 2009 IACC Autism Spectrum Disorder Research Portfolio Analysis Report. 2012a. Retrieved from the Department of Health and Human Services Interagency Autism Coordinating Committee website: <http://iacc.hhs.gov/portfolio-analysis/2010/index.shtml>
- Office of Autism Research Coordination (OARC). National Institute of Mental Health and Thomson Reuters, Inc.. Interagency Autism Coordinating Committee (IACC). IACC/OARC Autism Spectrum Disorder Research Publications Analysis Report: The Global Landscape of Autism Research. 2012b. Retrieved from the Department of Health and Human Services Interagency Autism Coordinating Committee website: <http://iacc.hhs.gov/publications-analysis/july2012/index.shtml>
- Ozonoff S, Jensen J. Brief report: specific executive function profiles in three neurodevelopmental disorders. *Journal of Autism and Developmental Disorders*. 1999; 29(2):171–7. [PubMed: 10382139]
- Pavitt K. Public Policies to Support Basic Research: What Can the Rest of the World Learn from US Theory and Practice? (And What They Should Not Learn). *Industrial and Corporate Change*. 2001; 10:761–779.
- Perkmann M, Walsh K. The two faces of collaboration: impacts of university-industry relations on public research. *Industrial and Corporate Change*. 2009; 18(6):1033–65.
- Perrin JM, Bloom SR, Gortmaker SL. The increase of childhood chronic conditions in the United States. *JAMA*. 2007; 297(24):2755–9. [PubMed: 17595277]
- Pescosolido BA, Jensen PS, Martin JK, Perry BL, Olafsdottir S, Fettes D. Public knowledge and assessment of child mental health problems: findings from the National Stigma Study-Children. *Journal of the American Academy of Child and Adolescent Psychiatry*. 2008; 47(3):339–49. [PubMed: 18216729]
- Pescosolido BA, Martin JK, Long JS, Medina TR, Phelan JC, Link BG. A disease like any other? A decade of change in public reactions to schizophrenia, depression, and alcohol dependence. *American Journal of Psychiatry*. 2010; 167(11):1321–30. [PubMed: 20843872]
- Pickersgill MD. Research, engagement and public bioethics: promoting socially robust science. *Journal of Medical Ethics*. 2011; 37:698–701. [PubMed: 21673017]
- Posey DJ, Aman MG, McCracken JT, et al. Positive effects of methylphenidate on inattention and hyperactivity in pervasive developmental disorders: an analysis of secondary measures. *Biological Psychiatry*. 2007; 61(4):538–44. [PubMed: 17276750]
- Ramtekkar UP, Reiersen AM, Todorov AA, Todd RD. Sex and age differences in attention-deficit/hyperactivity disorder symptoms and diagnoses: implications for DSM-V and ICD-11. *Journal of the American Academy of Child and Adolescent Psychiatry*. 2010; 49(3):217–28. [PubMed: 20410711]
- Reiersen AM. Links between autism spectrum disorder and ADHD symptom trajectories: important findings and unanswered questions. *Journal of the American Academy of Child and Adolescent Psychiatry*. 2011; 50(9):857–9. [PubMed: 21871367]

- Reynolds, R. Changing Minds: Advocates Reshape How We Think About Autism. SF Weekly. Oct 31. 2012 Retrieved Dec 26 from <http://www.sfweekly.com/2012-10-31/news/autism-autism-speaks-autism-self-advocacy-network-fragile-x-syndrome-genetics-medicine-biology-science-culture>
- Robertson SM. Neurodiversity, Quality of Life, and Autistic Adults: Shifting Research and Professional Focuses onto Real-Life Challenges. *Disability Studies Quarterly*. 2010; 30(1) online only. Retrieved from <http://dsq-sds.org/article/view/1069/1234>.
- Ronald A, Hoekstra RA. Autism spectrum disorders and autistic traits: A decade of new twin studies. *American Journal of Medical Genetics B Neuropsychiatric Genetics*. 2011; 156B(3):255–274.
- Rommelse NN, Franke B, Geurts HM, Hartman CA, Buitelaar JK. Shared heritability of attention-deficit/hyperactivity disorder and autism spectrum disorder. *European Child and Adolescent Psychiatry*. 2010; 19(3):281–95. [PubMed: 20148275]
- Rommelse NN, Geurts HM, Franke B, Buitelaar JK, Hartman CA. A review on cognitive and brain endophenotypes that may be common in autism spectrum disorder and attention-deficit/hyperactivity disorder and facilitate the search for pleiotropic genes. *Neuroscience Biobehavioral Reviews*. 2011; 35(6):1363–96. [PubMed: 21382410]
- Rosler M, Casas M, Konofal E, Buitelaar J. Attention deficit hyperactivity disorder in adults. *World Journal of Biological Psychiatry*. 2010; 11(5):684–98. [PubMed: 20521876]
- Scheffler RM, Hinshaw SP, Modrek S, Levine P. The global market for ADHD medications. *Health Affairs*. 2007; 26(2):450–7. [PubMed: 17339673]
- Schomerus G, Schwahn C, Holzinger A, et al. Evolution of public attitudes about mental illness: a systematic review and meta-analysis. *Acta Psychiatrica Scandinavica*. 2012; 125(6):440–452. [PubMed: 22242976]
- Searight HR, McLaren AL. Attention-deficit hyperactivity disorder: the medicalization of misbehavior. *Journal of Clinical Psychology in Medical Settings*. 1998; 5(4):467–495.
- Sergeant JA, Geurts H, Oosterlaan J. How specific is a deficit of executive functioning for attention-deficit/hyperactivity disorder? *Behavioral Brain Research*. 2002; 130(1-2):3–28.
- SFARI. SFARI Base / SSC: Researcher Welcome Packet. 2010. Retrieved from https://simonsfoundation.s3.amazonaws.com/share/SFARI_Researcher_Welcome.pdf
- Sharp RR, Landy DC. The financing of clinical genetics research by disease advocacy organizations: A review of funding disclosures in biomedical journals. *American Journal of Medical Genetics A*. 2010; 152A(12):3051–6.
- Silverman, C. *Understanding Autism: Parents, Doctors and the History of a Disorder*. Princeton University Press; Princeton, NJ: 2012.
- Silverman C, Brosco JP. Understanding autism: parents and pediatricians in historical perspective. *Archives of Pediatric and Adolescent Medicine*. 2007; 161(4):392–8.
- Singh I. Will the “real boy” please behave: dosing dilemmas for parents of boys with ADHD. *The American Journal of Bioethics*. 2005; 5(3):34–47. [PubMed: 16006369]
- Singh I. Beyond polemics: science and ethics of ADHD. *Nature Reviews Neuroscience*. 2008; 9(12): 957–64.
- Singh I, Rose N. Biomarkers in psychiatry. *Nature*. 2009; 460(7252):202–7. [PubMed: 19587761]
- Singh J, Hallmayer J, Illes J. Interacting and paradoxical forces in neuroscience and society. *Nature Reviews Neuroscience*. 2007; 8(2):153–60. J.
- Singh J, Illes J, Lazzeroni L, Hallmayer J. Trends in US autism research funding. *Journal of Autism and Developmental Disorders*. 2009; 39(5):788–95. [PubMed: 19148735]
- Sismondo S. Pharmaceutical company funding and its consequences: a qualitative systematic review. *Contemporary Clinical Trials*. 2008; 29:109–113. [PubMed: 17919992]
- St. Pourcain B, Mandy WP, Heron J, Golding J, Davey Smith G, Skuse DH. Links between co-occurring social-communication and hyperactive-inattentive trait trajectories. *Journal of the American Academy of Child and Adolescent Psychiatry*. 2011; 50(9):892–902. [PubMed: 21871371]
- Takarae Y, Minshew NJ, Luna B, Sweeney JA. Atypical involvement of frontostriatal systems during sensorimotor control in autism. *Psychiatry Research*. 2007; 156(2):117–27. [PubMed: 17913474]

- Terry SF, Terry PF, Rauén KA, Uitto J, Bercovitch LG. Advocacy groups as research organizations: the PXE International example. *Nature Reviews Genetics*. 2007; 8(2):157–64.
- Timimi S. Child psychiatry and its relationship with the pharmaceutical industry: theoretical and practical issues. *Advances in Psychiatric Treatment*. 2008; 14:3–9.
- Timimi S, Taylor E. ADHD is best understood as a cultural construct. *The British Journal of Psychiatry: the Journal of Mental Science*. 2004; 184:8–9. [PubMed: 14702221]
- Timimi S, Moncrieff J, Jureidini J, et al. A critique of the international consensus statement on ADHD. *Clinical Child and Family Psychology Review*. 2004; 7(1):59–63. [PubMed: 15119688]
- Tungaraza T, Poole R. Influence of drug company authorship and sponsorship on drug trial outcomes. *The British Journal of Psychiatry: The Journal of Mental Science*. 2007; 191:82–3. [PubMed: 17602130]
- van den Hazel P, Zuurbier M, Babisch W, et al. Today's epidemics in children: possible relations to environmental pollution and suggested preventive measures. *Acta Paediatrica*. 2006; 95(453):18–25. [PubMed: 17000565]
- Walsh P, Elsabbagh M, Bolton P, Singh I. In search of biomarkers for autism: scientific, social and ethical challenges. *Nature Reviews Neuroscience*. 2011; 12(10):603–612.
- Wehmeier PM, Schacht A, Barkley RA. Social and emotional impairment in children and adolescents with ADHD and the impact on quality of life. *Journal of Adolescent Health*. 2010; 46(3):209–17. [PubMed: 20159496]
- Wink LK, Erickson CA, McDougale CJ. Pharmacologic treatment of behavioral symptoms associated with autism and other pervasive developmental disorders. *Current Treatment Options in Neurology*. 2010; 12(6):5 29–38.
- Wisdom JP, Bruce K, Saedi GA, Weis T, Green CA. 'Stealing me from myself': identity and recovery in personal accounts of mental illness. *The Australian and New Zealand Journal of Psychiatry*. 2008; 42(6):489–95. [PubMed: 18465375]
- Zeiner P, Gjevik E, Weidle B. Response to atomoxetine in boys with high-functioning autism spectrum disorders and attention deficit/hyperactivity disorder. *Acta Paediatrica*. 2011; 100(9): 1258–61. [PubMed: 21392103]

Figure 1. Proportion of ADHD and ASD research by focus

Percentage of ADHD (light gray bars) and ASD (dark gray bars) articles focusing on Basic (Bc), Description (Dn), Treatment (Tx) or Other (Oth) research during two time periods (1970-1999 and 2000-2010). Error bars indicate 95% confidence intervals calculated for the proportion of articles sampled from total articles identified in the Pubmed database.

Figure 2. Proportion of ADHD and ASD research by funder

Percentage of ADHD (light gray bars) and ASD (dark gray bars) articles funded by government (Gt), for-profit (Fp), non-profit (Np), mixed (Mx), or not reported (Nr) sources during two time periods (1970-1999 and 2000-2010). Error bars indicate 95% confidence intervals calculated for the proportion of articles sampled from total articles identified in the Pubmed database.

Figure 3. Proportion of ADHD and ASD research focus by research funder

Percentage of ADHD (light gray bars) and ASD (dark gray bars) literature samples focusing on Basic (Bc), Description (Dn), Treatment (Tx), or Other (Oth) research focus within each funding source from 1970-2010. Articles not reporting a funding source were excluded from analysis (32% and 33% of ADHD and ASD sample, respectively).

Figure 4. Author-reported COIs in ADHD and ASD research

A high percentage of both ADHD and ASD samples did not explicitly report conflicts of interest ($n = 64\%$ and 59% , respectively). Error bars indicate 95% confidence intervals calculated for the proportion of articles sampled from total articles identified in the Pubmed database.

Table 1
Number of Research Articles Identified and Coded for Literature Analysis of ADHD and ASD Research

Condition	Year	Total Articles (n)	Articles Sampled (n)	Articles Sampled (%)
ADHD	1970	19	10	53
ADHD	1975	82	27	33
ADHD	1980	78	25	32
ADHD	1985	190	57	30
ADHD	1990	227	68	30
ADHD	1995	337	85	25
ADHD	2000	674	135	20
ADHD	2005	1349	202	15
ADHD	2010	2062	207	10
ASD	1970	58	20	34
ASD	1975	109	35	32
ASD	1980	95	30	32
ASD	1985	145	45	31
ASD	1990	184	50	27
ASD	1995	199	50	25
ASD	2000	404	80	20
ASD	2005	853	125	15
ASD	2010	1997	197	10
ADHD	1970-99	933	272	29
ADHD	2000-10	4085	544	13
ASD	1970-99	790	230	29
ASD	2000-10	3254	402	12