TITLE PAGE

Comparative Meta-analyses of Brain Structural and Functional Abnormalities during Cognitive Control in Attention-Deficit/Hyperactivity Disorder and Autism Spectrum Disorder

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Word count: 4718

Abstract: 250

ABSTRACT

Background: People with attention-deficit/hyperactivity disorder (ADHD) and autism spectrum disorder (ASD) have abnormalities in frontal, temporal, parietal and striato-thalamic networks. It is unclear to what extent these abnormalities are distinctive or shared. This comparative meta-analysis aimed to identify the most consistent disorder-differentiating and shared structural and functional abnormalities.

Methods: Systematic literature search was conducted for whole-brain voxel-based morphometry (VBM) and fMRI studies of cognitive control comparing people with ASD or ADHD with typically developing controls. Regional gray matter volume (GMV) and fMRI abnormalities during cognitive control were compared in the overall sample and in age-, sex- and IQ-matched subgroups with seed-based *d* mapping meta-analytic methods.

Results: Eighty-six independent VBM (1533 ADHD and 1295 controls; 1445 ASD and 1477 controls) and 60 fMRI datasets (1001 ADHD and 1004 controls; 335 ASD and 353 controls) were identified. The VBM meta-analyses revealed ADHD-differentiating *decreased* ventromedial orbitofrontal ($z = 2.22$, $p < .0001$) but ASD-differentiating *increased* bilateral temporal and right dorsolateral prefrontal GMV (zs ≥ 1.64, ps ≤ .002).The fMRI meta-analyses of cognitive control revealed ASD-differentiating medial prefrontal underactivation but overactivation in bilateral ventrolateral prefrontal cortices and precuneus (zs ≥ 1.04, ps ≤ .003). During motor response inhibition specifically, ADHD relative to ASD showed right inferior fronto-striatal underactivation (zs ≥ 1.14, ps ≤ .003) but shared right anterior insula underactivation.

Conclusions: People with ADHD and ASD have mostly distinct structural abnormalities, with enlarged fronto-temporal GMV in ASD and reduced orbitofrontal GMV in ADHD; and mostly distinct functional abnormalities, which were more pronounced in ASD.

TEXT

1. Introduction

Attention-deficit/hyperactivity disorder (ADHD) and autism spectrum disorder (ASD) are distinct neurodevelopmental conditions. ADHD is characterized by age-inappropriate symptoms of inattention, hyperactivity and impulsivity, whereas ASD is characterized by difficulties in social interaction/communication and stereotypical repetitive behavior (American Psychiatric Association (APA), 2013). The estimated prevalence of ADHD (5-7%) is higher than ASD (1-2%) worldwide (Elsabbagh et al., 2012; Polanczyk, Willcutt, Salum, Kieling, & Rohde, 2014). In both disorders, brain structural abnormalities have been observed in frontal, temporal, parietal and striato-thalamic networks (Ecker, 2017; Norman et al., 2016), although the extent of their overlap is poorly understood. Furthermore, both disorders are associated with cognitive control deficits (F. Craig et al., 2016), although ASD relative to ADHD seem less severely impaired (see meta-analyses Lipszyc & Schachar, 2010; Willcutt, Sonuga-Barke, Nigg, & Sergeant, 2008) and display more heterogeneous performance (Geurts, van den Bergh, & Ruzzano, 2014; Kuiper, Verhoeven, & Geurts, 2016). Exploring abnormalities in brain structure and cognitive control function could help elucidate the disorder-differentiating and shared difficulties in ASD and ADHD.

In ADHD, brain abnormalities are thought to represent delayed maturation in brain structure and function mediating late-developing cognitive functions such as cognitive control (Hoogman et al., 2017; Shaw et al., 2007; Sripada, Kessler, & Angstadt, 2014). Correspondingly, previous voxel-based morphometry (VBM) meta-analyses have revealed reduced gray matter volume (GMV) in ventromedial orbitofrontal cortex (vmOFC) and basal ganglia (BG) (Frodl & Skokauskas, 2012; Nakao, Radua, Rubia, & Mataix-Cols, 2011; Norman et al., 2016). In addition, mega-analytic studies by the ENIGMA consortium of subcortical and cortical structure involving over 1700 and 2200 individuals with ADHD,

respectively, found reduced GMV in BG, amygdala and hippocampus (Hoogman et al., 2017), as well as reduced cortical surface areas and thickness in several frontal, temporal and parietal regions (Hoogman et al., 2019).

Converging with these findings are meta-analytic reports of underactivation in lateral and medial frontostriatal networks in ADHD relative to controls during cognitive control such as in right inferior frontal gyrus (IFG)/anterior insula (AI), supplementary motor area (SMA)/anterior cingulate cortex (ACC), and the striatum (Hart, Radua, Nakao, Mataix-Cols, & Rubia, 2013; McCarthy, Skokauskas, & Frodl, 2014; Norman et al., 2016). The role of right IFG as potential biomarker of ADHD in particular has been discussed in several studies and a meta-analysis showing disorder-specificity of underactivation in right and/or left IFG during cognitive control in ADHD children relative to pediatric bipolar disorder (Passarotti, Sweeney, & Pavuluri, 2010), obsessive-compulsive disorder (Norman et al., 2016) and conduct disorder (Rubia, 2018; Rubia, Halari, et al., 2010).

In ASD, findings from neuroimaging, post-mortem and head circumference development studies have led to the “early brain overgrowth theory” (Courchesne, Campbell, & Solso, 2011; Lange et al., 2015; Redcay & Courchesne, 2005; Schumann et al., 2010), which, however, has been contested in recent studies (Ecker, Schmeisser, Loth, & Murphy, 2017; Raznahan et al., 2013). Meta-analytic and mega-analytic findings have varied but GMV reduction in the striatum and amygdala/hippocampus were among the more frequently reported (Cauda et al., 2011; DeRamus & Kana, 2015; Nickl-Jockschat et al., 2012; van Rooij et al., 2018; Via, Radua, Cardoner, Happe, & Mataix-Cols, 2011). Another recent meta-analysis of VBM studies in over 900 ASD patients, however, primarily found cortical abnormalities such as GMV decrease in medial prefrontal cortex (mPFC) and posterior insula; and increase in left anterior temporal, right inferior temporo-parietal, left dorsolateral prefrontal (dlPFC) and precentral cortices (Carlisi et al., 2017). Furthermore, the ENIGMA

mega-analysis has found cortical thickness increase in frontal and decrease in temporal areas (van Rooij et al., 2018).

The whole-brain meta-analysis of fMRI studies of cognitive control in ASD (Carlisi et al., 2017) has found underactivation in salience and executive network areas such as mPFC, left dorsolateral and right ventrolateral prefrontal cortices (vlPFC)/AI, left cerebellum, inferior parietal lobe (IPL) and right premotor area; and overactivation in right temporo-parietal regions including default mode network (DMN) areas.

While these meta-analytic findings suggest partially overlapping brain abnormalities in ASD and ADHD, only direct comparisons can elucidate their differences and commonalities. Among such studies, a VBM study showed reduced GMV in ADHD relative to ASD in right posterior cerebellum and ASD-differentiating reduced left middle/superior temporal gyri (M/STG) (Lim et al., 2015). Furthermore, fMRI studies have shown ASD-differentiating mPFC underactivation during reward reversal (Chantiluke, Barrett, Giampietro, Brammer, Simmons, Murphy, et al., 2015), shared dlPFC underactivation during sustained attention and working memory (Chantiluke, Barrett, Giampietro, Brammer, Simmons, & Rubia, 2015; Christakou et al., 2013); and shared precuneus abnormalities during sustained attention, reward reversal and the resting state (Chantiluke, Barrett, Giampietro, Brammer, Simmons, Murphy, et al., 2015; Christakou et al., 2013; Di Martino et al., 2013). Importantly, during successful motor inhibition, ADHD-differentiating underactivation was observed in left vlPFC and BG and ASD-differentiating overactivation in bilateral IFG (Chantiluke, Barrett, Giampietro, Santosh, et al., 2015). Few imaging studies, however, have directly compared the two disorders and their relatively small sample sizes have limited statistical power.

We therefore conducted meta-analyses of structural and functional abnormalities related to functions that are commonly impaired in ASD and ADHD, i.e., cognitive control. The aim of the study was to establish the most consistently disorder-differentiating and shared structural

and functional deficits, which is important for developing disorder-specific or transdiagnostic treatment. Guided by previous comparative studies and meta-analyses in ASD and/or ADHD, we hypothesized that these disorders are characterized by both shared abnormalities in salience, cognitive control, and default mode networks as well as disorder-differentiating impairments. Structurally, we hypothesized ADHD-differentiating reduced GMV in BG/insula relative to ASD (Lim et al., 2015; Norman et al., 2016), and ASD-differentiating increased GMV in frontal and temporo-parietal regions (Carlisi et al., 2017; Lim et al., 2015). During cognitive control, we expected ADHD-differentiating reduced activation in right IFG and BG relative to ASD (Chantiluke, Barrett, Giampietro, Santosh, et al., 2015; Norman et al., 2016; Passarotti et al., 2010; Rubia et al., 2009), ASD-differentiating underactivation relative to ADHD in the medial frontal part of the cognitive control network (Carlisi et al., 2017; Chantiluke, Barrett, Giampietro, Brammer, Simmons, Murphy, et al., 2015), and shared abnormal overactivation in precuneus in both disorders (Chantiluke, Barrett, Giampietro, Brammer, Simmons, Murphy, et al., 2015; Christakou et al., 2013; Di Martino et al., 2013).

2. Methods

2.1. Publication Search and Study Inclusion

Systematic literature search was conducted for peer-reviewed English language publications in PubMed, Scopus, Web of Science and ScienceDirect until 30th November 2018, for whole-brain fMRI or VBM studies in ASD and ADHD. Manual search was conducted in reference lists of previous meta-analyses. Included studies compared the ASD or ADHD groups against typically developing (TD) controls on GMV or on cognitive-control fMRI BOLD signal from stop-signal, go/no-go, switch, Stroop, Simon and flanker, using predefined inhibitory contrasts (Supplement 1). Only whole-brain neuroimaging data were included, to prevent bias towards specific neuroanatomy (Friston, Rotshtein, Geng, Sterzer, & Henson, 2006). Excluded studies used region of interest (ROI) approaches or involved <10 patients, which

were deemed lacking in statistical power (Desmond & Glover, 2002; Nakao et al., 2011; Thirion et al., 2007). Studies that potentially report duplicate data from other publications (including mega-analyses), have no TD controls, or have provided no peak coordinates, were excluded. When samples overlapped, the largest sample was included. Mean age, proportion of males, mean IQ, cognitive control tasks, current and lifetime psychostimulant use (i.e., proportion of participants being prescribed the medication) and effect size and coordinate location of peaks for regional GMV and activation differences were extracted from each study and authors were contacted for missing information. Reports of exclusion or inclusion of people with co-occurring ASD or ADHD in the counterpart disorder groups were also extracted from the literature. Data were extracted from all studies by SL, 64% of which were also extracted by LN and CC who achieved 100% agreement. This meta-analysis was not pre-registered in a time-stamped, institutional registry prior to the research being conducted.

2.2. Meta-Analyses

The anisotropic seed-based *d* Mapping (AES-SDM) meta-analytic software (www.sdmproject.com; Supplement 1) employed in previous meta-analyses of ASD and ADHD (Carlisi et al., 2017; Frodl & Skokauskas, 2012; McCarthy et al., 2014; Norman et al., 2016) was used for the present voxel-wise meta-analyses. The software can accommodate statistical parametric maps or peak coordinates and effect sizes (*t*-scores) data. For the latter, AES-SDM computes signed (positive/negative) effect sizes and variance maps of brain regional differences between clinical and control groups by convolving an anisotropic non-normalized Gaussian kernel with Hedges effect size of each peak. Voxels correlated with the peak values are assigned higher effect sizes. Maps are then combined across studies based on random-effect model, accounting for sample size, within-study variability and between-study heterogeneity. Correlated datasets (e.g., when the same group of participants completed several cognitive tasks) were included in the meta-analysis as a

single set (Norman et al., 2016), adjusted for shared variance of brain activation or structure across datasets. The Meta-analysis of Observational Studies in Epidemiology (MOOSE) guidelines were followed (Stroup et al., 2000).

Age, sex and IQ were compared across patient and control groups prior to meta-analyses in STATA14 (StataCorp, 2015), using sample-size weighted *F*-statistics. First, VBM meta-analyses were conducted in each disorder relative to TD controls and then between the two disorders. Second, equivalent fMRI meta-analyses were conducted to examine the neural impairments observed during cognitive control within and between disorders using all available data. To explore specific cognitive-control subconstructs (e.g., Bari & Robbins, 2013), we conducted fMRI sub-meta-analyses of prepotent motor response inhibition, including studies employing the go/no-go and stop-signal tasks only. No other cognitive control subconstructs were explored due to insufficient data. To find the most consistent disorder-differentiating neural abnormalities regardless of demographic characteristics, we conducted sensitivity meta-analyses in an age-, sex- and IQ-matched subgroup, instead of covarying group differences in these variables that could result in false positives (Dennis et al., 2009; Miller & Chapman, 2001). An iterative algorithm computed group differences in age, sex and IQ for all possible combinations of studies, selecting the largest subgroups with statistically nonsignificant group differences in the three variables (Carlisi et al., 2017). Findings surviving the sensitivity analyses in the matched subgroups are the only ones reported and discussed.

Furthermore, conjunction analyses were used to asses overlapping fMRI and GMV abnormalities within and across disorders (using threshold $p < .005$). To assess consistency of findings across age groups, supplementary age-stratified sub-meta-analyses were conducted in overall pediatric or adult age groups and in their respective age-, sex- and IQ-matched subgroups, where possible (Supplements 3 and 4). These were complemented with a series of sample-size weighted correlational analyses between the mean sample age

and extracted effect sizes of brain abnormalities averaged over 10-mm radius spheres centered at the peaks of disorder-differentiating or shared abnormalities, applying Bonferroni multiple comparison correction (Supplement 5). Non-parametric correlations were chosen due to the bimodal distribution of age among studies. Following previous meta-analyses (Hart et al., 2013; Norman et al., 2016), psychostimulant effects were explored in separate meta-regressions between brain structure/function and lifetime psychostimulant exposure, i.e., proportions of samples who have ever been exposed to psychostimulants, or current psychostimulant exposure, in brain regions that are found impaired in ADHD (Supplement 6). Supplementary meta-analyses covarying for task types (motor response inhibition, cognitive interference, motor switching, combination of tasks) and behavioral task performance (impaired, unimpaired) were also conducted to assess their impacts on disorder-differentiating findings (Supplement 7).

A statistical threshold $p < .005$ was used for all meta-analyses (Radua & Mataix-Cols, 2009; Radua, Mataix-Cols, et al., 2012), and a reduced threshold $p < .0005$ and a cluster extent 20 voxels was used in the meta-regressions to control for false positives (Radua, Borgwardt, et al., 2012). Egger's tests assessed potential publication bias in the disorder-differentiating and shared findings. Jack-knife sensitivity analyses examined replicability of findings through iterative whole-brain meta-analyses, leaving one dataset out at a time (Supplement 8; Radua & Mataix-Cols, 2009).

3. Results

3.1. Search Results and Sample Characteristics

The systematic literature search identified 140 VBM and fMRI articles of cognitive control in ASD and ADHD. Accounting for datasets of same clinical participants and, where possible, separating data from pediatric and adult participants resulted in 86 independent VBM datasets (38 datasets including 1533 ADHD participants and 1295 controls; 48 datasets

involving 1445 ASD participants and 1477 controls) and 60 independent cognitive-control fMRI datasets (42 datasets involving 1001 ADHD participants and 1004 controls; 18 datasets involving 335 ASD participants and 353 controls) (Tables 1-2). Groups did not differ in age in VBM, $F(3, 83) = 1.24$, $p = .30$, and fMRI datasets, $F(3, 56) = .68$, $p = .57$, but did in sex in VBM, $F(3, 83) = 6.03$, $p = .0009$, and fMRI datasets, $F(3, 56) = 5.93$, $p = .0014$; and in IQ in VBM, $F(3, 67) = 16.2$, $p < .0001$) and fMRI datasets $F(3, 45) = 15.5$, $p < .0001$. See Table 3 for demographic characteristics.

3.2. Disorder-Differentiating and Shared Brain Structure Abnormalities

3.2.1. ADHD VBM

Relative to TD controls, ADHD had reduced GMV in vmOFC/vmPFC/rostral ACC (rACC), extending into right caudate, and in right putamen/posterior insula/STG, left precingulate gyrus (pre-CG), right rostrolateral PFC and left vlPFC/STG/temporal pole (Table 4A-i; Figure 1A-i). Age-stratified analyses showed reduced GMV in right STG/putamen/posterior insula, right caudate and rACC/ventromedial PFC (vmPFC) among pediatric participants and vmOFC/subcallosal gyrus in both age groups (Supplements 3,4). Current and lifetime psychostimulant exposures were associated with increased vmOFC GMV (Supplement 6).

3.2.2. ASD VBM

Relative to TD controls, ASD had GMV reduction in dACC/dorsomedial PFC (dmPFC), left cerebellum, right hippocampus/PHG/FFG and dorsomedial thalamus; and enhancement in left anterior inferior/middle/superior temporal gyri (I/M/STG)/posterior insula, bilateral precuneus/posterior cingulate cortex (PCC) and right middle/superior frontal gyrus (M/SFG) (Table 4A-ii; Figure 1A-ii). Most abnormalities in the overall sample, i.e., in left cerebellum, dorsomedial thalamus, precuneus/PCC and right MFG/SFG/dlPFC GMV were also found

among pediatric participants, and enhanced left anterior STG/MTG GMV was found in both age subgroups (Supplements 3,4).

3.2.3. ADHD *vs.* ASD VBM

People with ADHD, relative to ASD, had consistently disorder-differentiating reduced vmOFC/rACC/left caudate GMV; while people with ASD, relative to ADHD, showed increased GMV in left anterior STG/MTG, right MFG/SFG/dlPFC, and right posterior MTG/STG (Table 4A-iii,iv; Figure 1A-iii,iv). Reduced vmOFC GMV was most consistently ADHD-differentiating in adults, while the medial prefrontal GMV reduction in rACC/dmPFC was more apparent among pediatric participants (Supplements 3,4).

3.3. Disorder-Differentiating and Shared Brain Abnormalities during Cognitive Control

3.3.1. ADHD fMRI

During cognitive control, ADHD relative to TD controls, showed underactivation in right thalamus/caudate, left MTG/STG/superior temporal pole, bilateral SMA/dmPFC, left IFG/AI/temporal pole, right AI/putamen, left postcingulate gyrus (post-CG), left MFG/dlPFC and right MTG (Table 4B-i, Figure 1B-i). Age-stratified analyses showed underactivated dmPFC clusters and left post-CG among pediatric participants, in all regions but the dmPFC and left post-CG in adults; and in left M/STG/temporal pole in both groups (Supplements 3,4). Lifetime psychostimulant exposure was positively associated with activation in left IFG (Supplement 6).

During motor response inhibition specifically, underactivation was found in ADHD relative to TD controls in left MFG/dlPFC, left anterior MTG/STG, left post-CG, right vlPFC/OFC/AI,right IFG, and right caudate (Table 4C-i, Figure 1C-i). Age-stratified analyses showed that underactivation in left MTG/STG was apparent among pediatric participants, underactivation

in left MFG/dlPFC was apparent in adults, while underactivation in right vlPFC/AI was apparent in both age groups (Supplements 3,4).

3.3.2. ASD fMRI

During cognitive control, ASD relative to TD controls showed underactivation in ACC/midcingulate/dmPFC, left MFG/dlPFC, right MFG/dlPFC, left IPL and left lingual gyrus/cerebellum; and overactivation in left precuneus/midcingulate, right inferior occipital gyrus (IOG), left vlPFC/OFC, left MFG/rostrolateral PFC and right IFG (Table 4B-ii, Figure 1B-ii). Underactivation in rdACC/dmPFC and left IPL; and overactivation in precuneus, left vlPFC/OFC and left MFG/dlPFC were found in adults (Supplements 3,4). No pediatric sub-meta-analyses were conducted due to insufficient fMRI data.

During motor response inhibition, underactivation was found in ASD relative to TD controls in right AI/vlPFC, left cerebellum, right MFG/dlPFC and right PCC/precuneus; while overactivation was found in left vlPFC/OFC and right IOG/fusiform gyrus (FFG)/ITG (Table 4C-ii; Figure 1C-ii). No age-stratified sub-meta-analyses were conducted due to insufficient data.

3.3.3. ADHD *vs.* ASD fMRI

During cognitive control, ASD-differentiating underactivation was found in rACC/midcingulate/dmPFC and left MFG/dlPFC; and overactivation was found in precuneus, right IOG/FFG, right IFG and left vlPFC/OFC (Table 4B-iii,iv; Figure 1B-iii,iv). The age-stratified analysis, which was conducted only in adults due to available data, found ASD-differentiating underactivation relative to ADHD in rdACC/dmPFC and overactivation in precuneus and left vlPFC/OFC (Supplement 4). No ADHD-differentiating abnormalities were found.

During motor response inhibition, ADHD-differentiating underactivation was found in right caudate and IFG. Furthermore, ASD-differentiating underactivation was found in left lingual gyrus/FFG/cerebellum, right precuneus and right MFG/dlPFC; while overactivation was found in right IOG/FFG, left vlPFC/OFC and left MFG/SFG/dlPFC (Table 4C-iii,iv; Figure 1C-iii,iv). Underactivation in right AI (MNI coordinates: 40, 20, -6; 51 voxels) was shared between disorders.

3.5. Multimodal VBM and fMRI Analyses

In ADHD relative to TD controls, overlapping reduced GMV and fMRI underactivation was found during cognitive control in right caudate nucleus (MNI coordinates: 10, 10, 8; 194 voxels). In ASD relative to TD controls, reduced GMV and fMRI underactivation was found in dACC/mPFC (MNI coordinates: 0, 40, 16; 575 voxels).

3.6. Controlling for Task Type and Performance in fMRI Meta-Analysis

The disorder-differentiating impairment during cognitive control was unchanged after covarying for task types and performance. During motor response inhibition, ADHD-differentiating underactivation in right IFG and caudate did not survive covarying for task performance (Supplement 7).

3.7. Publication Bias and Jack-Knife Reliability Findings

Egger tests suggest no significant publication bias for the structural, *t*s(84) = .32-2.29, *p*s ≥ .1, and functional abnormalities during cognitive control, *t*s(58) = .04-1.90, *p*s ≥ .38, and during motor response inhibition specifically, *t*s(40) = .41-1.37, *p*s ≥ .99 (Bonferroni adjusted *p*-values). Jack-knife reliability analyses suggest robust disorder-differentiating findings (Supplement 8).

4. Discussion

We aimed to elucidate the most consistent disorder-differentiating and shared brain abnormalities in ASD and ADHD. The findings revealed predominantly disorder-differentiating abnormalities, particularly striking in the VBM meta-analysis, where we found ADHD-differentiating *reduced* GMV in vmOFC; and ASD-differentiating *increased* GMV in bilateral temporal and right lateral prefrontal cortices. In fMRI, the findings overall showed predominantly ASD-differentiating abnormalities, including underactivation in medial frontal and overactivation in bilateral ventrolateral regions and precuneus during cognitive control. During motor response inhibition specifically, ADHD-differentiating underactivation was in right IFG and caudate, while ASD had differentiating underactivation mostly in posterior regions, and overactivation in left dorsal and ventral frontal regions (Figure 2). Both disorders shared underactivation in right AI. The findings overall suggest that people with ADHD and ASD have mostly distinct brain abnormalities.

The ADHD-differentiating decreased GMV in vmOFC relative to ASD may be related to common reports of reward-based decision-making neural network dysfunctions in ADHD (e.g., Chantiluke et al., 2014; Cubillo, Halari, Smith, Taylor, & Rubia, 2012; Rubia, 2018; Tegelbeckers et al., 2018), and supports the hypothesis of distinctive reward processing in ASD and ADHD (Kohls et al., 2014; van Dongen et al., 2015). Reduced vmOFC GMV in ADHD compared to TD controls extends relatively recent meta-analytic findings (McGrath & Stoodley, 2019; Norman et al., 2016), and there have been correlational reports between OFC GMV reduction and increased ADHD symptoms in large-scale general population studies (Albaugh et al., 2017; Fuentes et al., 2012; Korponay et al., 2017). Interestingly, our age-stratified results suggest that the ADHD-differentiating deficit features more consistently in adulthood, when co-occurring addiction behavioral problems increase (e.g., Breyer et al., 2009; Ortal et al., 2015), more so in ADHD than in ASD (e.g., Sizoo et al., 2010; Solberg et al., 2019).

The increased left anterior and right posterior temporal GMV in ASD is a consistent VBM meta-analytic finding in ASD relative to TD controls (Carlisi et al., 2017; Cauda et al., 2011; DeRamus & Kana, 2015; Duerden, Mak-Fan, Taylor, & Roberts, 2012). Enhanced left anterior GMV was the only mega-analytic impairment finding in over 400 people with ASD but it did not survive in a smaller age- and sex-matched subgroups (Riddle, Cascio, & Woodward, 2017). Our meta-analysis may have increased statistical power to detect the differences. The ASD-differentiating increased left temporal GMV extends findings from a small VBM ASD/ADHD comparative study (Lim et al., 2015). The left temporal lobe plays roles in semantic and language processing (Binder et al., 2011), while the right posterior temporoparietal cortices plays a role in social interaction and mentalizing, i.e., the ability to attribute mental states in others (Krall et al., 2015). These structures are important for social cognition, which has been thought to be an ASD-specific impairment (Kana et al., 2015; Lombardo, Chakrabarti, Bullmore, & Baron-Cohen, 2011; White, Frith, Rellecke, Al-Noor, & Gilbert, 2014).

The ASD-differentiating increased right dlPFC GMV has not converged in smaller meta-analyses (Carlisi et al., 2017; DeRamus & Kana, 2015), possibly reflecting heterogeneity in findings. Right dlPFC is important for cognitive control, working memory and cognitive flexibility (Szczepanski & Knight, 2014). Neuronal and grey matter overgrowth have been reported in pediatric ASD in small ROI-based neuroimaging and post-mortem studies (Carper & Courchesne, 2005; Courchesne, Mouton, et al., 2011; Mitchell et al., 2009), but they have not been replicated in wider age range of ASD cases with cognitive flexibility deficits (Griebling et al., 2010).

The disorder-differentiating GMV *increase* in ASD and *decrease* in ADHD may possibly be related to the disorders' contrasting developmental trajectories (Courchesne, Campbell, et al., 2011; Shaw et al., 2007). However, while most of our ADHD-differentiating findings showed reduction in structure and function that may possibly reflect delayed maturation in

ADHD, the ASD-differentiating enhanced clusters were not found consistently in the pediatric sub-meta-analysis. Recent findings suggest that early brain overgrowth is not a defining characteristic of toddlers with high-risk for developing ASD (Hazlett et al., 2017), and may be specific to boys with regressive autism (Nordahl et al., 2011), who are underrepresented across studies. Thus, our findings are unlikely to reflect early brain overgrowth.

In the fMRI meta-analyses, ASD-differentiating impairments were predominant medial and left middle prefrontal underactivation and in bilateral ventrolateral prefrontal overactivation during cognitive control, while ADHD-differentiating underactivation emerged during motor inhibition in right inferior frontal and striatal regions. The ADHD-differentiating underactivation in right IFG and caudate, key regions implicated in inhibitory control (Rae, Hughes, Weaver, Anderson, & Rowe, 2014; Zhang, Geng, & Lee, 2017), are consistent with previous meta-analytic findings in ADHD during cognitive control (Hart et al., 2013; McCarthy et al., 2014; Norman et al., 2016) and extends the role of these regions, in particular right IFG, as disorder-specific neurofunctional biomarker of ADHD, as it has previously been observed relative to bipolar, obsessive compulsive and conduct disorders (Norman et al., 2016; Passarotti et al., 2010; Rubia, 2018; Rubia, Cubillo, et al., 2010; Rubia, Halari, et al., 2010; Rubia et al., 2009).

The mPFC underactivation in ASD is a consistent meta-analytic finding during cognitive control and related functions (Carlisi et al., 2017; Di Martino et al., 2009; Philip et al., 2012). The region is also implicated in functions such as sensory, emotion and social processing domains typically impaired in ASD (Kana, Patriquin, Black, Channell, & Wicker, 2016; Martinez-Sanchis, 2014; South & Rodgers, 2017). Intriguingly, the mPFC underactivation was ASD-differentiating relative to ADHD. While both medial and lateral PFC are activated during motor inhibition (Rae et al., 2014; Zhang et al., 2017), the activation of mPFC are more reliably tapped by cognitive interference tasks thus it may have closer associations to change or conflict detection (Aron, Herz, Brown, Forstmann, & Zaghloul, 2016). Whether our

findings represent dissociated frontal brain functional impairment in ASD from ADHD in sub-constructs of cognitive control should thus be tested further meta-analytically when more fMRI findings are available.

While both disorders show functional abnormalities in prefrontal cortex in both hemispheres, the ASD-differentiating atypical activation was more predominantly on the left, in contrast to the right-lateralized ADHD-differentiating fronto-striatal underactivation, although atypical brain lateralization is not uncommon finding in ASD (Dichter, 2012; Floris & Howells, 2018; Kleinhans, Muller, Cohen, & Courchesne, 2008). Most importantly, comparisons between each disorder relative their respective TD controls show that neural impairment in ADHD is overwhelmingly characterized by fronto-striato-temporal underactivation, which is in line with previous findings of a developmental lag of cognitive control networks (Sripada et al., 2014), whereas the impairments in ASD implicate both under- and overactivation clusters in executive, attentional and, even, fronto-parieto-occipital visuo-perceptual brain regions. Of note, abnormally enhanced recruitment of posterior brain regions in ASD has been observed during working memory (Koshino et al., 2005; Vogan et al., 2014), psychomotor vigilance (Christakou et al., 2013; Murphy et al., 2014) and temporal discounting (Chantiluke et al., 2014; Norman et al., 2017). This thus suggests a complex pattern of neurofunctional abnormality in ASD, with compromised cortical specialization, possibly reflecting both neural impairments inherent to ASD and, possibly, ensuing neuronal compensation (see review Floris & Howells, 2018).

The ASD-differentiating overactivation in PCC/precuneus, which was also unimpaired in ADHD relative to their respective controls, was unexpected, however. The overactivation in precuneus/PCC in ASD, which has been shown in a variety of tasks and resting-state condition (Christakou et al., 2013; Kennedy, Redcay, & Courchesne, 2006; Murdaugh et al., 2012; Spencer et al., 2012), presumably indicates DMN dysregulation. The lack of overactivation in PCC/precuneus in ADHD during cognitive control were apparent in

previous meta-analyses (McCarthy et al., 2014; Norman et al., 2016), and could potentially be related to psychostimulant exposure which has shown to normalize DMN functioning (Liddle et al., 2011; Peterson et al., 2009; Rubia et al., 2014).

Finally, shared functional abnormality between disorders was found during motor response inhibition only in right AI, which is part of the salience network (Menon & Uddin, 2010). The limited shared abnormality may seem at odds with typical observation of psychiatric comorbidities in clinical settings, but individuals with ASD and ADHD are typically selectively recruited into imaging studies, excluding specific psychiatric comorbidities, which could have emphasized the differences between disorders, at the cost of their representativeness.

On the other hand, the findings of disorder differences are more likely to be underestimated. First, typically stringent statistical corrections applied by individual studies could have concealed true group differences in coordinate-based meta-analyses. The ADHD-differentiating findings, particularly, are likely underestimated by co-occurring ADHD in the ASD groups due to past preclusion of ADHD diagnosis in ASD (APA, 2000). Studies attempting to include more representative samples of the disorders may have included comorbid ASD and ADHD cases, perhaps at higher rates in ASD than in ADHD, as shown in prevalence studies in community representative samples (Gjevik, Eldevik, Fjæran-Granum, & Sponheim, 2011; Hollingdale, Woodhouse, Young, Fridman, & Mandy, 2019; Salazar et al., 2015; Simonoff et al., 2008). Long-term medication exposure is also likely to have masked the ADHD-differentiating findings.

Other limitations of the meta-analyses include the fewer number of participants with ASD relative to ADHD, which could have reduced power for detecting small ASD-differentiating impairments and increased the probability of false positive findings, particularly in the fMRI meta- and sub-meta-analyses. The representativeness of the meta-analytic findings may also be limited by the fact that many studies, particularly in ADHD, investigated males

specifically. In ASD, the majority of studies have focused on adults and predominantly high-functioning individuals only (with few exceptions, i.e., Cai et al., 2018; Contarino et al., 2016; Retico et al., 2016; Riva et al., 2013; Wang et al., 2017; Q. Yang et al., 2018), even though individuals with learning disability made up a significant proportion of the ASD population (e.g., Charman et al., 2011). Furthermore, brain-behavior correlations could not be examined due to variations of disorder trait measures across studies. Finally, the influence of task discrepancies across studies could not be fully assessed due to limited data for the non-motor cognitive control tasks.

5. Conclusions

These comparative meta-analyses of brain structure and function show predominantly disorder-differentiating abnormalities in the form of *decreased* GMV in vmOFC reward processing regions in ADHD and *increased* GMV in ASD in frontal and temporal cortices, part of the central executive and social cognition networks. Disorder-differentiating fMRI deficits were predominantly observed in ASD in medial frontal executive, ventrolateral prefrontal and DMN regions when including all cognitive control tasks; and in ADHD in inferior fronto-striatal regions during motor response inhibition only. Shared functional abnormality was limited to right AI during motor response inhibition. Therefore, people with ADHD and ASD appear to have mostly distinct brain structure and cognitive-control functional abnormalities. The findings contribute to the elucidation of the differential brain abnormalities in the two disorders, which is important for the understanding of their underlying pathophysiology and could ultimately aid in the development of future, disorder-differentiated behavioral, pharmacological or neurotherapeutic treatments.

STATEMENTS

Acknowledgement: We thank all authors of the included studies who provided additional data for this meta-analysis. We also thank Toby Wise for insightful discussions on the statistical methods used in this meta-analysis.

Financial support: SL and LN were supported by Medical Research Council and Institute of Psychiatry, Psychology, and Neuroscience (IoPPN) PhD Excellence awards. CC is supported by a Wellcome Trust Sir Henry Wellcome Postdoctoral Fellowship (206459/Z/17/Z). JR receives support from the Instituto de Salud Carlos III and co-funded by European Union (ERDF/ESF, 'Investing in your future', Miguel Servet Research Contract CPII19/00009 and Research Project Grant PI19/00394). HH was supported by a grant from the Lila Weston Foundation for Medical Research and the Kids Company to KR. ES and KR receive research support from the National Institute of Health Research (NIHR) Biomedical Research Centre at South London and Maudsley Foundation Trust (IS-BRC-1215-20018). ES furthermore is supported by the NIHR through a program grant (RP-PG-1211-20016) and Senior Investigator Award (NF-SI-0514-10073), the European Union Innovative Medicines Initiative (EU-IMI 115300), Autistica (7237) Medical Research Council (MR/R000832/1, MR/P019293/1), the Economic and Social Research Council (ESRC 003041/1) and Guy's and St Thomas' Charitable Foundation (GSTT EF1150502) and the Maudsley Charity. KR and SL are currently supported by an MRC Grant MR/P012647/1 to KR. This study is supported by funding from the UK Department of Health via the National Institute for Health Research (NIHR) Biomedical Research Centre (BRC) for Mental Health at South London and the Maudsley National Health Service (NHS) Foundation Trust and the IoPPN, King's College London, which also support both senior authors, ES and KR. The views expressed are those of the authors and not necessarily those of the NHS, the NIHR or the Department of Health.

Conflicts of interest: KR has received grants from Lilly and Shire pharmaceuticals and speaker's bureau from Shire, Lilly and Medice. Other authors report no biomedical financial interests or potential conflicts of interest.

Ethical standards: The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

FIGURE LEGENDS

Fig. 1. Brain abnormalities in the ADHD and ASD groups. Abnormalities in the (A) gray matter volume and brain activations during (B) cognitive control and (C) motor response inhibition. Rows (i) and (ii) show abnormalities in ADHD and ASD relative to typically developing (TD) controls. Abnormalities in ADHD versus ASD, each relative to TD controls are shown in (iii) overall samples and (iv) age-, sex-, and IQ-matched subgroups. In the overall sample, shared reduced rACC/mPFC GMV (MNI coordinates: 0,46,12; 119 voxels), and subthreshold overactivation in ADHD and underactivation in ASD in dmPFC (MNI coordinates: -2, 34, 36; 82 voxels) were observed but did not survive sensitivity analysis. A statistical threshold of $p < .005$ with a cluster extent of 20 voxels were used in all analyses.

Fig. 2. Summary of consistent disorder-differentiating and shared brain abnormalities in ADHD and ASD. Findings of (A) gray matter volume abnormalities and brain activation abnormalities during (B) cognitive control and (C) motor response inhibition. A statistical threshold of $p < .005$ with a cluster extent of 20 voxels were used in all analyses.

TABLES

Table 1. Sample Characteristics and Summary Findings of VBM and fMRI Cognitive Control Studies in ADHD

Source	Age group	Task	Patients			Controls			
			N (% male)	Age, y	IQ	N (% male)	Age, y	IQ	
(A) VBM studies in ADHD									
Ahrendts et al. (2011)	Adult	--	31 (65)	31.2	n/a	31 (65)	31.5	n/a	ADHD<TD: L/R oc
Montes et al. (2010)	Adult	--	20 (50)	29.0	102.9	20 (50)	27.6	100.2	ADHD<TD: R cauc
Amico, Stauber, Koutsouleris, and Frodl (2011)	Adult	--	20 (75)	33.6	n/a	20 (75)	34.7	n/a	--
Bonath, Tegelbeckers, Wilke, Flechtner, and Krauel (2016)	Pediat.	--	18 (100)	13.6	106.8	18 (100)	14.1	108.1	ADHD<TD: L/R ce amygdala complex
Bralten et al. (2016)	Mixed	--	307 (68)	17.1	97.1	196 (49)	16.7	106.6	ADHD<TD: L pre-(paracingulate/cing paracingulate/cing
Brieber et al. (2007)	Pediat.	--	15 (100)	13.1	104.1	15 (100)	13.3	107.7	ADHD<TD: L/R ca L STG, L MOG; AD precuneus, L IPL
Carmona et al. (2005)	Pediat.	--	25 (84)	10.8	n/a	25 (84)	11.2	n/a	ADHD<TD: L pre-/ inferior and superio
Depue, Burgess, Bidwell, Willcutt, and Banich (2010)	Adult	--	31 (61)	20.0	114.2	21 (65)	19.3	112.6	--
Gehricke et al. (2017)	Adult	--	32 (81)	25.3	n/a	40 (83)	23.9	n/a	ADHD<TD: R M/IF
He et al. (2015)	Pediat.	--	37 (100)	9.9	n/a	35 (100)	10.7	n/a	ADHD<TD: R OFC
Iannaccone, Hauser, Ball, et al. (2015)	Pediat.	--	18 (50)	14.5	114.5	18 (61)	14.8	108.5	ADHD<TD: R med cerebellum; ADHD
Jagger-Rickels, Kibby, and Constance (2018)	Pediat.	--	41 (44)	9.6	n/a	32 (56)	9.7	n/a	ADHD<TD: L MTG insula, L/R thalamu medial SFG, L pre calcarine/cuneus,
Johnston et al. (2014)	Pediat.	--	34 (100)	12.5	99.8	34 (100)	13.2	103.7	ADHD<TD: Brains
Kappel et al. (2015)	Pediat.	--	14 (71)	9.8	104.6	10 (80)	11.0	111.9	ADHD<TD: R STG ADHD>TD: L para rectal gyrus

	Adult	--	16 (94)	23.5	97.8	20 (100)	23.7	108.4	ADHD<TD: R supr hippocampus, L re
Kaya et al. (2018)	Pediat.	--	19 (74)	10.3	113.5	18 (67)	10.2	119.7	ADHD>TD: L/R SF MOG, L cuneus
Kobel et al. (2010)	Pediat.	--	14 (100)	10.4	n/a	12 (100)	10.9	n/a	ADHD<TD: R S/M
Kumar, Arya, and Agarwal (2017)	Pediat.	--	18 (100)	9.6	92.1	18 (100)	9.7	109.7	ADHD<TD: L OFC
Li et al. (2015)	Pediat.	--	30 (100)	10.3	121.7	30 (100)	10.3	107.1	ADHD<TD: R insu
Lim et al. (2015)	Pediat.	--	44 (100)	13.6	92.2	33 (100)	14.3	110	ADHD<TD: L/R ce
Maier et al. (2015)	Adult	--	131 (48)	34.5	113.1	95 (47)	37.7	121	--
McAlonan et al. (2007)	Pediat.	--	28 (100)	9.9	109.9	31 (100)	9.6	116.5	ADHD<TD: R MFC thalamus, precune
Moreno-Alcázar et al. (2016)	Adult	--	44 (66)	31.6	105.0	44 (66)	32.6	106.0	ADHD<TD: R SMA
Onnink et al. (2014)	Adult	--	119 (39)	36.3	107.5	107 (42)	36.9	110.2	--
Overmeyer et al. (2001)	Pediat.	--	18 (83)	10.4	99	16 (94)	10.3	n/a	ADHD<TD: R PCC
Ramesh and Rai (2013)	Pediat.	--	15 (26)	16.8	n/a	15 (26)	16.7	n/a	ADHD<TD: L cingu medial SFG, L tem supramarginal gyru
Roman-Urrestarazu et al. (2016)	Adult	--	49 (76)	22.2	96.6	34 (50)	22.9	112.2	ADHD<TD: L/R ca
Saad et al. (2017)	Pediat.	--	16 (75)	12.8	n/a	28 (68)	13.1	n/a	--
	Pediat.	--	18 (72)	13.7	n/a	28 (68)	13.1	n/a	--
Sasayama et al. (2010)	Pediat.	--	18 (72)	10.6	90	17 (71)	10.0	n/a	ADHD<TD: L/R an STS, L parietal cor PHG
Seidman et al. (2011)	Adult	--	74 (51)	37.3	116	54 (46)	34.3	115.8	--
Sethi et al. (2017)	Adult	--	30 (63)	33.7	109.0	30 (63)	32.6	110.1	ADHD<TD: R IPC
Shimada et al. (2015)	Pediat.	--	17 (88)	10.3	95.3	15 (73)	12.8	104.1	ADHD<TD: L puta
Stevens and Haney-Caron (2012)	Pediat.	--	24 (67)	15.7	n/a	24 (70)	16.0	n/a	--
van Wingen et al. (2013)	Adult	--	14 (100)	32.0	104	15 (100)	37.0	99	ADHD<TD: R puta pre-CG
Vilgis, Sun, Chen, Silk, and Vance (2016)	Pediat.	--	48 (100)	12.6	92.2	31 (100)	12.8	109.6	ADHD<TD: R SPL
Villemonteix et al. (2015)	Pediat.	--	33 (55)	10.3	105.6	24 (50)	10.0	109.7	ADHD<TD: R insu
	Pediat.	--	20 (80)	10.4	107.4	24 (50)	10.0	109.7	ADHD<TD: R MFC
Wang, Jiang, Cao, and Wang (2007)	Pediat.	--	12 (100)	13.4	n/a	12 (100)	13.5	n/a	ADHD<TD: L SPL, lobe

P. Yang et al. (2008)	Pediat.	--	57 (61)	11.1	97.9	57 (60)	11.7	n/a	ADHD<TD: L/R ca cuneus
(B) fMRI cognitive control studies in ADHD									
Banich et al. (2009)	Adult	Stroop	23 (61)	20.0	116	23 (57)	19.0	113	ADHD>TD: R MFC
Bhaijiwala, Chevrier, and Schachar (2014)	Pediat.	Stop	12 (58)	13.8	n/a	12 (50)	15.4	n/a	ADHD<TD: R MFC
Booth et al. (2005)	Pediat.	GNG	12 (67)	11.0	n/a	12 (58)	11.7	n/a	ADHD<TD: L/R pr thalamus.
Carmona et al. (2012)	Adult	GNG	19 (100)	33.6	110.9	19 (100)	29.4	111.7	ADHD<TD: R STG
Chantiluke, Barrett, Giampietro, Santosh, et al. (2015)	Pediat.	Stop	18 (100)	14.3	95	25 (100)	13.4	109	ADHD<TD:L OFC/
Chen et al. (2015)	Adult	GNG	29 (100)	24.9	n/a	25 (100)	25.6	n/a	--
Chou, Chia, Shang, and Gau (2015)	Pediat.	Stroop	42 (81)	10.5	108.5	20 (80)	12.0	106.5	ADHD<TD: R MFC SPL, R medial FG ADHD>TD: L/R SF pre-treatment), pos
Congdon et al. (2010)	Adult	Stop	35 (54)	30.9	n/a	62 (45)	30.8	n/a	--
Cubillo et al. (2010) [a]	Adult	Stop, Switch	11 (100)	29.0	92	14 (100)	28.0	106	ADHD<TD: L IFC/A putamen/PMC, L/F L IFG/insula/ putar
Cubillo et al. (2014)	Pediat.	Stop	19 (100)	13.1	92	29 (100)	13.8	110	ADHD<TD: L/R IF ADHD>TD: L cere CG/posterior insula
Cubillo, Halari, Giampietro, Taylor, and Rubia (2011) [a]	Adult	Simon	11 (100)	29.0	92	15 (100)	28.0	112	ADHD<TD: L OFC
Dibbets, Evers, Hurks, Marchetta, and Jolles (2009) [b]	Adult	GNG	16 (100)	28.9	n/a	13 (100)	28.1	n/a	--
Dibbets, Evers, Hurks, Bakker, and Jolles (2010) [b]	Adult	Switch	15 (100)	28.8	n/a	14 (100)	28.6	n/a	ADHD<TD: R puta L OFC/ claustrum/ precuneus, R lingu
Durston, Mulder, Casey, Ziermans, and van Engeland (2006)	Pediat.	GNG	11 (100)	14.0	100	11 (100)	15.3	106	--
L. Y. Fan, Chou, and Gau (2017) [c]	Adult.	Stroop	12 (42)	28.9	115.8	12 (42)	30.3	118.3	ADHD>TD: R IFG,
	Adult	Stroop	12 (42)	32.5	119.9	12 (42)	30.3	118.3	ADHD>TD: R IFG
L. Y. Fan, Shang, Tseng, Gau, and Chou (2018)	Pediat.	Stroop	27 (89)	12.1	105.2	27 (78)	11.8	110.4	ADHD < TD: R MF
Hwang et al. (2015)	Pediat.	Stroop	26 (65)	13.9	106.4	35 (51)	14.5	105.1	ADHD < TD: Media

Iannaccone, Hauser, Staempfli, et al. (2015)	Pediat.	GNG/ Flanker	18 (50)	14.5	108.5	18 (61)	14.8	114.4	ADHD<TD: R MFC insula/putamen/pre hippocampus, L FF pons/cerebellum
Janssen, Heslenfeld, Mourik, Logan, and Oosterlaan (2015)	Pediat.	Stop	21 (90)	10.6	98.6	17 (76)	10.3	108.7	ADHD<TD: L/R mI ADHD>TD: L/R AC L post-CG, L pre-C
Konrad, Neufang, Hanisch, Fink, and Herpertz-Dahlmann (2006)	Pediat.	Flanker	16 (100)	10.2	103	16 (100)	10.3	105	ADHD<TD: L pre-C
Kooistra et al. (2010)	Adult	GNG	11 (100)	21.5	110	11 (100)	10.1	125	ADHD>TD: L/R AC supramarginal gyru IFG, L SFG, parac nucleus, L posteric post-CG, R mPFC
J. Ma et al. (2012)	Pediat.	GNG	15 (53)	9.8	100.2	15 (53)	22.3	102.6	ADHD>TD: R ITF, MOG, L/R cerebell
I. Ma et al. (2016)	Pediat.	Stroop	25 (76)	15.4	98.3	33 (67)	15.3	108.9	--
Massat et al. (2018)	Pediat.	Stop	18 (44)	10.0	106.8	19 (47)	10.6	114.4	ADHD>TD: L caud insula, L caudate t
Passarotti et al. (2010)	Pediat.	Stop	11 (55)	13.1	107.6	15 (48)	9.9	101.2	ADHD<TD: R MFC caudate tail, L cau
Peterson et al. (2009)	Pediat.	Stroop	16 (81)	14.1	101.2	20 (60)	14.1	118.5	ADHD<TD: L ACC ADHD>TD: R SFG
Rasmussen et al. (2016)	Adult	GNG	50 (82)	24.8	102.1	23 (70)	24.1	109.2	ADHD<TD: R supr L/R MFG. R fronta caudate/ accumbe gyrus, R insula, R
Rubia, Smith, Brammer, Toone, and Taylor (2005)	Pediat.	Stop	16 (100)	13.2	100	21 (100)	13.4	95	ADHD<TD: R IFC,
Rubia, Halari, Cubillo, et al. (2011) [d]	Pediat.	Simon	12 (100)	13.0	90	13 (100)	14.0	102	ADHD<TD: R IFC/ SMA/ACC/PCC/SF
Rubia, Halari, Mohammad, Taylor, and Brammer (2011) [d]	Pediat.	Stop	12 (100)	13.0	90	13 (100)	13.0	102	ADHD<TD: B IFC, IPL, precuneus, PC
Schulz et al. (2004)	Pediat.	GNG	10 (100)	17.9	88.4	9 (100)	17.5	91.9	ADHD<TD: R pre- cerebellum; ADHD IPL, R precuneus
Schulz et al. (2014)	Adult	GNG	14 (100)	23.3	n/a	14 (100)	22.8	n/a	--

Schulz et al. (2017)	Adult	Stroop	27 (89)	24.2	n/a	28 (86)	24.6	n/a	ADHD<TD: L/R ce R OFG, R SOG, R
Sebastian et al. (2012) [e]	Adult	GNG Stroop Stop	20 (55)	33.3	115.3	24 (46)	17.5	115.7	ADHD<TD: R cauc central lobule/mid-
Shang, Sheng, Yang, Chou, and Gau (2018) [f]	Adult	Stroop	25 (48)	29.1	112.8	30 (50)	28.2	115.4	ADHD<TD: L IFG,
	Adult	Stroop	25 (56)	28.5	113.1	30 (50)	28.2	115.4	ADHD<TD: L IFG,
Siniatchkin et al. (2012)	Pediat.	GNG	12 (83)	9.3	n/a	12 (75)	30.3	n/a	ADHD<TD: ACC,
Smith, Taylor, Brammer, Toone, and Rubia (2006) [g]	Pediat.	GNG	17(100)	12.8	n/a	18 (100)	9.3	n/a	ADHD<TD: L MFG
		Stroop	19 (100)	12.9	n/a	24 (100)	12.8	n/a	--
		Switch	14 (100)	13.3	n/a	27 (100)	12.9	n/a	ADHD<TD: L STG
Spinelli et al. (2011)	Pediat.	GNG	13 (69)	10.6	109.2	17 (47)	13.3	108.8	ADHD>TD: R pre-
Szekely et al. (2018)	Adult	Stop	64 (56)	24.0	n/a	84 (57)	24.5	n/a	--
Tamm, Menon, Ringel, and Reiss (2004)	Pediat.	GNG	10 (100)	16.0	109.2	12 (100)	10.6	111.6	ADHD<TD: R ACC
Thornton, Bray, Langevin, and Dewey (2018)	Pediat.	GNG	20 (90)	12.4	109.4	20 (40)	10.6	112.6	--
van Hulst, de Zeeuw, Rijks, Neggers, and Durston (2017)	Pediat.	GNG	24 (100)	11.2	105.6	26 (100)	10.5	117.3	--
van Rooij et al. (2015)	Pediat.	Stop	108 (64)	15.1	92.7	77 (49)	16.0	109.2	ADHD<TD: L STG
	Adult	Stop	77 (78)	20.3	99.1	45 (33)	14.6	106.4	ADHD<TD: L SFG
Zamorano et al. (2017)	Pediat.	Stroop	17 (100)	11.6	104.2	17 (100)	11.7	109.8	ADHD>TD: R med

Abbreviations. N=sample size, y=year, pediat=pediatric (child/adolescent) sample, ADHD=attentional-deficit/hyperactivity disorder, GNG=Go/No-Go. Brain regions (in alphabetical order): ACC=anterior cingulate cortex, AI=anterior insula, BG=basal ganglia, CC=cing dACC=dorsal ACC, FFG=fusiform gyrus, GP=globus pallidus, I/M/SFG=inferior/middle/superior frontal gyrus, I/SPL=inferior/ superio mPFC=medial prefrontal cortex, M/STG=middle/superior temporal gyrus, OFC=orbitofrontal cortex, OFG=orbitofrontal gyrus, PCC=poster PMC=premotor cortex, pre-/post-CG=pre-/post-central gyrus, SMA=supplementary motor cortex, STL=superior temporal lobe, STS=superio cortex, a-g datasets were combined, adjusting their variance according to the method outlined in Norman et al. (2016). See Supplement Ta

Table 2. Sample Characteristics and Summary Findings of VBM and fMRI Cognitive Control Studies in A

Source	Age group	Task	Patients			Controls			
			N (% male)	Age, y	IQ	N (% male)	Age, y	IQ	
(A) VBM studies in ASD									
Abell et al. (1999)	Adult	--	15 (80)	28.8	n/a	15 (80)	25.3	n/a	ASD<TD: R paraci ASD>TD: L amygd
Boddaert et al. (2004)	Pediat.	--	21 (76)	9.3	n/a	12 (58)	10.8	n/a	ASD<TD: L/R STS
Bonilha et al. (2008)	Pediat.	--	12 (100)	12.4	n/a	16 (100)	13.2	n/a	ASD>TD: L/R IFG, precuneus, L/R ST SFG, L/R SPL, L in occipital gyrus, L li L/R PHG, L/R mPF
Brieber et al. (2007)	Pediat.	--	15 (100)	14.2	106.8	15 (100)	13.3	107.7	ASD<TD: L/R ITG/ hippocampus; ASD
Cai et al. (2018)	Pediat.	--	38 (84)	9.6	75.8	27 (96)	8.3	98.6	ASD<TD: R cerebe gyrus; ASD>TD: L
Cheng, Chou, Fan, and Lin (2011)	Pediat.	--	25 (100)	13.7	101.6	25 (100)	13.5	109.0	ASD<TD: R IFG, F gyrus, STG; ASD> MFG, FFG, subcal
Contarino, Bulgheroni, Annunziata, Erbetta, and Riva (2016)	Pediat.	--	25 (88)	6.1	56	25 (65)	6.1	103	--
M. Craig et al. (2007)	Adult	--	14 (0)	37.9	103.4	19 (0)	35.0	111.2	ASD<TD: Cuneus,
D'Mello, Crocetti, Mostofsky, and Stoodley (2015)	Pediat.	--	35 (86)	10.4	n/a	35 (60)	10.4	n/a	ASD<TD: R lingua L PCC/precuneus,
Ecker et al. (2012)	Adult	--	89 (100)	27.0	110	89 (100)	28.0	113.0	ASD<TD: R occipi lingual gyrus, L/R i PCC; ASD>TD: L A putamen/caudate,
Foster et al. (2015)	Pediat.	--	38 (100)	12.4	102.5	46 (100)	12.6	113.1	ASD<TD: R STG, R central sulcus, L SMA, R SFG, L AC gyrus, R lingual gy supramarginal/ang caudate
Freitag et al. (2008)	Mixed	--	15 (87)	17.5	101.2	15 (87)	18.6	112.1	ASD<TD: R intrap
Greimel et al. (2013)	Mixed	--	47 (100)	18.3	107.5	51 (100)	21.4	112.5	ASD<TD: ACC, L/

Groen, Buitelaar, van der Gaag, and Zwiers (2011)	Pediat.	--	17 (82)	14.4	98.0	25 (88)	15.5	105.0	--
Hyde, Samson, Evans, and Mottron (2010)	Mixed	--	15 (100)	22.7	100.4	15 (100)	19.2	106.6	ASD<TD: R post-C reticular, medial FC
Itahashi et al. (2015)	Adult	--	46 (100)	30.2	106.0	46 (100)	30.5	109.2	--
Katz et al. (2016)	Adult	--	23 (100)	26.6	n/a	32 (100)	29.8	n/a	ASD>TD: L/R OFC
Kaufmann et al. (2013)	Pediat.	--	10 (80)	14.7	102.3	10 (80)	13.8	109.5	ASD<TD: Lateral p precuneus
Ke et al. (2008)	Pediat.	--	17 (82)	8.9	108.8	15 (80)	9.7	109.8	ASD<TD: R PHG; MFG, R cerebellur
Kosaka et al. (2010)	Adult	--	32 (100)	23.8	101.6	40 (100)	22.5	109.7	ASD<TD: R insula
Kurth et al. (2011)	Pediat.	--	52 (73)	11.2	102.2	52 (73)	11.1	106.0	ASD<TD: Hypotha
Kwon, Ow, Pedatella, Lotspeich, and Reiss (2004)	Pediat.	--	20 (100)	13.5	n/a	13 (100)	13.6	n/a	ASD<TD: R ITG, F
Langen et al. (2009)	Pediat.	--	99 (92)	12.9	107.6	89 (92)	12.4	110.0	--
Lim et al. (2015)	Pediat.	--	19 (100)	14.9	113.0	33 (100)	14.9	110.0	ASD>TD: L MTG/S
Lin, Ni, Lai, Tseng, and Gau (2015)	Pediat.	--	28 (100)	10.7	106.9	43 (100)	10.6	115.2	ASD<TD: R post-C gyrus, L/R subloba
	Pediat.	--	40 (100)	14.7	101.5	18 (100)	15.5	108.7	--
	Adult	--	18 (100)	22.2	99.6	29 (100)	23.4	116.8	ASD>TD: L/R SFG
Lin, Tseng, Lai, Chang, and Gau (2017)	Pediat.	--	20 (100)	13.5	103.8	54 (100)	12.8	112.5	ASD>TD: L cerebe
McAlonan et al. (2002)	Adult	--	17 (90)	32.0	96.0	24 (92)	33.0	114.0	ASD<TD: R cerebe SFG, precuneus
McAlonan et al. (2008)	Pediat.	--	33 (82)	11.6	113.2	55 (86)	10.7	117.1	ASD<TD: L dlPFC posterior parietal c
Mengotti et al. (2011)	Pediat.	--	20 (90)	7.0	n/a	22 (91)	7.7	n/a	ASD<TD: L SMA, precuneus
Mueller et al. (2013)	Adult	--	12 (75)	35.5	111.3	12 (67)	33.3	110.8	ASD<TD: L/R TPJ pole, L/R mPFC, p
Ni et al. (2018)	Pediat.	--	81 (100)	12.6	107.4	61 (100)	12.4	112.0	ASD<TD: L lateral
Pereira et al. (2018)	Mixed		19 (82)	17.4	99.8	25 (66)	18.5	105.8	ASD<TD: L/R cere lobe, L FFG, L/R C medial FG, L PHG brainstem, R cereb
Poulin-Lord et al. (2014)	Mixed	--	23 (87)	19.8	100.3	22 (86)	22.6	107.3	--
Poustka et al. (2012)	Pediat.	--	18 (89)	9.7	111.0	18 (89)	9.7	112.8	--

Radeloff et al. (2014)	Mixed	--	34 (91)	19.1	105.7	26 (85)	19.5	107.8	--
Retico et al. (2016)	Pediat.	--	76 (50)	4.6	71	76 (50)	4.6	73	ASD<TD: L poster ASD>TD: L precur mPFC, L SPL, mid
Riedel et al. (2014)	Adult	--	30 (63)	35.4	124.5	30 (63)	35.5	123.6	--
Riva et al. (2013)	Pediat.	--	26 (89)	5.8	51.6	21 (62)	6.8	n/a	ASD<TD: L/R cere IFG, L MOG/SOG,
Rojas et al. (2006)	Mixed	--	24 (100)	20.8	94.8	23 (100)	21.4	118.7	--
Sato et al. (2017)	Adult	--	36 (69)	27.0	110.4	36 (69)	24.9	n/a	ASD<TD: R IOG/I L/MFG, R SMA, L/
Schmitz et al. (2006)	Adult	--	10 (100)	38.0	105.0	12 (100)	39.0	106	ASD>TD: L IFG, A
Toal et al. (2010)	Adult	--	65 (88)	31.0	98.0	33 (91)	32.0	105	ASD<TD: R cerebe PHG/STG/TG/FFG
Waiter et al. (2004)	Pediat.	--	16 (100)	15.4	100.4	16 (100)	15.5	99.7	ASD<TD: R thalam R PCC, L/R STG,
Wang et al. (2017)	Pediat.	--	31 (100)	4.8	62.5	31 (100)	4.8	97.1	ASD>TD: L STG, I
Wilson, Tregellas, Hagerman, Rogers, and Rojas (2009)	Adult	--	10 (80)	30.1	91.5	10 (70)	29.4	127.2	--
Q. Yang et al. (2018)	Pediat.	--	16 (63)	10.4	45.3	16 (63)	10.5	97.5	ASD<TD: L cerebe
(B) fMRI studies in ASD									
Ambrosino et al. (2014)	Pediat.	GNG	19 (100)	11.5	112	19 (100)	11.1	120	--
Chantiluke, Barrett, Giampietro, Santosh, et al. (2015)	Pediat.	Stop	19 (100)	14.7	112	25 (100)	13.4	109	ASD<TD: L IPL; A
Daly et al. (2014)	Adult	GNG	14 (100)	31	115	14 (100)	31	123	ASD<TD: R IFG, L
Denisova et al. (2017)	Mixed	Simon	20 (95)	22.7	n/a	20 (95)	23.2	n/a	ASD>TD: R lingua
Duerden et al. (2013)	Adult	GNG	16 (69)	27.2	112	17 (71)	30.7	114	ASD<TD: R MFG;
J. Fan et al. (2012)	Adult	Flanker	12 (75)	30	115	12 (83)	28	120	ASD<TD: ACC
Gooskens et al. (2018)	Pediat.	Stop	26 (35)	11.3	108.9	53 (45)	10.8	111.9	--
Kana, Keller, Minshew, and Just (2007)	Adult	GNG	12 (92)	26.8	110	12 (92)	22.5	117	ASD<TD: L ITG, R post-CG, R insula/
Kennedy et al. (2006)	Adult	Stroop	15 (100)	25.5	96	14 (100)	26.1	n/a	ASD>TD: mPFC, p
Prat, Stocco, Neuhaus, and Kleinhans (2016)	Adult	GNG	16 (63)	25.3	107.4	17 (65)	25.6	111.0	--
Schmitz et al. (2006)	Adult	GNG, Switch, Stroop	10 (100)	38	105	12 (100)	39	106	ASD>TD: L M/IFG parietal lobe (Switc

Shafritz, Dichter, Baranek, and Belger (2008)	Adult	Switch	18 (89)	22.3	103	15 (87)	24.3	111	ASD<TD: L dlPFC
Shafritz, Bregman, Ikuta, and Szeszko (2015)	Mixed	GNG	15 (80)	18.1	102	15 (80)	18.4	115	ASD<TD: R IFG/in
Solomon et al. (2014)	Pediat.	Switch	27 (19)	15.4	108	27 (19)	16.1	113	ASD<TD: L PCC,
Vaidya et al. (2011)	Pediat.	Stroop	11 (100)	10.8	114	14 (100)	11.0	119	ASD<TD: ACC, L
van Hulst et al. (2017)	Pediat.	GNG	26 (100)	10.8	109.6	26 (100)	10.5	117.3	--
Velasquez et al. (2017)	Adult	GNG	19 (68)	25.8	111	22 (73)	29.0	112	ASD<TD: R ACC,
Yerys et al. (2015)	Pediat.	Switch	20 (80)	11.3	115	19 (68)	11.4	120	ASD>TD: L MFG/

Abbreviations. N=sample size, y=year, pediat.=pediatric (child/adolescent) sample, ASD=autism spectrum disorder, TD=typically developin
Brain region (in alphabetical order): ACC=anterior cingulate cortex, BG=basal ganglia, dACC=dorsal ACC, dlPFC=dorsolateral prefrontal c
I/M/medial/SFG=inferior/middle/medial/superior frontal gyrus, I/M/STG=inferior/middle/superior temporal gyrus, I/SPL=inferior/superior pari
OFC=orbital frontal cortex, OFG=orbital frontal gyrus, PCC=posterior cingulate cortex, pre-/post-CG=pre-/post-central gyrus, PHG=parahip
SMA=supplementary motor area, STS=superior temporal sulcus. See Supplement Table S2b for further information.

Table 3. Characteristics of Overall Sample and Subgroups Matched on Age, Sex and IQ

	ADHD	ASD	TD_{ADHD}	TD_{ASD}
(A) Overall Sample				
VBM				
N	1533	1445	1295	1477
% males	69	88	67	87
Mean age (range), y	20.9 (6-65)	17.2 (2-59)	21.1 (6-65)	16.4 (2-58)
Mean FSIQ (SD)	103 (7.2)	99 (17.3)	110 (10.8)	108 (5.1)
fMRI during Cognitive Control				
N	1001	335	1004	353
% males	77	83	69	80
Mean age (range), y	18.3 (7-50)	20.7 (7-52)	18.6 (7-50)	19.2 (7-52)
Mean FSIQ (SD)	102 (7.1)	109 (5.2)	109 (13.2)	114 (4.4)
fMRI during Motor Response Inhibition				
N	745	212	743	232
% males	77	82	69	78
Mean age (range), y	18.9 (7-50)	21.6 (8-52)	19.0 (7-50)	19.1 (8-52)
Mean FSIQ (SD)	101 (7.2)	109 (3.7)	109 (14.8)	114 (4.4)
(B) Matched Subgroups				
VBM				
N	825	758	778	781
% males	78	80	78	80
Mean age (range), y	16.7 (6-65)	17.4 (3-59)	17.4 (6-65)	16.1 (2-58)
Mean FSIQ (SD)	102 (8.3)	97 (18.0)	109 (4.7)	107 (12.6)
fMRI during Cognitive Control				
N	586	335	628	353
% males	83	83	79	80
Mean age (range), y	17.6 (7-50)	20.7 (7-52)	17.6 (7-50)	19.2 (7-52)
Mean FSIQ (SD)	105 (7.7)	109 (4.8)	109 (16.0)	114 (4.1)
fMRI during Motor Response Inhibition				
N	354	212	421	232
% males	78	82	73	78
Mean age (range), y	21.3 (7-50)	21.6 (8-52)	21.6 (7-50)	19.1 (8-52)
Mean FSIQ (SD)	106 (9.6)	109 (3.6)	114 (7.8)	114 (4.3)

Abbreviations: N = overall number of subjects, TD_{ADHD} = typically developing controls in the ADHD studies, TD_{ASD} = typically developing controls in the ASD studies, VBM = voxel-based morphometry, fMRI = functional Magnetic Resonance Imaging, % males = proportion of males among the samples, y = year, FSIQ = full scale IQ, and SD = standard deviation. The demographic characteristics presented here were calculated from the independent datasets with non-overlapping participants.

Table 4. Brain Structural and Functional Abnormalities in ADHD relative to ASD

Contrasts	MNI coord. x, y, z	SDM Z	p-value	Voxels No	BA
(A) Structural Abnormalities					
(i) ADHD (*vs.* TD)					
ADHD < TD					
L/R vmOFC/vmPFC/rACC and R caudate	2,48,-18	2.48	.00009	2902	11/10
R putamen/posterior insula/STG	30,-4,4	1.98	.0009	902	48/22
L pre-CG	-40,-6,56	1.88	.001	110	6
R rostrolateral PFC	28,66,-4	1.98	.0009	79	11
L vlPFC/STG/temporal pole	-26,16,-24	1.93	.001	57	38
ADHD > TD					
Nil	--	--	--	--	--
(ii) ASD (*vs.* TD)					
ASD < TD					
L/R dACC/dmPFC	4,42,18	1.61	.0004	575	24/32
L cerebellum	-10,-66,-48	1.35	.002	113	
R hippocampus/PHG/FFG	24,-6,-22	1.38	.002	104	34/20/36
Dorsomedial thalamus	0,0,20	1.39	.001	46	
ASD > TD					
L anterior I/M/STG/posterior insula	-60,-20,-14	2.55	.000002	1828	20/21/22/48
L/R PCC/precuneus,	-8,-50,26	1.99	.0003	437	23/26/7
R MFG/SFG/dlPFC	24,48,24	2.13	.0001	218	46
ADHD (*vs.* TD) *vs.* ASD (*vs.* TD)					
(iii) Overall Sample					
ADHD (*vs.* TD) reduced *vs.* ASD (*vs.* TD)					
vmOFC/rACC/L caudate	4,22,-10	2.22	.00009	1543	25/11
L post-CG	-42,-14,48	1.86	.0007	276	6
L MFG/SFG/dlPFC	-14,58,14	1.90	.0006	114	10
ASD (*vs.* TD) increased *vs.* ADHD (*vs.* TD)					
L anterior STG/MTG	-46,-16,-2	1.91	.0005	601	48/22/20/21
R MFG/SFG/dlPFC	24,46,24	1.98	.0004	150	46
R MFG/SFG	18,66,6	1.73	.001	91	10
L MTG/temporal pole	-46,6,-26	1.68	.002	56	20
R posterior MTG/STG	46,-36,4	1.64	.002	52	21
(iv) Matched Subgroups					
ADHD (*vs.* TD) reduced *vs.* ASD (*vs.* TD)					
vmOFC/rACC	2,48,-18	2.03	.001	442	11/10
L MOG	-22,-88,10	2.02	.001	85	18
ASD (*vs.* TD) reduced *vs.* ADHD (*vs.* TD)					
R PHG/amygdala/FFG/hippocampus	28,-6,-24	1.37	.0002	386	28/34/36/35
Dorsomedial thalamus	2,-6,16	1.18	.0006	92	
ASD (*vs.* TD) increased *vs.* ADHD (*vs.* TD)					
R MTG/STG/angular gyrus	50, -40 ,8	2.28	.0004	463	42/40/22/21/39
R MFG/SFG/dlPFC	24, 44, 24	2.00	.001	65	46
L anterior MTG/STG	-50, -20, -8	1.84	.003	36	48/22/21/20
PCC	-6, -50, 28	1.84	.003	33	23/30
(B) Functional Abnormalities during Cognitive Control					

(i) ADHD (*vs.* TD)					
ADHD < TD					
R thalamus/caudate	10,-4,12	1.74	.0001	449	
L M/STG/superior temporal pole	-52,-16,-12	1.31	.001	285	21/22/38
L/R SMA/dmPFC	4,6,52	1.33	.001	130	6/24
L IFG/AI/temporal pole	-50,14,4	1.25	.002	82	45/48
R AI/putamen	32,20,0	1.27	.002	65	48
L post-CG	-48,-12,54	1.26	.002	53	6
L MFG/dlPFC	-30,30,44	1.24	.002	35	9
R MTG	46,-2,-24	1.18	.003	33	21
ADHD > TD					
Nil	--	--	--	--	--
(ii) ASD (*vs.* TD)					
ASD < TD					
L/R ACC/midcingulate/dmPFC	0,34,20	2.12	.000001	2708	24/10/32
L MFG/dlPFC	-42,34,24	1.42	.0003	370	45/46/48
R MFG/dlPFC	42,10,48	1.28	.0007	113	9
L IPL	-34,-46,52	1.11	.002	91	40
L lingual gyrus/cerebellum, lobule IV/V	-14,-48,-10	1.08	.003	89	30/19
ASD > TD					
Precuneus/midcingulate	-2,-44,56	1.48	.00007	1115	7/5/4
R IOG	36,-70,-6	1.37	.0002	226	19
L vlPFC/OFC	-30,40,-8	1.14	.0009	90	47/11
L MFG/rostrolateral PFC	-30,48,10	1.14	.0008	81	10
R IFG	42,22,18	1.08	.002	64	45
ADHD (*vs.* TD) *vs.* ASD (*vs.* TD)					
(iii) Overall Sample					
ASD (*vs.* TD) reduced *vs.* ADHD (*vs.* TD)					
rACC/midcingulate/dmPFC	0,30,20	2.42	~0	2903	24/10/32
L MFG/dlPFC	-44,34,24	1.19	.0004	319	45/46/48
ASD (*vs.* TD) increased *vs.* ADHD (*vs.* TD)					
Precuneus	0,-42,50	1.50	.00009	1001	7/4
R IOG/FFG	36,-70,-8	1.35	.0003	147	19
R IFG	44,24,18	1.27	.0005	138	48/45
L vlPFC/OFC	-30,44,-8	1.04	.002	32	47/11
L MFG	-30,50,8	1.02	.003	25	10
(iv) Matched Subgroups					
ADHD (*vs.*TD) reduced *vs.* ASD (*vs.* TD)					
SMA	-4, 12, 54	-1.33	.0003	353	6
L STG/MTG/temporal pole	-40, -6, -12	-1.01	.003	40	48/21/38
ASD (*vs.* TD) reduced *vs.* ADHD (*vs.* TD)					
rACC/dmPFC	2,28,20	2.30	.0000002	2815	24/32/9/10
L MFG/dlPFC	-40,34,28	1.03	.001	211	45/45/48
L IPL/SPL	-32,-46,54	1.06	.0009	192	40/7/2
ASD (*vs.* TD) increased *vs.* ADHD (*vs.* TD)					
Precuneus/PCC	-2, -40, 50	1.25	.0006	433	5/4
R FFG/IOG/ITG	36, -70 ,-8	1.49	.0001	247	19/37
R IFG	44, 24, 18	1.24	.0007	88	48/45

L vlPFC/OFC	-30, 40, -8	1.10	.002	57	11/47
(C) Functional Abnormalities during Motor Response Inhibition					
(i) ADHD (*vs.* TD)					
ADHD < TD					
L MFG/dlPFC	-30,30,44	1.70	.0002	235	9/46/8
L anterior MTG/STG	-52,-18,-10	1.57	.0005	210	22/21/20/48
L post-CG	-48,-10,54	1.52	.0006	198	6
R IFG	46,32,22	1.54	.0005	188	45/48/46
R vlPFC/OFC/AI	30,36,-16	1.30	.002	172	47/38
R caudate	10,20,0	1.38	.001	91	--
ADHD > TD					
Nil	--	--	--	--	--
(ii) ASD (*vs.* TD)					
ASD < TD					
R AI/vlPFC	44,20,0	1.42	.0004	491	47/45/48
L cerebellum, hemispheric lobule IV & V/ lingual gyrus/FFG	-14,-46,-10	1.33	.001	492	30/19/18/37
R MFG/dlPFC	40,12,50	1.43	.0004	251	9
R PCC/precuneus	16,-36,44	1.35	.0008	58	7
ASD > TD					
L vlPFC/OFC	-28,48,8	1.19	.0003	703	11/10/46/47
R IOG/FFG/ITG	36,-72,-8	1.50	.00001	489	19/37
ADHD (*vs.* TD) *vs.* ASD (*vs.* TD)					
(iii) Overall Sample					
ADHD (*vs.* TD) reduced *vs.* ASD (*vs.* TD)					
R caudate	10,22,0	1.20	.0008	98	--
R IFG	42,26,20	1.14	.001	97	48/45
ASD (*vs.* TD) reduced *vs.* ADHD (*vs.* TD)					
L lingual gyrus/FFG/cerebellum lobule IV	-18,-54,-12	1.17	.001	243	19/37/30
rACC/dmPFC	0,32,22	1.09	.002	203	24/32
L MFG/IFG	-44,34,16	1.11	.002	109	45/48
R precuneus	16,-36,44	1.27	.0008	37	7
R MFG/dlPFC	42,10,48	1.04	.003	20	9/6
ASD (*vs.* TD) increased *vs.* ADHD (*vs.* TD)					
R IOG/FFG	36,-70,-8	1.84	.00001	417	19/37/18
L vlPFC/OFC	-28,42,-14	1.21	.0007	372	11/47
L MFG/SFG/dlPFC	-30,46,6	1.12	.001	183	10/46/11
L posterior MTG	-48,-54,4	1.16	.001	63	37/21
(iv) Matched Subgroups					
ADHD (*vs.* TD) reduced *vs.* ASD (*vs.* TD)					
R caudate	8,20,2	1.17	.001	117	--
R IFG	42,26,20	1.18	.001	74	48
ASD (*vs.* TD) reduced *vs.* ADHD (*vs.* TD)					
L cerebellum lobule IV/FFG/lingual gyrus	-16,-48,-12	1.39	.0003	1082	19/37
R MFG/dlPFC	42,14,48	1.22	.0007	104	9/6
L SPL/precuneus	-18,-70,58	1.00	.002	50	7
R precuneus	16,-36,44	1.21	.0008	41	7
ASD (*vs.* TD) increased *vs.* ADHD (*vs.* TD)					

R IOG/FFG	36,-70,-10	-1.82 .00001	504	19/37
L vlPFC/OFC	-28,36,-8	-1.17 .001	265	11/47
L MFG/SFG/dlPFC	-28,54,8	-1.10 .002	171	10/46/11

Abbreviations: MNI = Montreal Neurological Institute, SDM = Seed-based d mapping, BA = Brodmann Area, TD = typically developing controls, brain regions (in alphabetical order): AI = anterior insula, dACC = dorsal anterior cingulate cortex, dlPFC = dorsolateral prefrontal cortex, dmPFC = dorsomedial prefrontal cortex, FFG = fusiform gyrus, IFG = inferior frontal gyrus, I/MOG = inferior/middle occipital gyrus, I/M/STG = inferior/middle/superior temporal gyrus, I/SPL = inferior/superior parietal lobe, M/SFG = middle/superior frontal gyrus, PCC = posterior cingulate cortex, PFC=prefrontal cortex, PHG=parahippocampal gyrus, pre-CG=precentral gyrus, rACC = rostral anterior cingulate cortex, SMA = supplementary motor area, vlPFC = ventrolateral prefrontal cortex, vmOFC = ventromedial orbitofrontal cortex, vmPFC = ventromedial prefrontal cortex. Bold prints indicate regions which survived the sensitivity analyses in subgroups matched on age, sex and IQ.

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Figure 1

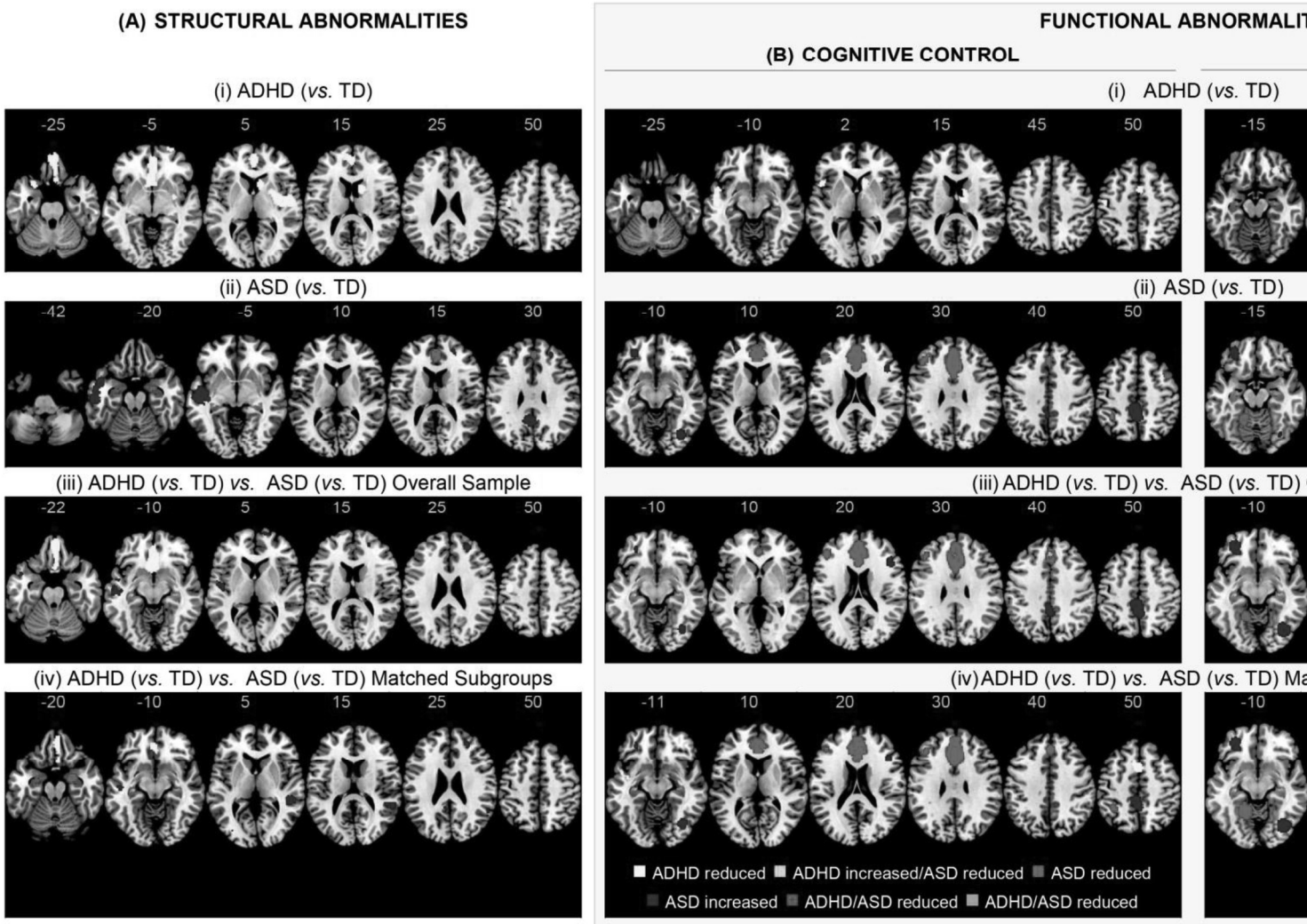
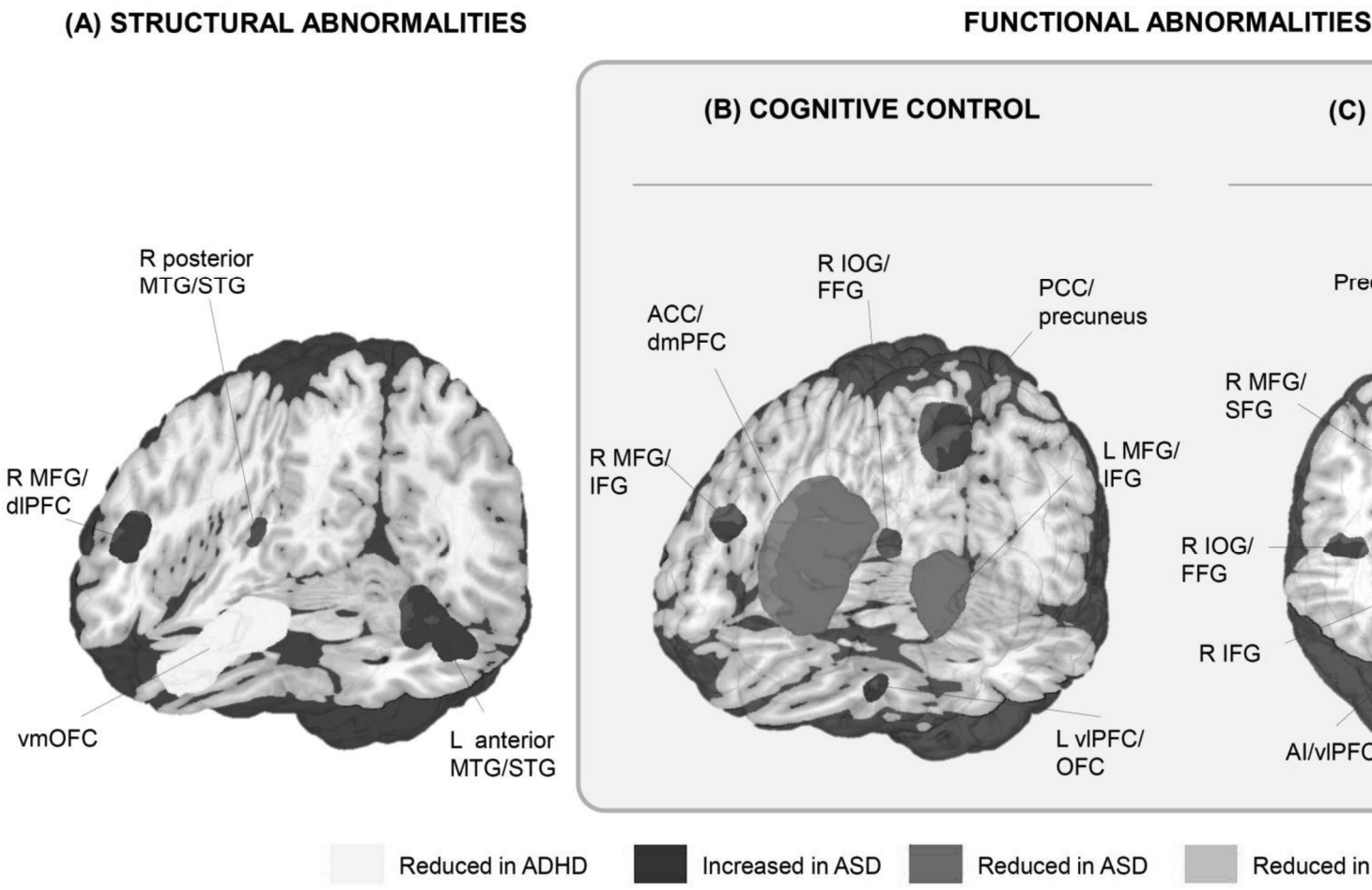

(A) STRUCTURAL ABNORMALITIES
FUNCTIONAL ABNORMALIT
(B) COGNITIVE CONTROL
(i) ADHD (vs. TD)
-25 -5 5 15 25 50
(ii) ASD (vs. TD)
-42 -20 -5 10 15 30
(iii) ADHD (vs. TD) vs. ASD (vs. TD) Overall Sample
-22 -10 5 15 25 50
(iv) ADHD (vs. TD) vs. ASD (vs. TD) Matched Subgroups
-20 -10 5 15 25 50
(i) ADHD (vs. TD)
-25 -10 2 15 45 50
-15
(ii) ASD (vs. TD)
-10 10 20 30 40 50
-15
(iii) ADHD (vs. TD) vs. ASD (vs. TD)
-10 10 20 30 40 50
-10
(iv) ADHD (vs. TD) vs. ASD (vs. TD) Ma
-11 10 20 30 40 50
-10
ADHD reduced
ADHD increased/ASD reduced
ASD reduced
ASD increased
ADHD/ASD reduced
ADHD/ASD reduced

Figure 2


(A) STRUCTURAL ABNORMALITIES
FUNCTIONAL ABNORMALITIES
(B) COGNITIVE CONTROL
(C)
R posterior MTG/STG
R MFG/ dlPFC
vmOFC
L anterior MTG/STG
R IOG/ FFG
PCC/ precuneus
ACC/ dmPFC
R MFG/ IFG
L MFG/ IFG
L vlPFC/ OFC
R MFG/ SFG
R IOG/ FFG
R IFG
AI/vlPFC
Reduced in ADHD
Increased in ASD
Reduced in ASD
Reduced in

SUPPLEMENTARY MATERIALS

Comparative Meta-analyses of Brain Structural and Functional Abnormalities during Cognitive Control in Attention-Deficit/Hyperactivity Disorder and Autism Spectrum Disorder

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Contents

Supplement 1: Literature Search and Methods

Literature Search

A comprehensive literature search was conducted by SL, LN, and CC in PubMed, Scopus, Web of Science and ScienceDirect to identify whole-brain functional magnetic resonance imaging (fMRI) or voxel-based morphometry (VBM) studies comparing individuals with ASD or ADHD against typical controls. The searches were conducted up to 30th November 2018 and used key words related to: (1) ASD, i.e., autism OR autistic OR Asperger OR ASD OR autism spectrum disorder OR pervasive developmental disorder; (2) ADHD, i.e., hyperkinetic OR ADHD or attention-deficit/hyperactivity disorder; (3) VBM; (4) inhibitory function, i.e., inhibition OR stop OR Stroop OR flanker OR go/no-go OR Simon OR interference OR executive function OR switch; and (5) neuroimaging, i.e., fMRI OR MRI.

The following syntaxes were used on PubMed to search for (1) ADHD VBM studies: (“ADHD”[Title/Abstract] OR “attention-deficit/hyperactivity disorder”[Title/Abstract] OR “hyperkinetic”[Title/Abstract]) AND ("VBM"[Title/Abstract] OR "voxel-based morphometry"[Title/Abstract]) and (2) ASD VBM studies: (“Autism”[Title/Abstract] OR “autistic”[Title/Abstract] OR “autism spectrum disorders”[Title/Abstract] OR “pervasive developmental disorders”[Title/Abstract] OR “ASD”[Title/Abstract] OR “PDD”[Title/Abstract] OR “Asperger”[Title/Abstract]) AND ("VBM"[Title/Abstract] OR "voxel-based morphometry"[Title/Abstract]).

The following syntaxes were used on PubMed to search for (1) ADHD fMRI studies: (((“ADHD”[Title/Abstract] OR “hyperkinetic”[Title/Abstract] OR "attention-deficit/hyperactivity disorders"[Title/Abstract])) AND ("inhibition"[Title/Abstract] OR "stop" [Title/Abstract] OR "stroop"[Title/Abstract] OR "flanker "[Title/Abstract] OR " go/no-go "[Title/Abstract] OR " Simon"[Title/Abstract] OR "interference"[Title/Abstract] OR "executive function"[Title/Abstract] OR " switch"[Title/Abstract])) AND ("MRI"[Title/Abstract] OR "fMRI"[Title/Abstract]), and (2) ASD fMRI studies: (((“Autism”[Title/Abstract] OR “autistic”[Title/Abstract] OR “autism spectrum disorders”[Title/Abstract] OR “pervasive developmental disorders”[Title/Abstract] OR “ASD”[Title/Abstract] OR “PDD”[Title/Abstract]

OR “Asperger”[Title/Abstract])) AND ("inhibition"[Title/Abstract] OR "stop" [Title/Abstract] OR "stroop"[Title/Abstract] OR "flanker "[Title/Abstract] OR " go/no-go "[Title/Abstract] OR " Simon"[Title/Abstract] OR "interference"[Title/Abstract] OR "executive function"[Title/Abstract] OR " switch"[Title/Abstract])) AND ("MRI"[Title/Abstract] OR "fMRI"[Title/Abstract]).

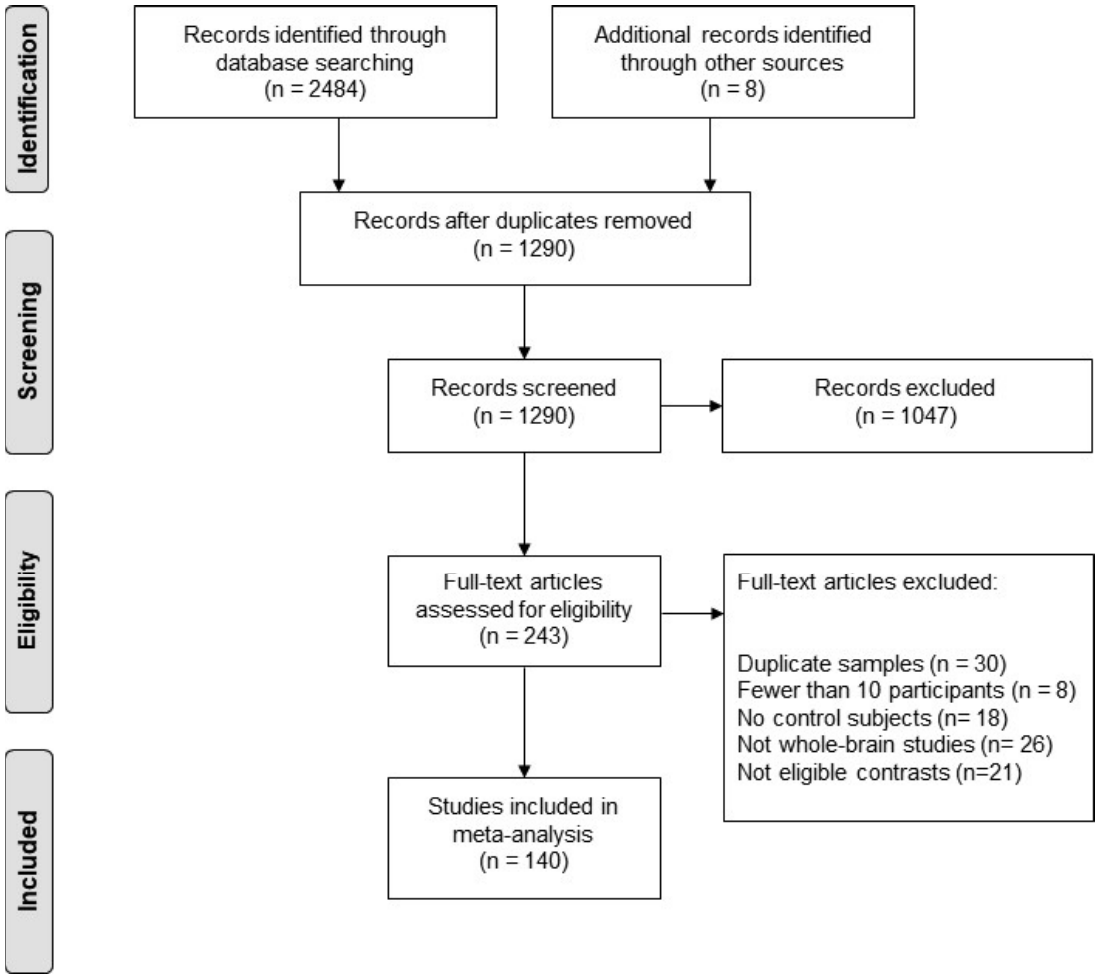
Only predefined contrasts comparing inhibitory control (i.e., stop, no-go, incongruent or switch trials) against a control condition (i.e., failed stop, go, oddball, congruent or repeated trials) were included in the fMRI meta-analysis. Data extracted included age, sex, IQ, current and historic exposure of psychostimulant medications and comorbidity of ASD and ADHD in the counterpart disorder groups. From the database searches, 2484 records were retrieved, and eight further records were identified from past meta-analyses. After duplicates were removed, 1290 records remained and were screened, yielding 243 full-text articles assessed for eligibility, and 140 included in the meta-analysis. Of the full-text articles excluded, 30 included samples already used in previous publications, eight included fewer than ten participants, 18 had no control participants, 26 were not whole-brain studies and 21 did not include eligible contrast.

Seed-based *d* Mapping (SDM)

The anisotropic seed-based *d* Mapping AES-SDM (www.sdmproject.com) is meta-analytic software for neuroimaging data. The software takes both statistical parametric maps of MRI/fMRI contrasts (Radua et al., 2012), and the conventional peak coordinates and effect sizes (*t*-scores) as input data. When provided with the latter type of data, AES-SDM estimates signed (positive/negative) effect size and variance maps that represent the difference of brain activations or gray matter structures between patient and control groups. These maps are computed by convolving an anisotropic non-normalized Gaussian kernel with Hedges effect size of each peak. Thus, voxels correlated with peaks are assigned higher effect sizes. Combinations of maps between studies are based on a random-effects model, accounting for sample size, within-study variability and between-study heterogeneity. An update of AES-SDM software also allows adjustment for correlated datasets, accounting

for shared variance of brain activations or structure across datasets (Norman et al., 2016), e.g., when pairs of datasets investigating two inhibitory tasks take places in the same or largely overlapping sample.

Figure S1. Flow Diagram of Literature Search and Study Selection Process



Flow diagram describing the literature search, which included the databases PubMed, ScienceDirect, Scopus and Web of Knowledge

Supplement 2: Full Characteristic Tables and Summary Findings of ADHD and ASD Neuroimaging St

Table S2a. Sample Characteristics and Summary Findings of VBM and fMRI Cognitive Control Studie

Source	Age group	Task	Patients						Controls			
			N (% male)	Age, Range, y	IQ	Life Stim %	Cur Stim %	Com ASD %	N (% male)	Age, y Range, y	IQ	
(A) VBM studies in ADHD												
Ahrendts et al. (2011)	Adult	--	31 (65)	31.2 (18-55)	n/a	3	0	n/a	31 (65)	31.5 (19-52)	n/a	ADH
Montes et al. (2010)	Adult	--	20 (50)	29.0 (25-35)	102.9	0	0	n/a	20 (50)	27.6 (25-35)	100.2	ADH
Amico, Stauber, Koutsouleris, and Frodl (2011)	Adult	--	20 (75)	33.6 (n/a)	n/a	n/a	30	n/a	20 (75)	34.7 (n/a)	n/a	--
Bonath, Tegelbeckers, Wilke, Flechtner, and Krauel (2016)	Pediat.	--	18 (100)	13.6 (11-17)	106.8	78	56	n/a	18 (100)	14.1 (11-17)	108.1	ADH hipp
Bralten et al. (2016)	Mixed	--	307 (68)	17.1 (8-30)	97.1	89	n/a	n/a	196 (49)	16.7 (8-30)	106.6	ADH para FG/
Brieber et al. (2007)	Pediat.	--	15 (100)	13.1 (10-16)	104.1	n/a	67	0	15 (100)	13.3 (10-16)	107.7	ADH MFG CG,
Carmona et al. (2005)	Pediat.	--	25 (84)	10.8 (6-16)	n/a	100	100	n/a	25 (84)	11.2 (6-16)	n/a	ADH gyru cere
Depue, Burgess, Bidwell, Willcutt, and Banich (2010)	Adult	--	31 (61)	20.0 (n/a)	114.2	77	77	n/a	21 (65)	19.3 (n/a)	112.6	--
Gehricke et al. (2017)	Adult	--	32 (81)	25.3 (n/a)	n/a	n/a	25	n/a	40 (83)	23.9 (n/a)	n/a	ADH
He et al. (2015)	Pediat.	--	37 (100)	9.9 (7-16)	n/a	0	0	n/a	35 (100)	10.7 (8-15)	n/a	ADH midc
Iannaccone, Hauser, Ball, et al. (2015)	Pediat.	--	18 (50)	14.5 (12-16)	114.5	72	72	n/a	18 (61)	14.8 (12-16)	108.5	ADH gyru
Jagger-Rickels, Kibby, and Constance (2018)	Pediat.	--	41 (44)	9.6 (8-12)	n/a	n/a	n/a	n/a	32 (56)	9.7 (8-12)	n/a	ADH L/R L/R cingu supr

Johnston et al. (2014)	Pediat.	--	34 (100)	12.5 (n/a)	99.8	n/a	29	n/a	34 (100)	13.2 (n/a)	103.7	ADH
Kappel et al. (2015)	Pediat.	--	14 (71)	9.8 (8-12)	104.6	0	0	n/a	10 (80)	11.0 (8-12)	111.9	ADH oper orbit
	Adult	--	16 (94)	23.5 (19-31)	97.8	38	0	n/a	20 (100)	23.7 (19-31)	108.4	ADH R hip
Kaya et al. (2018)	Pediat.	--	19 (74)	10.3 (7-14)	113.5	0	0	n/a	18 (67)	10.2 (6-14)	119.7	ADH post-
Kobel et al. (2010)	Pediat.	--	14 (100)	10.4 (9-13)	n/a	100	100	n/a	12 (100)	10.9 (9-13)	n/a	ADH
Kumar, Arya, and Agarwal (2017)	Pediat.	--	18 (100)	9.6 (7-13)	92.1	n/a	0	0	18 (100)	9.7 (7-13)	109.7	ADH
Li et al. (2015)	Pediat.	--	30 (100)	10.3 (8-14)	121.7	0	0	n/a	30 (100)	10.3 (8-14)	107.1	ADH
Lim et al. (2015)	Pediat.	--	44 (100)	13.6 (10-18)	92.2	18	14	0	33 (100)	14.3 (10-18)	110	ADH
Maier et al. (2015)	Adult	--	131 (48)	34.5 (18-58)	113.1	27	0	0	95 (47)	37.7 (n/a)	121	--
McAlonan et al. (2007)	Pediat.	--	28 (100)	9.9 (6-13)	109.9	100	100	n/a	31 (100)	9.6 (6-13)	116.5	ADH pallio cerel
Moreno-Alcázar et al. (2016)	Adult	--	44 (66)	31.6 (18-54)	105.0	66	66	n/a	44 (66)	32.6 (18-54)	106.0	ADH
Onnink et al. (2014)	Adult	--	119 (39)	36.3, (n/a)	107.5	80	69	n/a	107 (42)	36.9 (n/a)	110.2	--
Overmeyer et al. (2001)	Pediat.	--	18 (83)	10.4 (8-13)	99	94	94	n/a	16 (94)	10.3 (7-14)	n/a	ADH
Ramesh and Rai (2013)	Pediat.	--	15 (26)	16.8 (11-20)	n/a	n/a	n/a	n/a	15 (26)	16.7 (11-20)	n/a	ADH SFG L ST
Roman-Urrestarazu et al. (2016)	Adult	--	49 (76)	22.2 (20-24)	96.6	2	2	0	34 (50)	22.9 (20-24)	112.2	ADH
Saad et al. (2017)	Pediat.	--	16 (75)	12.8 (8-17)	n/a	38	38	n/a	28 (68)	13.1 (8–17)	n/a	--
	Pediat.	--	18 (72)	13.7 (8-17)	n/a			n/a	28 (68)	13.1 (8–17)	n/a	--
Sasayama et al. (2010)	Pediat.	--	18 (72)	10.6 (6-16)	90	83	72	0	17 (71)	10.0 (6-14)	n/a	ADH occip temp

Seidman et al. (2011)	Adult	--	74 (51)	37.3 (18-59)	116	69	28	n/a	54 (46)	34.3 (18-59)	115.8	--
Sethi et al. (2017)	Adult	--	30 (63)	33.7 (18-65)	109.0	100	100	n/a	30 (63)	32.6 (18-65)	110.1	ADH
Shimada et al. (2015)	Pediat.	--	17 (88)	10.3 (n/a)	95.3	n/a	n/a	n/a	15 (73)	12.8 (n/a)	104.1	ADH
Stevens and Haney-Caron (2012)	Pediat.	--	24 (67)	15.7 (12-18)	n/a	n/a	n/a	n/a	24 (70)	16.0 (12-18)	n/a	--
van Wingen et al. (2013)	Adult	--	14 (100)	32.0 (22-50)	104	0	0	n/a	15 (100)	37.0 (22-50)	99	ADH midb
Vilgis, Sun, Chen, Silk, and Vance (2016)	Pediat.	--	48 (100)	12.6 (8-17)	92.2	25	25	n/a	31 (100)	12.8 (8-17)	109.6	ADH
Villemonteix et al. (2015)	Pediat.	--	33 (55)	10.3 (7-13)	105.6	0	0	n/a	24 (50)	10 (7-13)	109.7	ADH
	Pediat.	--	20 (80)	10.4 (7-13)	107.4	100	100	n/a	24 (50)	10 (7-13)	109.7	ADH
Wang, Jiang, Cao, and Wang (2007)	Pediat.	--	12 (100)	13.4 (n/a)	n/a	n/a	0	n/a	12 (100)	13.5 (n/a)	n/a	ADH occip
P. Yang et al. (2008)	Pediat.	--	57 (61)	11.1 (7-17)	97.9	n/a	86	n/a	57 (60)	11.7 (7-17)	n/a	ADH sulcu
(B) fMRI cognitive control studies in ADHD												
Banich et al. (2009)	Adult	Stroop	23 (61)	20.0 (n/a)	116	87	61	n/a	23 (57)	19.0 (n/a)	113	ADH
Bhaijiwala, Chevrier, and Schachar (2014)	Pediat.	Stop	12 (58)	13.8 (9-18)	n/a	100	100	0	12 (50)	15.4 (9-18)	n/a	ADH MFG
Booth et al. (2005)	Pediat.	GNG	12 (67)	11.0 (9-12)	n/a	100	100	n/a	12 (58)	11.7 (9-12)	n/a	ADH IFG,
Carmona et al. (2012)	Adult	GNG	19 (100)	33.6 (n/a)	110.9	0	0	n/a	19 (100)	29.4 (n/a)	111.7	ADH
Chantiluke, Barrett, Giampietro, Santosh, et al. (2015)	Pediat.	Stop	18 (100)	14.3 (10-17)	95	78	61	0	25 (100)	13.4 (10-17)	109	ADH
Chen et al. (2015)	Adult	GNG	29 (100)	24.9 (n/a)	n/a	0	0	n/a	25 (100)	25.6 (n/a)	n/a	--
Chou, Chia, Shang, and Gau (2015)	Pediat.	Stroop	42 (81)	10.5 (7-17)	108.5	0	0	n/a	20 (80)	12.0 (8-17)	106.5	ADH treat grou dlPF CG (
Congdon et al. (2010)	Adult	Stop	35 (54)	30.9 (21-50)	n/a	n/a	29	n/a	62 (45)	30.8 (21-50)	n/a	--

Cubillo et al. (2010) [a]	Adult	Stop, Switch	11 (100)	29.0 (26-30)	92	0	0	n/a	14 (100)	28.0 (26-30)	106	ADH putar IFG/i /post
Cubillo et al. (2014)	Pediat.	Stop	19 (100)	13.1 (10-17)	92	0	0	0	29 (100)	13.8 (10-17)	110	ADH cerel PCC putar
Cubillo, Halari, Giampietro, Taylor, and Rubia (2011) [a]	Adult	Simon	11 (100)	29.0 (26-30)	92	0	0	n/a	15 (100)	28.0 (26-30)	112	ADH
Dibbets, Evers, Hurks, Marchetta, and Jolles (2009) [b]	Adult	GNG	16 (100)	28.9 (21-42)	n/a	88	88	n/a	13 (100)	28.1 (21-41)	n/a	--
Dibbets, Evers, Hurks, Bakker, and Jolles (2010) [b]	Adult	Switch	15 (100)	28.8 (21-42)	n/a	80	80	n/a	14 (100)	28.6 (21-41)	n/a	ADH thala R dA insul
Durston, Mulder, Casey, Ziermans, and van Engeland (2006)	Pediat.	GNG	11 (100)	14.0 (8-20)	100	82	55	n/a	11 (100)	15.3 (8-20)	106	--
L. Y. Fan, Chou, and Gau (2017) [c]	Adult	Stroop	12 (42)	28.9 (n/a)	115.8	0	0	n/a	12 (42)	30.3 (n/a)	118.3	ADH
	Adult	Stroop	12 (42)	32.5 (n/a)	119.9	0	0	n/a	12 (42)	30.3 (n/a)	118.3	ADH
L. Y. Fan, Shang, Tseng, Gau, and Chou (2018)	Pediat.	Stroop	27 (89)	12.1 (9-15)	105.2	0	0	n/a	27 (78)	11.8 (9-16)	110.4	ADH
Hwang et al. (2015)	Pediat.	Stroop	26 (65)	13.9 (n/a)	106.4	n/a	42	0	35 (51)	14.5 (n/a)	105.1	ADH
Iannaccone, Hauser, Staempfli, et al. (2015)	Pediat.	GNG/ Flanker	18 (50)	14.5 (12-16)	108.5	72	72	n/a	18 (61)	14.8 (12-16)	114.4	ADH MTG ITG/ FFG/ pons
Janssen, Heslenfeld, Mourik, Logan, and Oosterlaan (2015)	Pediat.	Stop	21 (90)	10.6 (8-13)	98.6	90	90	n/a	17 (76)	10.3 (8-13)	108.7	ADH L SF R cu
Konrad, Neufang, Hanisch, Fink, and Herpertz-Dahlmann (2006)	Pediat.	Flanker	16 (100)	10.2 (8-12)	103	0	0	0	16 (100)	10.3 (8-12)	105	ADH SPL
Kooistra et al. (2010)	Adult	GNG	11 (100)	21.5 (18-25)	110	100	0	n/a	11 (100)	10.1 (18-25)	125	ADH gyrus pole, medi

												L late L PC
J. Ma et al. (2012)	Pediat.	GNG	15 (53)	9.8 (8-12)	100.2	27	0	n/a	15 (53)	22.3 (8-12)	102.6	ADH IOG, hippo
I. Ma et al. (2016)	Pediat.	Stroop	25 (76)	15.4 (14-17)	98.3	n/a	60	n/a	33 (67)	15.3 (14-17)	108.9	--
Massat et al. (2018)	Pediat.	Stop	18 (44)	10.0 (8-12)	106.8	0	0	n/a	19 (47)	10.6 (8-12)	114.4	ADH putar
Passarotti et al. (2010)	Pediat.	Stop	11 (55)	13.1 (10-18)	107.6	48	0	n/a	15 (48)	9.9 (10-18)	101.2	ADH ADH verm
Peterson et al. (2009)	Pediat.	Stroop	16 (81)	14.1 (7-18)	101.2	100	0	n/a	20 (60)	14.1 (7-18)	118.5	ADH caud
Rasmussen et al. (2016)	Adult	GNG	50 (82)	24.8 (n/a)	102.1	n/a	4	n/a	23 (70)	24.1 (n/a)	109.2	ADH angu L/R p R OF
Rubia, Smith, Brammer, Toone, and Taylor (2005)	Pediat.	Stop	16 (100)	13.2 (9-16)	100	0	0	n/a	21 (100)	13.4 (9-16)	95	ADH
Rubia, Halari, Cubillo, et al. (2011) [d]	Pediat.	Simon	12 (100)	13.0 (10-15)	90	0	0	0	13 (100)	14.0 (11-16)	102	ADH R SM
Rubia, Halari, Mohammad, Taylor, and Brammer (2011) [d]	Pediat.	Stop	12 (100)	13.0 (10-15)	90	0	0	0	13 (100)	13.0 (11-16)	102	ADH MTL
Schulz et al. (2004)	Pediat.	GNG	10 (100)	17.9 (15-19)	88.4	70	0	0	9 (100)	17.5 (16-19)	91.9	ADH gyrus medi
Schulz et al. (2014)	Adult	GNG	14 (100)	23.3 (19-27)	n/a	71	0	0	14 (100)	22.8 (18-26)	n/a	--
Schulz et al. (2017)	Adult	Stroop	27 (89)	24.2 (21-28)	n/a	74	0	0	28 (86)	24.6 (21-28)	n/a	ADH IFG, MOG
Sebastian et al. (2012) [e]	Adult	GNG Stroop Stop	20 (55)	33.3 (n/a)	115.3	0	0	n/a	24 (46)	17.5 (n/a)	115.7	ADH para R GP
Shang, Sheng, Yang, Chou, and Gau (2018) [f]	Adult	Stroop	25 (48)	29.1 (17-44)	112.8	0	0	n/a	30 (50)	28.2 (20-42)	115.4	ADH
	Adult	Stroop	25 (56)	28.5 (17-50)	113.1	0	0	n/a	30 (50)	28.2 (20-42)	115.4	ADH
Siniatchkin et al. (2012)	Pediat.	GNG	12 (83)	9.3 (7-13)	n/a	n/a	n/a	n/a	12 (75)	30.3 (7-13)	n/a	ADH

Smith, Taylor, Brammer, Toone, and Rubia (2006) [g]	Pediat.	GNG	17(100)	12.8 (n/a)	n/a	0	0	0	18 (100)	9.3 (n/a)	n/a	ADH
		Stroop	19 (100)	12.9 (n/a)	n/a	0	0	0	24 (100)	12.8 (n/a)	n/a	--
		Switch	14 (100)	13.3 (n/a)	n/a	0	0	0	27 (100)	12.9 (n/a)	n/a	ADH IPL/S
Spinelli et al. (2011)	Pediat.	GNG	13 (69)	10.6 (8-13)	109.2	n/a	15	n/a	17 (47)	13.3 (8-13)	108.8	ADH
Szekely et al. (2018)	Adult	Stop	64 (56)	24.0 (n/a)	n/a	n/a	62.5	n/a	84 (57)	24.5 (n/a)	n/a	--
Tamm, Menon, Ringel, and Reiss (2004)	Pediat.	GNG	10 (100)	16.0 (14-18)	109.2	n/a	50	n/a	12 (100)	10.6 (14-16)	111.6	ADH
Thornton, Bray, Langevin, and Dewey (2018)	Pediat.	GNG	20 (90)	12.4 (8-17)	109.4	n/a	n/a	0	20 (40)	10.6 (8-17)	112.6	--
van Hulst, de Zeeuw, Rijks, Neggers, and Durston (2017)	Pediat.	GNG	24 (100)	11.2 (8-12)	105.6	n/a	n/a	n/a	26 (100)	10.5 (8-12)	117.3	--
van Rooij et al. (2015)	Pediat.	Stop	108 (64)	15.1 (8-17)	92.7	75	n/a	n/a	77 (49)	16.0 (9-17)	109.2	ADH
	Adult	Stop	77 (78)	20.3 (18-25)	99.1	79	n/a	n/a	45 (33)	14.6 (18-23)	106.4	ADH
Zamorano et al. (2017)	Pediat.	Stroop	17 (100)	11.6 (10-12)	104.2	100	100	n/a	17 (100)	11.7 (10-12)	109.8	ADH

Abbreviations. N=sample size, y=year, pediat.=pediatric (child/adolescent) sample, life/cur stim exp=lifetime/current stimulant expos
based on explicit reporting or study exclusion criteria, ADHD=attentional-deficit/hyperactivity disorder, TD=typically developing contr
(in alphabetical order): ACC=anterior cingulate cortex, BG=basal ganglia, dACC=dorsal ACC, dlPFC=dorsolateral prefrontal cortex,
I/M/medial/SFG=inferior/middle/medial/superior frontal gyrus, I/M/SOG=inferior/middle/superior occipital gyrus, I/M/STG=inferior/mi
parietal lobe, mPFC=medial prefrontal cortex, OFC=orbital frontal cortex, OFG=orbital frontal gyrus, PCC=posterior cingulate cortex
PHG=parahippocampal gyrus, PMC=premotor cortex, SMA=supplementary motor area, STS=superior temporal sulcus

Table S2b. Sample Characteristics and Summary Findings of VBM and fMRI Cognitive Control Studie

Source	Age group	Task	Patients				Controls			
			N (% male)	Age (Range), y	IQ	Com ADHD %	N (% male)	Age (Range), y	IQ	
(A) VBM studies in ASD										
Abell et al. (1999)	Adult	--	15 (80)	28.8 (n/a)	n/a	n/a	15 (80)	25.3 (n/a)	n/a	ASD<TD: R paracing amygdala, L/R anteri
Boddaert et al. (2004)	Pediat.	--	21 (76)	9.3 (7-15)	n/a	n/a	12 (58)	10.8 (7-15)	n/a	ASD<TD: L/R STS
Bonilha et al. (2008)	Pediat.	--	12 (100)	12.4 (8-15)	n/a	n/a	16 (100)	13.2 (n/a)	n/a	ASD>TD: L/R IFG, L precuneus, L/R STG SPL, L insula, L puta lingual gyrus, L pre-C IPL
Brieber et al. (2007)	Pediat.	--	15 (100)	14.2 (10-16)	106.8	0	15 (100)	13.3 (10-16)	107.7	ASD<TD: L/R ITG/hi hippocampus; ASD>
Cai et al. (2018)	Pediat.	--	38 (84)	9.6 (5-16)	75.8	n/a	27 (96)	8.3 (5-14)	98.6	ASD<TD: R cerebell ASD>TD: L ITG, L/R
Cheng, Chou, Fan, and Lin (2011)	Pediat.	--	25 (100)	13.7 (10-18)	101.6	n/a	25 (100)	13.5 (11-18)	109.0	ASD<TD: R IFG, R p STG; ASD>TD: ACC subcallosal gyrus
Contarino, Bulgheroni, Annunziata, Erbetta, and Riva (2016)	Pediat.	--	25 (88)	6.1 (2-12)	56	n/a	25 (65)	6.1 (2-12)	103	--
M. Craig et al. (2007)	Adult	--	14 (0)	37.9 (n/a)	103.4	n/a	19 (0)	35.0 (n/a)	111.2	ASD<TD: Cuneus, L
D'Mello, Crocetti, Mostofsky, and Stoodley (2015)	Pediat.	--	35 (86)	10.4 (8-13)	n/a	n/a	35 (60)	10.4 (8-13)	n/a	ASD<TD: R lingual g PCC/precuneus, R S
Ecker et al. (2012)	Adult	--	89 (100)	27.0 (18-43)	110	n/a	89 (100)	28.0 (18-43)	113.0	ASD<TD: R occipital gyrus, L/R inferior an /R ITG/MTG/STG/ L/ thalamus, L/R dlPFC
Foster et al. (2015)	Pediat.	--	38 (100)	12.4 (6-17)	102.5	n/a	46 (100)	12.6 (7-17)	113.1	ASD<TD: R STG, L/ central sulcus, L med SFG, L ACC, L OFC gyrus, L FFG, L post supramarginal/angul
Freitag et al. (2008)	Mixed	--	15 (87)	17.5 (n/a)	101.2	n/a	15 (87)	18.6 (n/a)	112.1	ASD<TD: R intrapari

Greimel et al. (2013)	Mixed	--	47 (100)	18.3 (10-50)	107.5	13	51 (100)	21.4 (8-47)	112.5	ASD<TD: ACC, L/R
Groen, Buitelaar, van der Gaag, and Zwiers (2011)	Pediat.	--	17 (82)	14.4 (12-18)	98.0	n/a	25 (88)	15.5 (12-18)	105.0	--
Hyde, Samson, Evans, and Mottron (2010)	Mixed	--	15 (100)	22.7 (14-33)	100.4	n/a	15 (100)	19.2 (14-34)	106.6	ASD<TD: R post-CG medial FG/OFC, L/R
Itahashi et al. (2015)	Adult	--	46 (100)	30.2 (19-50)	106.0	n/a	46 (100)	30.5 (19-47)	109.2	--
Katz et al. (2016)	Adult	--	23 (100)	26.6 (18-45)	n/a	n/a	32 (100)	29.8 (19-48)	n/a	ASD>TD: L/R OFC,
Kaufmann et al. (2013)	Pediat.	--	10 (80)	14.7 (n/a)	102.3	n/a	10 (80)	13.8 (n/a)	109.5	ASD<TD: Lateral po precuneus
Ke et al. (2008)	Pediat.	--	17 (82)	8.9 (6-14)	108.8	n/a	15 (80)	9.7 (6-14)	109.8	ASD<TD: R PHG; AS cerebellum
Kosaka et al. (2010)	Adult	--	32 (100)	23.8 (17-32)	101.6	n/a	40 (100)	22.5 (18-34)	109.7	ASD<TD: R insula, R
Kurth et al. (2011)	Pediat.	--	52 (73)	11.2 (5-20)	102.2	n/a	52 (73)	11.1 (6-19)	106.0	ASD<TD: Hypothala
Kwon, Ow, Pedatella, Lotspeich, and Reiss (2004)	Pediat.	--	20 (100)	13.5 (10-18)	n/a	n/a	13 (100)	13.6 (10-18)	n/a	ASD<TD: R ITG, R e
Langen et al. (2009)	Pediat.	--	99 (92)	12.9 (7-24)	107.6	n/a	89 (92)	12.4 (6-24)	110.0	--
Lim et al. (2015)	Pediat.	--	19 (100)	14.9 (11-17)	113.0	0	33 (100)	14.9 (11-17)	110.0	ASD>TD: L MTG/ST
Lin, Ni, Lai, Tseng, and Gau (2015)	Pediat. (Child)	--	28 (100)	10.7 (7-12)	106.9	9	43 (100)	10.6 (7-12)	115.2	ASD<TD: R post-CG L/R sublobar areas
	Pediat. (Adolescent)	--	40 (100)	14.7 (13-17)	101.5		18 (100)	15.5 (13-17)	108.7	--
	Adult	--	18 (100)	22.2 (18-29)	99.6		29 (100)	23.4 (18-29)	116.8	ASD>TD: L/R SFG,
Lin, Tseng, Lai, Chang, and Gau (2017)	Pediat.	--	20 (100)	13.5 (8-19)	103.8	0	54 (100)	12.8 (8-19)	112.5	ASD>TD: L cerebellu
McAlonan et al. (2002)	Adult	--	17 (90)	32.0 (18-49)	96.0	n/a	24 (92)	33.0 (18-49)	114.0	ASD<TD: R cerebell precuneus
McAlonan et al. (2008)	Pediat.	--	33 (82)	11.6 (7-16)	113.2	0	55 (86)	10.7 (7-16)	117.1	ASD<TD: L dlPFC, L parietal cortices
Mengotti et al. (2011)	Pediat.	--	20 (90)	7.0 (4-14)	n/a	0	22 (91)	7.7 (4-11)	n/a	ASD<TD: L SMA, R precuneus
Mueller et al. (2013)	Adult	--	12 (75)	35.5 (n/a)	111.3	n/a	12 (67)	33.3 (n/a)	110.8	ASD<TD: L/R TPJ, L mPFC, paracingulate

Ni et al. (2018)	Pediat.	--	81 (100)	12.6 (7-17)	107.4	14.8	61 (100)	12.4 (7-17)	112.0	ASD<TD: L lateral oc
Pereira et al. (2018)	Mixed		19 (82)	17.4 (14-25)	99.8	n/a	25 (66)	18.5 (14-25)	105.8	ASD<TD: L/R cerebe FFG, L/R CG, L para PHG L amygdala, L cerebellum, posterior
Poulin-Lord et al. (2014)	Mixed	--	23 (87)	19.8 (14-30)	100.3	n/a	22 (86)	22.6 (15-35)	107.3	--
Poustka et al. (2012)	Pediat.	--	18 (89)	9.7 (6-12)	111.0	n/a	18 (89)	9.7 (6-12)	112.8	--
Radeloff et al. (2014)	Mixed	--	34 (91)	19.1 (14-33)	105.7	n/a	26 (85)	19.5 (14-27)	107.8	--
Retico et al. (2016)	Pediat.	--	76 (50)	4.6 (3-7)	71	n/a	76 (50)	4.6 (2-7)	73	ASD<TD: L posterior precuneus, L PCC, R CC
Riedel et al. (2014)	Adult	--	30 (63.3)	35.4 (21-52)	124.5	n/a	30 (63)	35.5 (22-53)	123.6	--
Riva et al. (2013)	Pediat.	--	26 (89)	5.8 (2-10)	51.6	n/a	21 (62)	6.8 (3-10)	n/a	ASD<TD: L/R cerebe MOG/SOG, L ITG, L
Rojas et al. (2006)	Mixed	--	24 (100)	20.8 (7-44)	94.8	n/a	23 (100)	21.4 (7-44)	118.7	--
Sato et al. (2017)	Adult	--	36 (69.4)	27.0 (18-53)	110.4	n/a	36 (69)	24.9 (20-43)	n/a	ASD<TD: R IOG/ITG SMA, L/R CG, ACC,
Schmitz et al. (2006)	Adult	--	10 (100)	38.0 (18-52)	105.0	0	12 (100)	39.0 (18-52)	106	ASD>TD: L IFG, AC
Toal et al. (2010)	Adult	--	65 (88)	31.0 (16-59)	98.0	n/a	33 (91)	32.0 (19-58)	105	ASD<TD: R cerebell cerebellum
Waiter et al. (2004)	Pediat.	--	16 (100)	15.4 (12-20)	100.4	n/a	16 (100)	15.5 (12-20)	99.7	ASD<TD: R thalamu L/R STG, L lingual g
Wang et al. (2017)	Pediat.	--	31 (100)	4.8 (3-7)	62.5	n/a	31 (100)	4.8 (3-6)	97.1	ASD>TD: L STG, L p
Wilson, Tregellas, Hagerman, Rogers, and Rojas (2009)	Adult	--	10 (80)	30.1 (22-47)	91.5	n/a	10 (70)	29.4 (21-43)	127.2	--
Q. Yang et al. (2018)	Pediat.	--	16 (63)	10.4 (6-15)	45.3	n/a	16 (63)	10.5 (6-15)	97.5	ASD<TD: L cerebellu
(B) fMRI studies in ASD										
Ambrosino et al. (2014)	Pediat.	GNG	19 (100)	11.5 (9-12)	112	n/a	19 (100)	11.1 (9-14)	120	--
Chantiluke, Barrett, Giampietro, Santosh, et al. (2015)	Pediat.	Stop	19 (100)	14.7 (10-17)	112	0	25 (100)	13.4 (10-17)	109	ASD<TD: L IPL; ASD

Daly et al. (2014)	Adult	GNG	14 (100)	31 (n/a)	115	n/a	14 (100)	31 (n/a)	123	ASD<TD: R IFG, L th
Denisova et al. (2017)	Mixed	Simon	20 (95)	22.7 (n/a)	n/a	n/a	20 (95)	23.2 (n/a)	n/a	ASD>TD: R lingual g
Duerden et al. (2013)	Adult	GNG	16 (69)	27.2 (19-39)	112	0	17 (71)	30.7 (20-43)	114	ASD<TD: R MFG; AS
J. Fan et al. (2012)	Adult	Flanker	12 (75)	30 (n/a)	115	n/a	12 (83)	28 (n/a)	120	ASD<TD: ACC
Gooskens et al. (2018)	Pediat.	Stop	26 (35)	11.3 (8-12)	108.9	n/a	53 (45)	10.8 (8-12)	111.9	--
Kana, Keller, Minshew, and Just (2007)	Adult	GNG	12 (92)	26.8 (n/a)	110	n/a	12 (92)	22.5 (n/a)	117	ASD<TD: L ITG, R P CG, R insula/IFG, L
Kennedy et al. (2006)	Adult	Stroop	15 (100)	25.5 (15-44)	96	n/a	14 (100)	26.1 (n/a)	n/a	ASD>TD: mPFC, pre
Prat, Stocco, Neuhaus, and Kleinhans (2016)	Adult	GNG	16 (63)	25.3 (18-35)	107.4	n/a	17 (65)	25.6 (19-44)	111.0	--
Schmitz et al. (2006)	Adult	GNG, Switch, Stroop	10 (100)	38 (18-52)	105	0	12 (100)	39 (18-52)	106	ASD>TD: L M/IFG, C lobe (Switch)
Shafritz, Dichter, Baranek, and Belger (2008)	Adult	Switch	18 (89)	22.3 (n/a)	103	n/a	15 (87)	24.3 (n/a)	111	ASD<TD: L dlPFC, A
Shafritz, Bregman, Ikuta, and Szeszko (2015)	Mixed	GNG	15 (80)	18.1 (13-23)	102	0	15 (80)	18.4 (12-23)	115	ASD<TD: R IFG/insu
Solomon et al. (2014)	Pediat.	Switch	27 (19)	15.4 (12-18)	108	55	27 (19)	16.1 (12-18)	113	ASD<TD: L PCC, L I
Vaidya et al. (2011)	Pediat.	Stroop	11 (100)	10.8 (7-12)	114	n/a	14 (100)	11.0 (n/a)	119	ASD<TD: ACC, L MF
van Hulst et al. (2017)	Pediat.	GNG	26 (100)	10.8 (8-12)	109.6	n/a	26 (100)	10.5 (8-12)	117.3	--
Velasquez et al. (2017)	Adult	GNG	19 (68)	25.8 (18-35)	111	0	22 (73)	29.0 (20-46)	112	ASD<TD: R ACC, po
Yerys et al. (2015)	Pediat.	Switch	20 (80)	11.3 (7-14)	115	n/a	19 (68)	11.4 (7-13)	120	ASD>TD: L MFG/ pr

Abbreviations. N=sample size, y=year, pediat.=pediatric (child/adolescent) sample, com ADHD=comorbid attention-deficit/hyperacti exclusion criteria, ASD=autism spectrum disorder, TD=typically developing controls, L/R=Left/Right, GNG = Go/No-Go. Brain regior cortex, BG=basal ganglia, dACC=dorsal ACC, dlPFC=dorsolateral prefrontal cortex, FFG=fusiform gyrus, I/M/medial/SFG=inferior/r I/M/SOG=inferior/middle/superior occipital gyrus, I/M/STG=inferior/middle/superior temporal gyrus, I/SPL=inferior/superior parietal lo frontal cortex, OFG=orbital frontal gyrus, PCC=posterior cingulate cortex, pre-/post-CG=pre-/post-central gyrus, PHG=parahippocar SMA=supplementary motor area, STS=superior temporal sulcus

Supplement 3: Meta-analyses in Pediatric Sample with ADHD and ASD

Table S3a. Characteristics of Overall Pediatric Sample and Age-, Sex- and IQ-matched Subgroups

	ADHD	ASD	TD_{ADHD}	TD_{ASD}
(A) Overall Sample				
VBM				
N	615	848	568	869
% males	81	87	82	86
Mean age (range), y	11.6 (6-20)	10.8 (2-24[a])	12.0 (6-20)	10.8 (2-24[a])
Mean FSIQ (SD)	102 (9.7)	94 (18.4)	110 (5.0)	106 (11.1)
fMRI during Cognitive Control				
N	568	--	572	--
% males	79	--	73	--
Mean age (range), y	13.0 (7-20)	--	13.1 (7-20)	--
Mean FSIQ (SD)	101 (6.7)	--	109 (5.5)	--
fMRI during Motor Response Inhibition				
N	389	--	395	--
% males	77	--	72	--
Mean age (range), y	13.1 (7-20)	--	13.0 (7-20)	--
Mean FSIQ (SD)	99 (7.1)	--	109 (5.5)	--
(B) Matched Subgroups				
VBM				
N	596	741	550	765
% males	82	86	82	84
Mean age (range), y	11.7 (6-20)	11.0 (2-24[a])	12.0 (6-20)	11.0 (2-24[a])
Mean FSIQ (SD)	101 (2.4)	96 (4.7)	109 (1.1)	106 (4.1)

Abbreviations: N = overall number of subjects, TD_{ASD} = typically developing controls in the ASD studies, TD_{ADHD} = typically developing controls in the ADHD studies, VBM = voxel-based morphometry, fMRI = functional Magnetic Resonance Imaging, % males = proportion of males among the samples, y = year, FSIQ = full scale IQ, and SD = standard deviation. The demographic characteristics presented here were calculated from the independent datasets with non-overlapping participants. Due to insufficient number of independent datasets, no fMRI meta-analysis in pediatric groups were carried out and no demographic information is reported here. [a]included one study primarily in adolescents with upper age limit of 24 years.

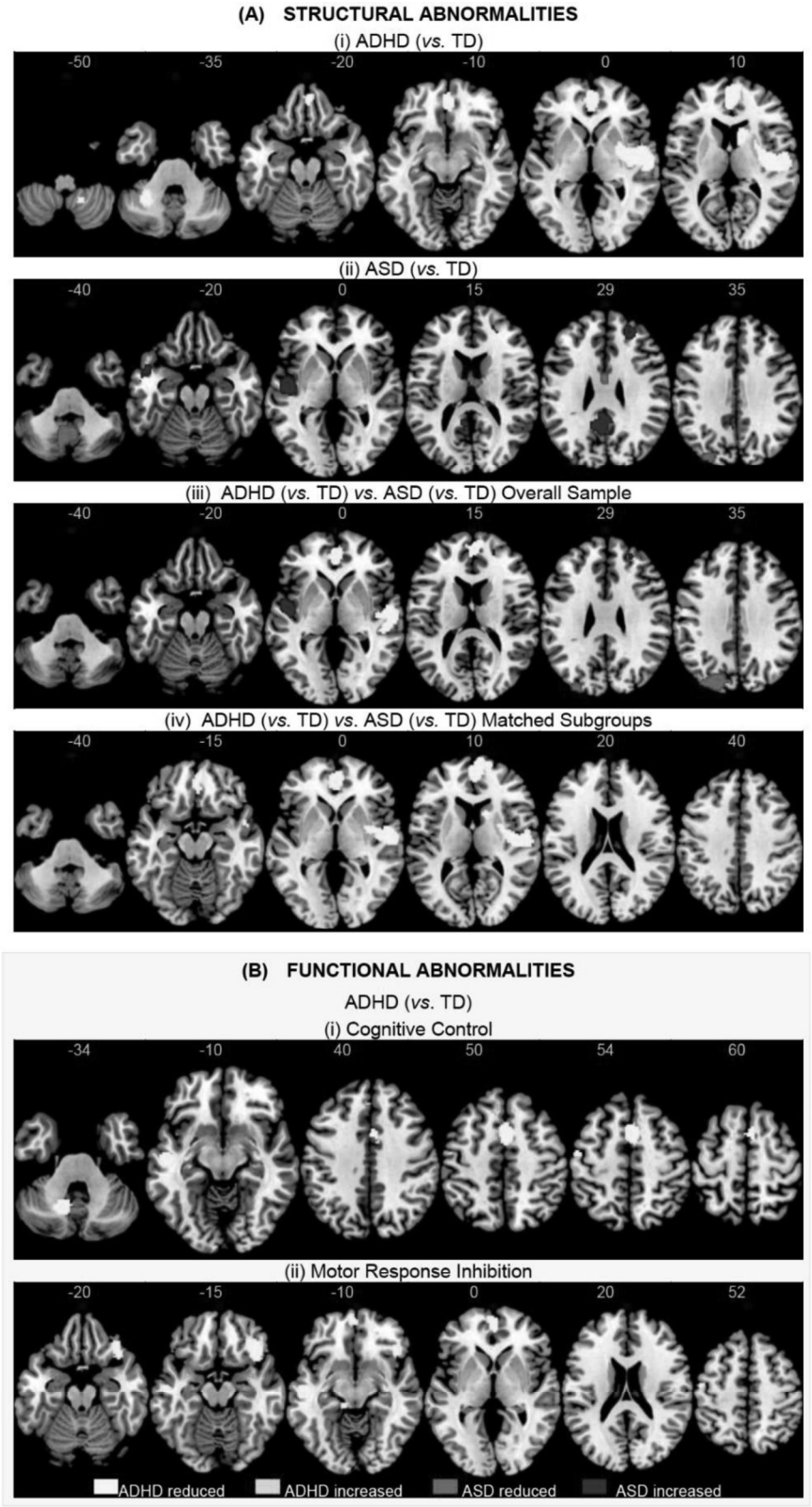
Table S3b. Structural and Functional Abnormalities in Pediatric Sample with ADHD and ASD

Contrasts	MNI coord. x, y, z	SDM Z	p-value	Voxels No	BA
(A) Structural Abnormalities					
(i) ADHD *vs*. TD					
ADHD < TD					
R STG/putamen/posterior insula*	56,-14,8	2.47	.0003	1709	48/22/38
rACC/vmPFC/vmOFC*	6,50,8	2.61	.0001	1223	32/10/11
R caudate*	18,12,10	2.44	.0003	353	--
L cerebellum hemispheric lobule VI	-28,-48,-34	2.08	.002	155	--
R cerebellum hemispheric lobule IX	16,-52,-46	1.93	.004	32	--
ADHD > TD					
Nil	--	--	--	--	--
(ii) ASD *vs.* TD					
ASD < TD					
L cerebellum lobule VIII*	-8,-66,-46	1.58	.0002	890	--
L MOG/SPG	-26,-82,40	1.59	.0002	415	19/7
Dorsomedial thalamus*	4,-4,16	1.48	.0003	144	--
Middle cingulate gyrus	0,-6,28	1.18	.002	23	--
ASD > TD					
L anterior temporal pole/STG/MTG*	-46,-10,-6	2.40	.00005	1051	21/48/22/20/38
Precuneus/PCC*	-4,-55,22	2.40	.00005	651	23/30/26
R MFG/SFG/dlPFC*	26,46,28	2.42	.00003	236	46/9
ADHD (*vs.* TD) *vs.* ASD (*vs.* TD)					
(iii) Overall Sample					
ADHD (*vs.* TD) reduced *vs.* ASD (*vs.* TD)					
R STG/MTG/AI	58,-12,0	2.29	.0006	938	22/21/48/38
mPFC/rACC/vmOFC*	6,58,10	2.46	.0003	906	10/32/11
L post-CG	-54,-12,34	2.02	.002	59	3/4
ASD (*vs.* TD) reduced *vs.* ADHD (*vs.* TD)					
L MOG	-24,-82,40	1.22	.0001	820	19
ASD (*vs.* TD) increased *vs.* ADHD (*vs.* TD)					
L posterior insula/STG/MTG*	-46,-8,-2	2.29	.0006	446	48/38
R MFG/dlPFC*	24,46,24	2.37	.0004	110	46
(iv) Matched Subgroups					
ADHD (*vs.* TD) reduced *vs.* ASD (*vs.* TD)					
R putamen/AI/STG	58,-12,2	2.09	.0006	1369	22/48
rACC/vmPFC/vmOFC*	6,60,12	2.36	.0001	1291	10/11/32
R caudate	14,14,8	1.87	.002	67	--
(B) Functional Abnormalities					
ADHD vs. TD					
(i) Cognitive Control					
ADHD < TD					
SMA/dmPFC*	4,6,50	1.72	.0001	554	6/32/24
L anterior MTG*	-50,-18,-10	1.63	.0003	197	48/22/20/21
L middle cerebellar peduncle	-14,-62,-36	1.26	.002	154	--
L post-CG*	-48,-10,56	1.23	.002	22	6
ADHD>TD					
L medial SFG	-8, 28, 48	1.09	.002	45	8/9/32

(ii) Motor Response Inhibition					
ADHD < TD					
R vlPFC/OFC/AI*	38,28,-16	1.74	.0005	379	47/38
L anterior MTG*	-52,-18,-10	2.06	.0001	323	22/21/10/48
vmOFC	-4,56,-6	1.43	.002	326	10
L lingual gyrus	-10,-32,-8	1.35	.003	47	27
L post-CG*	-48,-10,56	1.48	.002	27	6
ADHD > TD					
L medial SFG	-8,28,50	1.29	.002	39	8

Abbreviations: MNI = Montreal Neurological Institute, SDM = seed-based d mapping, BA = Brodmann Area, TD = typically developing controls, L/R = left/right. Brain regions (in alphabetical order): AI = anterior insula, dlPFC = dorsolateral prefrontal cortex, dmPFC = dorsomedial prefrontal cortex, mPFC = medial prefrontal cortex, MOG = middle occipital gyrus, M/SFG = middle/superior frontal gyrus, M/STG = middle/superior temporal gyrus, OFC = orbitofrontal cortex, PCC = posterior cingulate cortex, PHG =parahippocampal gyrus, pre-/post-CG =pre-/post-central gyrus, rACC = rostral anterior cingulate cortex, SMA =supplementary motor area, SPG = superior parietal gyrus, vlPFC = ventrolateral prefrontal cortex, vmOFC = ventromedial orbitofrontal cortex, vmPFC =ventromedial prefrontal cortex. Asterisks indicate overlapping impairments with findings in the age non-stratified overall samples. Bold fonts indicate overlapping disorder-differentiating impairment between the overall pediatric samples and age-, sex- and IQ-matched pediatric subgroups. No pediatric comparative fMRI meta-analyses involving the ASD population were carried out due to insufficient number of ASD independent datasets.

Figure S3. Structural and Functional Abnormalities in Pediatric Sample with ADHD and ASD



Abnormalities in the (A) gray matter volume (GMV) and (B) brain activations during (i) cognitive control and (ii) motor response inhibition only in ADHD relative to typically developing (TD) controls. A statistical threshold of $p < .005$ and a cluster extent of 20 voxels were used.

Supplement 4: Meta-analyses in Adults with ADHD and ASD

Table S4a. Characteristics of Adult Overall Sample and Subgroups Matched on Age, Sex and IQ

	ADHD	ASD	TD_{ADHD}	TD_{ASD}
(A) Overall Sample				
VBM				
N	611	417	531	427
% males	57	87	58	87
Mean age (range), y	32.0 (18-65)	29.1 (16[a]-59)	32.4 (18-65)	27.7 (18-58)
Mean FSIQ (SD)	108 (5.6)	104 (11.5)	112 (5.7)	113 (6.0)
fMRI during Cognitive Control				
N	433	152	432	135
% males	75	85	65	84
Mean age (range), y	25.4 (17-50)	28.7 (15[b]-52)	25.8 (18-50)	28.4 (18-52)
Mean FSIQ (SD)	106 (6.6)	108 (5.8)	112 (4.6)	114 (5.3)
fMRI during Motor Response Inhibition				
N	346	--	339	--
% males	77	--	65	--
Mean age (range), y	25.4 (18-50)	--	26.0 (18-50)	--
Mean FSIQ (SD)	103 (5.3)	--	111 (5.2)	--
(B) Matched Subgroups				
VBM				
N	287	232	275	223
% males	71	77	70	75
Mean age (range), y	27.7 (18-65)	31.4 (16[a]-59)	28.4 (18-65)	28.5 (18-58)
Mean FSIQ (SD)	103 (5.7)	102 (13.6)	108 (4.5)	114 (8.7)
fMRI during Overall Cognitive Control				
N	257	152	241	135
% males	81	85	80	84
Mean age (range), y	26.5 (17-50)	28.7 (15[b]-52)	26.0 (18-50)	28.4 (18-52)
Mean FSIQ (SD)	109 (6.8)	108 (5.8)	114 (3.8)	114 (5.3)

Abbreviations: N = overall number of subjects, TD_{ASD} = controls in the ASD studies, TD_{ADHD} = controls in the ADHD studies, VBM = voxel-based morphometry, fMRI = functional Magnetic Resonance Imaging, % males = proportion of males among the samples, y = year, FSIQ = full scale IQ, and SD = standard deviation. The demographic characteristics presented here were calculated from the independent datasets with non-overlapping participants. There were insufficient number of adult ASD fMRI datasets during motor control thus no meta-analyses involving adult ASD participants were conducted during prepotent response inhibition and the participant characteristics are not reported in this table. [a] included one study primarily in adults with lower age limit of 16 years. [b] included a study conducted primarily in adult with 3/12 participants aged 15-16 years old.

Table S4b. Structural and Functional Abnormalities in Adults with ADHD and ASD

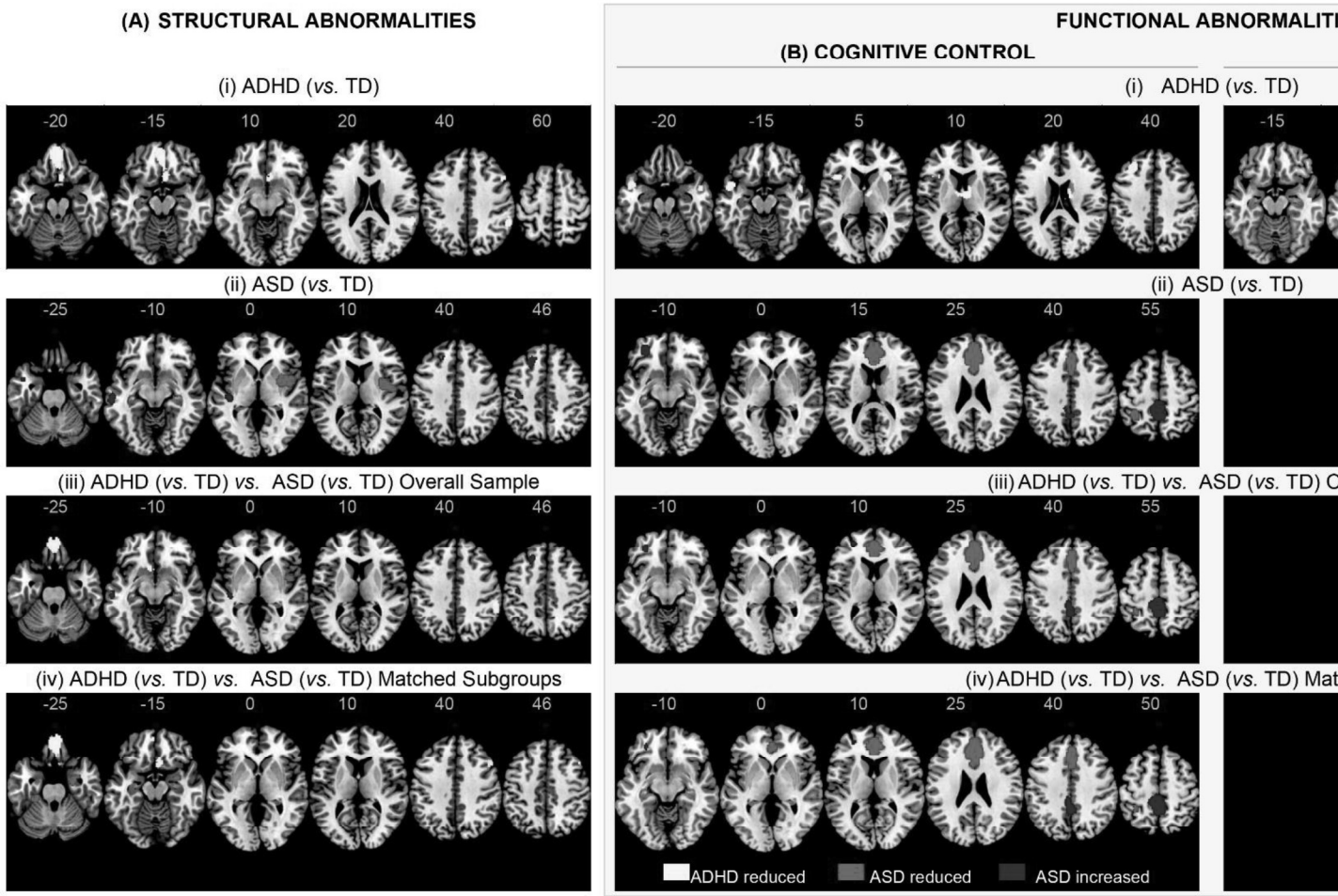
Contrasts	MNI coord. x, y, z	SDM Z	*p*-value	Voxels No	BA
(A) Structural Abnormalities					
(i) ADHD *vs.* TD					
ADHD < TD					
vmOFC/subcallosal gyrus*	0,56,-24	1.81	.00005	952	11/25
R supramarginal gyrus/posterior MTG/STG	54,-42,24	1.45	.0005	680	48/42/40/22/21/41
R IFG/MFG	46,16,40	1.11	.003	53	44/9
R SMA	8,26,64	1.03	.004	27	8
ADHD>TD					
Nil	--	--	--	--	--
(ii) ASD *vs.* TD					
ASD < TD					
R putamen/posterior insula	38, 6, -2	1.86	.001	920	48
R cerebellum crus I	26, -78, -24	1.80	.001	174	19/18
L/R cuneus	6, -70, 12	1.85	.001	67	17/18
R lingual gyrus	18,-96,-10	1.84	.001	45	18
L MOG	-36,-94,-10	1.73	.002	30	18
ASD > TD					
L anterior MTG/ITG*	-60,-22,-16	2.15	.00002	266	21/20/22
L pre-/post-CG	-38,-16, 50	1.75	.0002	212	6/4
L SFG/MFG/dlPFC	-20, 28, 44	1.84	.0001	117	9/8/32
L posterior STG	-40, -22, -2	1.61	.0007	111	48
R pre-/post-CG	46, -18, 50	1.50	.002	98	6/4
L MTG	-44, 4, -26	1.68	.0005	37	20/21
ADHD (*vs.* TD) *vs.* ASD (*vs.* TD)					
(iii) Overall Sample					
ADHD (*vs.* TD) reduced *vs.* ASD (*vs.* TD)					
vmOFC/subcallosal gyrus*	-4,56,-22	1.87	.00004	672	11
vmOFC/gyrus rectus*	-10,16,-12	1.29	.002	65	11
R supramarginal gyrus	58,-36,38	1.42	.0007	269	40/48
ASD (*vs.* TD) reduced *vs.* ADHD (*vs.* TD)					
R cerebellum, crus I	26,-78,-24	1.37	.002	261	--
R insula	44,2,2	1.34	.002	104	--
R occipital pole	6,-72,12	1.47	.001	60	18
R lingual gyrus	18,-94,-10	1.59	.0006	50	18
L occipital pole	-36,-94,-10	1.32	.002	27	18
ASD (*vs.* TD) increased *vs.* ADHD (*vs.* TD)					
L MTG*	-60,-22,-16	1.56	.0003	154	21/20
L pre-CG	-38,-16,50	1.33	.001	90	6
L dlPFC/MFG/SFG	-20,30,46	1.45	.0006	62	9/8
(iv) Matched Subgroups					
ADHD (*vs.* TD) reduced *vs.* ASD (*vs.* TD)					
vmOFC/subcallosal gyrus*	0,48,-28	1.39	.0006	604	11
vmOFC/gyrus rectus*	6,14,-18	1.15	.002	87	11
R IFG/MFG	46,18,40	1.25	.001	59	44
ASD (*vs.* TD) reduced *vs.* ADHD (*vs.* TD)					
R amygdala/PHG/FFG	30,-2,-22	1.95	.0003	375	36/34/28
L FFG	-28,-32,-26	1.49	.003	84	20/30/27

ASD (*vs.* TD) increased *vs.* ADHD (*vs.* TD)					
R posterior STG*	56,-42,22	1.24	.001	180	42/48/41
(B) Functional Abnormalities during Cognitive Control					
(i) ADHD *vs.* TD					
ADHD < TD					
L MFG/dlPFC*	-26,34,40	1.71	.0002	361	9/46/8
R caudate/dorsomedial thalamus*	6,-6,12	1.76	.0001	364	--
R AI/putamen*	30,24,2	1.40	.002	274	47/48
L temporal pole/STG/insula*	-48,8,-14	1.43	.001	270	38/21/48
L AI/IFG*	-36,20,6	1.37	.002	86	48/45
R temporal pole/MTG/STG*	52,4,-18	1.31	.003	74	21/38
R MTG/STG*	52,-12,-12	1.26	.003	41	22/20
R posterior STG	56,-40,18	1.30	.003	29	42
ADHD>TD					
Nil	--	--	--	--	--
(ii) ASD *vs.* TD					
ASD < TD					
rdACC/dmPFC*	-2,36,22	1.99	.00001	2885	32/24
L IPL/SPL*	-34,-46,52	1.43	.001	321	40/2/7
ASD > TD					
Precuneus*	6,-48,60	1.77	.00004	1181	5/4
L vlPFC/OFC*	-32,44,-14	1.35	.001	103	11/47
L MFG/dlPFC*	-26,48,14	1.35	.001	57	46/10
ADHD (*vs.* TD) *vs.* ASD (*vs.* TD)					
(iii) Overall Sample					
ASD (*vs.* TD) reduced *vs.* ADHD (*vs.* TD)					
mPFC/rACC/vmPFC/vmOFC*	0,36,20	2.70	.0000008	2948	32/24//9/10
L IPL/SPL/post-CG	-34,-42,54	1.29	.001	108	40/2/3
ASD (*vs.* TD) increased *vs.* ADHD (*vs.* TD)					
Precuneus/PCC*	-4,-40,52	2.35	.00001	1462	4/5/7
L MFG/dlPFC	-28,48,8	1.62	.001	69	46/10
L vlPFC/OFC*	-30,42,-8	1.55	.001	60	11/47
(iv) Matched Subgroups					
ASD (*vs.* TD) reduced *vs.* ADHD (*vs.* TD)					
dmPFC/ACC/vmPFC/vmOFC*	0,34,20	2.63	.0000005	3241	32/24/9/10/8/11
L IPL/SPL/post-CG*	-34,-42,54	1.22	.002	71	40/2/3
ASD (*vs.* TD) increased *vs.* ADHD (*vs.* TD)					
Precuneus/PCC*	-4,-40,54	2.33	.000008	1548	4/5/7
L vlPFC/OFC*	-30,42,-8	1.47	.002	33	11/47
L MFG/dlPFC	-28,48,8	1.48	.002	30	46/10
(C) Functional Abnormalities during Motor Response Inhibition					
(i) ADHD *vs.* TD					
ADHD < TD					
L MFG/dlPFC*	-28,28,48	1.81	.00006	554	9/46/8
R AI/putamen/IFG*	32,22,4	1.70	.0002	456	47/48/45
R MTG/STG	46,-20,-8	1.33	.002	255	48/22/21/20
R posterior STG/ supramarginal gyrus	54,-38,16	1.42	.001	165	42/48/41
R IPL	48,-36,50	1.33	.002	69	2/40
L Precuneus	-12,-32,58	1.39	.001	41	7
ADHD > TD					

Nil	--	--	--	--	--

Abbreviations: MNI=Montreal Neurological Institute, SDM=seed-based d mapping, BA=Brodmann Area, TD=typically developing controls, L/R = left/right. Brain regions (in alphabetical order): AI=anterior insula, dlPFC = dorsolateral prefrontal cortex, dmPFC = dorsomedial prefrontal cortex, FFG = fusiform gyrus, I/M/SFG = inferior/middle/superior frontal gyrus, I/M/STG=inferior/middle/superior temporal gyrus, I/SPL= inferior/superior parietal lobe, MOG = middle occipital gyrus, OFC = orbitofrontal cortex, PCC = posterior cingulate cortex, PHG = parahippocampal gyrus, pre-/post-CG = pre/postcentral gyrus, rACC = rostral anterior cingulate cortex, rdACC = rostrodorsal anterior cingulate cortex, SMA = supplemental motor area, vlPFC = ventrolateral prefrontal cortex, vmOFC = ventromedial orbitofrontal cortex, vmPFC = ventromedial prefrontal cortex. Asterisks indicate overlapping impairments with findings in the age non-stratified overall samples. Bold fonts indicate overlapping disorder-differentiating impairment between the adult overall samples and age-, sex- and IQ-matched adult subgroups. No adult fMRI meta-analyses during prepotent response inhibition involving the ASD population were carried out due to insufficient number of adult ASD independent datasets.

Figure S4. Structural and Functional Abnormalities in Adults with ADHD and ASD



Abnormalities in the (A) gray matter volume and brain activations during (B) cognitive control and (C) motor response inhibition. Rows
ASD relative to typically developing (TD) controls. Abnormalities in ADHD versus ASD, each relative to TD controls are shown in (iii) o
matched subgroups. No adult fMRI meta-analyses during motor control involving the ASD population were carried out due to insufficie
A statistical threshold of $p < .005$ with a cluster extent of 20 voxels were used in all analyses.

Supplement 5: Associations between Brain Abnormalities and Age

Correlational Analyses between Brain Abnormalities and Age

Among the most consistent disorder-differentiating VBM abnormalities, the ADHD-differentiating GMV reduction relative to ASD in medial orbitofrontal/anterior cingulate cortices was positively correlated with age (Spearman's ρ =.18, p <.0005), while the ASD-differentiating enhanced GMV relative to ADHD in right posterior temporal (ρ = -.30, p <.0005), right dorsolateral prefrontal (ρ = -.43, p <.0005) and left anterior posterior cortices (ρ = -.29, p <.0005) was negatively correlated with age (Table S4-i).

Among the most consistent disorder-differentiating fMRI abnormalities during cognitive control, the ASD-differentiating underactivation in left middle frontal/dorsolateral prefrontal cortex (ρ =.24, p <.0005), and the overactivation in precuneus (ρ = .36, p <.0005) and in left ventrolateral prefrontal cortex (ρ = .50, p <.0005) were all positively correlated with age. However, the ASD-differentiating underactivation in anterior cingulate/dorsomedial prefrontal and the overactivation in right fusiform gyrus/inferior occipital and in inferior frontal cortices were not correlated with age (Table S4-ii).

Finally, among the most consistent disorder-differentiating fMRI abnormalities during motor response control, the ADHD-differentiating underactivation in right caudate (ρ = .44, p <.0005) and inferior frontal gyrus (ρ = .20, p = .002) both were positively correlated with age. The ASD-differentiating underactivation in precuneus (ρ = -.21, p = .02) was negatively correlated with age, while the overactivation in left ventrolateral prefrontal/orbitofrontal (ρ = .61, p < .0005) and middle frontal/dorsolateral prefrontal cortices (ρ = .61, p < .0005) both were positively correlated with age. The ASD-differentiating underactivation in left cerebellum and right dorsolateral prefrontal cortex, and the ASD-differentiating overactivation in right inferior occipital gyrus/fusiform gyrus and the shared underactivation in ASD and ADHD in right AI were not correlated with age (Table S4-iii).

Table S5. Spearman's Correlations between Disorder-Differentiating or Shared Abnormalities and Age

	Peak MNI coord. x, y, z	ρ	*p*-value (Bonferroni adjusted)
(i) VBM Abnormalities			
ADHD (*vs.* TD) reduced *vs.* ASD (*vs.* TD)			
vmOFC/rACC	2, 48, -18	.18	<.0005
ASD (*vs.* TD) increased *vs.* ADHD (*vs.* TD)			
R MTG/STG/angular gyrus	50, -40 ,8	-.30	<.0005
R MFG/SFG/dlPFC	24, 44, 24	-.43	<.0005
L anterior MTG/STG	-50, -20, -8	-.29	<.0005
(ii) Cognitive-Control fMRI Abnormalities			
ASD (*vs.* TD) reduced *vs.* ADHD (*vs.* TD)			
rACC/dmPFC	2, 28, 20	-.09	.54
L MFG/dlPFC	-40, 34, 28	.24	<.0005
ASD (*vs.* TD) increased *vs.* ADHD (*vs.* TD)			
Precuneus/PCC	-2, -40, 50	.36	<.0005
R FFG/IOG/ITG	36, -70, -8	.07	>.99
R IFG	44, 24, 18	-.13	.11
L vlPFC/OFC	-30, 40, -8	.50	<.0005
(iii) Motor-Response-Inhibition fMRI Abnormalities			
ADHD (*vs.* TD) reduced *vs.* ASD (*vs.* TD)			
R caudate	8, 20, 2	.44	<.0005
R IFG	42, 26, 20	.20	.002
ASD (*vs.* TD) reduced *vs.* ADHD (*vs.* TD)			
L cerebellum lobule IV/FFG/lingual gyrus	-16, -48, -12	.02	.81
R MFG/dlPFC	42, 14, 48	-.06	>.99
R precuneus	16, -36, 44	-.21	.018
ASD (*vs.* TD) increased *vs.* ADHD (*vs.* TD)			
R IOG/FFG	36, -70, -10	.06	>.99
L vlPFC/OFC	-28, 36, -8	.61	<.0005
L MFG/SFG/dlPFC	-28, 54, 8	.61	<.0005
Reduced in ASD (*vs.* TD) and ADHD (*vs.* TD)			
R AI	40, 20, -6	-.08	.54

Abbreviations: MNI = Montreal Neurological Institute, L/R=left/right, SDM = Seed-based d mapping, BA = Brodmann Area, TD = typically developing controls, r = Pearson correlation coefficient, brain regions (in alphabetical order): AI = anterior insula, dlPFC = dorsolateral prefrontal cortex, dmPFC = dorsomedial prefrontal cortex, FFG = fusiform gyrus, IFG M/SFG = inferior/middle/superior frontal gyrus, IOG = inferior occipital gyrus, I/M/STG = inferior/middle/superior temporal gyrus, OFC=orbitofrontal cortex, PCC = posterior cingulate cortex, rACC = rostral anterior cingulate cortex, vlPFC = ventrolateral prefrontal cortex, vmOFC = ventromedial orbitofrontal cortex.

Additional Analyses Covarying for Age in the Sub-Meta-Analyses with Participants Matched on Age, Sex and IQ

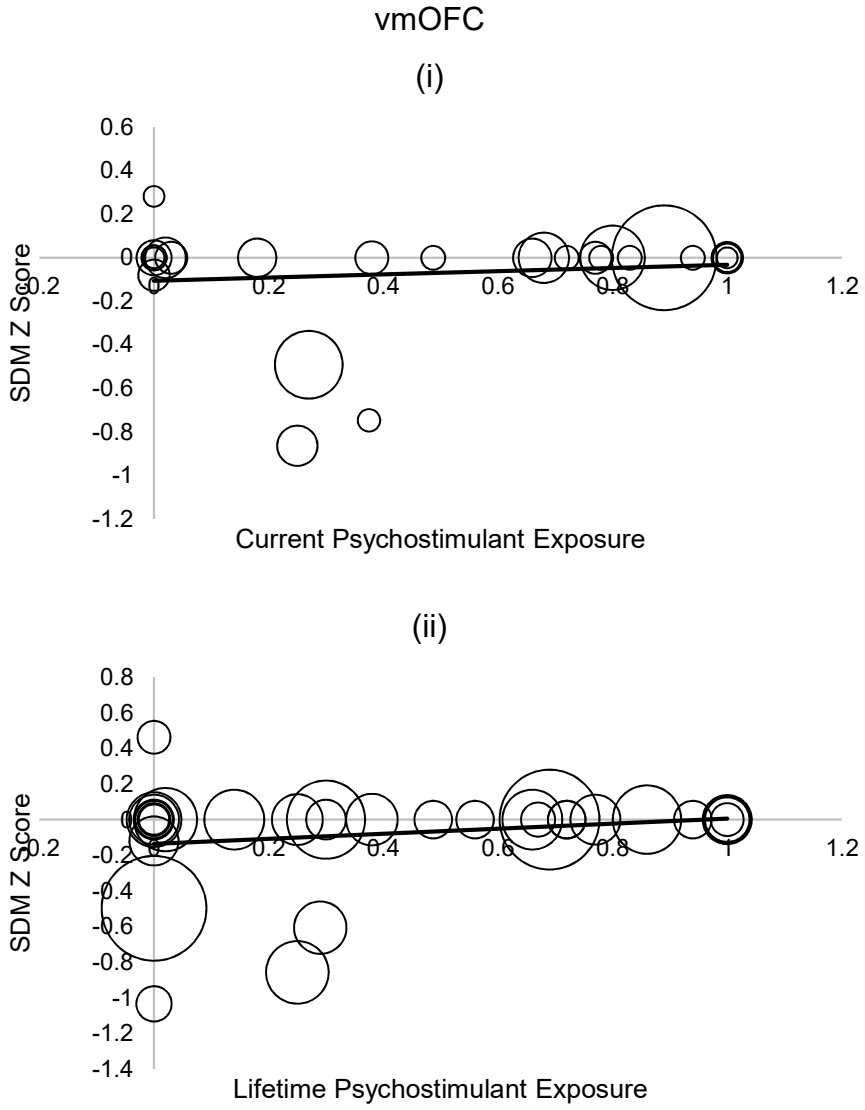
All disorder-differentiating findings in the VBM analysis, including the ADHD-differentiating reduced GMV in vmOFC/rACC (BA11; MNI coordinates: 2, 48, -18; *Z* = 2.04, *p* = .002, 193 voxels) remained after covarying for age, as did the ASD-differentiating increased GMV in right MTG/STG/angular gyrus (BA42/21/22/42; MNI coordinates: 50, -40, 8; *Z* = 2.46, *p* = .0003, 384 voxels), right MFG/SFG/dlPFC (BA46; MNI coordinates: 24, 44, 24; *Z* = 2.11, *p* = .001, 68 voxels) and left anterior MTG/STG (BA48/22/21/20; MNI coordinates: -50, -20, -8; *Z* = 1.98, *p* = .002, 58 voxels).

During cognitive control, the ASD-differentiating underactivation in rACC/dmPFC (BA32/24/9/10; MNI coordinates: 0, 30, 20; Z = 2.27, p = .0000002, 2809 voxels) and left MFG/dlPFC (BA46/45; MNI coordinates: -40,34,28; Z = 1.02, p = .001, 196 voxels), and all ASD-differentiating overactivation in precuneus/PCC (BA4/5; MNI coordinates: -2,-40,50; *Z* = 1.18, *p* = .0009, 348 voxels), right FFG/IOG/ITG (BA19/37; MNI coordinates: 36,-70,-8; Z = 1.50, p = .00007, 283 voxels), right IFG (BA48/45; MNI coordinates: 44,24,18; *Z* = 1.25, *p* = .0005, 112 voxels), and left vlPFC/OFC (BA11; MNI coordinates: -30, 40, -8; *Z* = 1.06, *p* = .002, 56 voxels) remained after covarying for age.

Specifically during motor response inhibition, with the exception of the shared right AI underactivation in both disorders, all other findings, i.e., the ADHD-differentiating underactivation in right caudate (BA25; MNI coordinates: 8,20,0; *Z* = 1.35, *p* = .0008, 188 voxels) and right inferior frontal gyrus (BA48/45; MNI coordinates: 42, 26, 20; *Z* = 1.32, *p* = .0009, 107 voxels); and the ASD-differentiating underactivation in left cerebellum/FFG/lingual gyrus (BA19/37/30; MNI coordinates: -16,-48,-12; *Z* = 1.37, *p* = .0003, 1045 voxels), right MFG/dlPFC (BA9; MNI coordinates: 42,14,48; *Z* = 1.18, *p* = .001, 77 voxels) and right precuneus (BA7; MNI coordinates: 16,-36,44; Z = -1.27, p = .0006, 49 voxels), and the ASD-differentiating overactivation in right IOG/FFG (BA19/37; MNI coordinates: 36,-72,-10; Z = 1.80, p = .00004, 461 voxels), and left vlPFC/OFC/MFG/SFG/dlPFC (BA11/10; MNI coordinates: -26,36,-8; *Z* = 1.41, *p* = .0005, 593 voxels) remained after covarying for age.

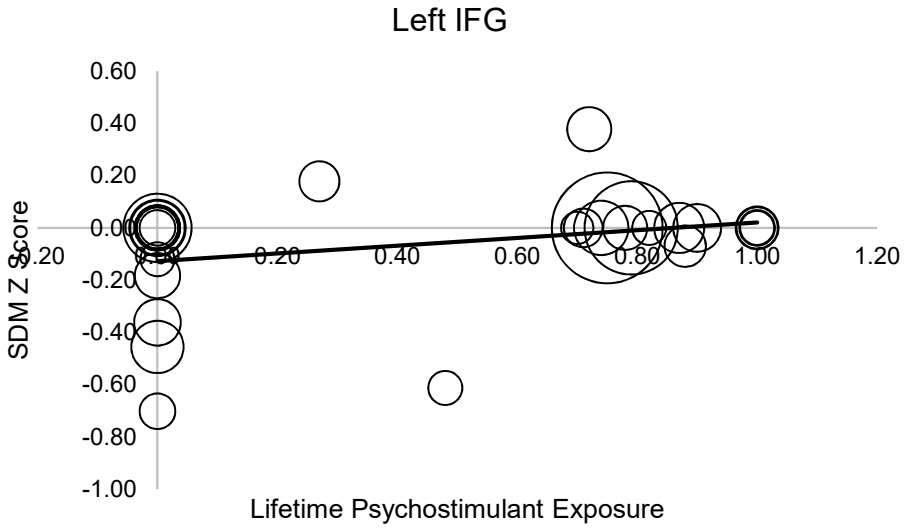
Supplement 6: Associations between Brain Abnormalities and Psychostimulant Exposure

Figure S6a. Association between VBM Abnormalities and Current Psychostimulant Exposure in ADHD



Current (i) and lifetime (ii) psychostimulant exposure were significantly associated with increased GMV in vmOFC (BA11; associations between SDM Z score and current and lifetime exposure peaked at MNI coordinates: -2, 52, -24; $Z = 1.99$, $p = .000002$, 362 voxels and coordinates: 0, 54, -26; $Z = 1.59$, $p = .0002$, 22 voxels, respectively).

Figure S6b. Association between fMRI Abnormalities and Lifetime Psychostimulant Exposure in ADHD



During overall cognitive control, lifetime psychostimulant exposure was positively associated with activation in left IFG (BA48; MNI coordinates: -46, 16, 4; Z = 1.42, p = .0002, 56 voxels). Current stimulant exposure was not significantly associated with brain functional activations in ADHD.

Supplement 7: Influences of Task Type or Performance in Disorder-differentiating Findings

Table S7. Task Types and Behavioural Performance Impairments in ADHD and ASD *vs.* TD

fMRI Studies	Task	Behavioural performance	Clinical group impaired?	Sub-group MA
ADHD Studies				
Banich et al. (2009)	Stroop	ADHD > TD (RT incongruent vs. congruent)	No	Yes
Bhaijiwala et al. (2014)	Stop	ADHD < TD (SSRT)	Yes	Yes
Booth et al. (2005)	GNG	ADHD < TD (Error rates, MRT)	Yes	Yes
Carmona et al. (2012)	GNG	ADHD < TD (MRT)	Yes	Yes
Chantiluke et al. (2015)	Stop	ADHD < TD (Omissions)	Yes	Yes
Chen et al. (2015)	GNG	ADHD = TD (Correct response, MRT)	No	Yes
Chou et al. (2015)	Stroop	ADHD < TD (Correct response, MRT)	Yes	Yes
Congdon et al. (2014)	Stop	ADHD = TD (SSRT, MRT, SDRT)	No	--
Cubillo et al. (2010)* Cubillo et al. (2011)*	Stop, Switch, Stroop	ADHD = TD (Stop: SSRT; switch: error rates and MRT; Stroop: error rates, MRT incongruent vs. congruent)	No	Yes
Cubillo et al. (2014)	Stop	ADHD = TD (SSRT, MRT, SDRT)	No	Yes
Dibbets et al. (2009)** Dibbets et al. (2010)**	GNG, Switch	ADHD < TD (Error rates) ADHD < TD (Omissions)	Yes	Yes
Durston et al. (2006)	GNG	ADHD = TD (Accuracy, MRT)	No	Yes
Fan et al. (2017)	Stroop	ADHD < TD (RT incongruent vs. congruent)	Yes	Yes
Fan et al. (2018)	Stroop	ADHD < TD (RT incongruent vs. congruent)	Yes	Yes
Hwang et al. (2015)	Stroop	ADHD < TD (MRT)	Yes	Yes
Iannaccone et al. (2015)	GNG/ Flanker	ADHD < TD (Accuracy)	Yes	Yes
Janssen et al. (2015)	Stop	ADHD < TD (SSRT, omissions)	Yes	--
Konrad et al. (2006)	Flanker	ADHD < TD (RT incongruent vs. congruent)	Yes	Yes
Kooistra et al. (2010)	GNG	ADHD < TD (MRT, SDRT)	Yes	Yes
Ma et al. (2012)	GNG	ADHD = TD (Commissions, omissions, MRT)	No	--
Ma et al. (2016)	Stroop	ADHD = TD (RT, error rates incongruent vs. congruent)	No	--
Massatt et al. (2018)	Stop	ADHD = TD (SSRT, MRT)	No	Yes
Passarotti et al. (2010)	Stop	ADHD < TD (Accuracy)	Yes	Yes
Peterson et al. (2009)	Stroop	ADHD = TD (RT incongruent vs. congruent)	No	Yes
Rassmussen et al. (2016)	GNG	ADHD < TD (Commissions)	Yes	--
Rubia et al.(2005)	Stop	ADHD < TD (SDRT, omissions)	Yes	Yes
Rubia et al. (2011)*** Rubia et al. (2011)***	Simon, Stop	ADHD < TD (MRT) ADHD < TD (SDRT)	Yes	Yes
Schulz et al. (2004)	GNG	ADHD < TD (Commissions)	Yes	Yes
Schulz et al. (2014)	GNG	ADHD < TD (Commissions, accuracy)	Yes	Yes
Schulz et al. (2017)	Stroop	ADHD = TD (MRT, error rates, omissions)	No	Yes
Sebastian et al. (2012)	GNG Stroop Stop	ADHD < TD (Stroop: interference effect; GNG: omissions; Stop: SSRT, SDRT)	Yes	Yes
Shang et al. (2018)	Stroop	ADHD = TD (MRT, SDRT)	No	Yes
Siniatchkin et al. (2012)	GNG	ADHD < TD (MRT)	Yes	Yes

Smith et al. (2006)	GNG, Stroop, Switch	ADHD < TD (GNG: MRT, SDRT; Switch: MRT; Stroop: SDRT)	Yes	Yes
Spinelli et al. (2011)	GNG	ADHD < TD (Omissions)	Yes	Yes
Szekely et al. (2018)	Stop	ADHD = TD (SSRT, MRT, accuracy)	No	--
Tamm et al. (2004)	GNG	ADHD < TD (Omissions, commissions)	Yes	Yes
Thornton et al. (2018)	GNG	ADHD < TD (Commissions)	Yes	--
Van Hulst et al. (2017)	GNG	ADHD < TD (Accuracy, SDRT, MRT)	Yes	Yes
Van Rooij et al. (2015) – adult	Stop	ADHD < TD (SSRT, errors, SDRT)	Yes	--
Van Rooij et al. (2015) – pediatric	Stop	ADHD < TD (SSRT, errors, SDRT)	Yes	--
Zamorano et al. (2017)	Stroop	ADHD > TD (RT incongruent vs. congruent)	No	Yes
ASD studies				
Ambrosino et al. (2014)	GNG	ASD = TD (Accuracy, MRT)	No	Yes
Chantiluke et al. (2015)	Stop	ASD = TD (SSRT, omissions, MRT)	No	Yes
Daly et al. (2014)	GNG	ASD = TD (MRT, probability of inhibition)	No	Yes
Denisova et al. (2017)	Stroop	ASD = TD (RT incongruent vs. congruent)	No	Yes
Duerden et al. (2013)	GNG	ASD = TD (Errors, MRT)	No	Yes
Fan et al. (2012)	Flanker	ASD < TD (Conflict errors, MRT)	Yes	Yes
Gooskens et al. (2018)	Stop	ASD = TD (SSRT, errors, MRT)	No	Yes
Kana et al. (2007)	GNG	ASD = TD (Commissions, MRT)	No	Yes
Kennedy et al. (2006)	Stroop	ASD = TD (Accuracy, MRT)	No	Yes
Prat et al. (2016)	GNG	ASD = TD (Accuracy, MRT)	No	Yes
Schmitz et al. (2006)	GNG, Switch, Stroop	ASD = TD (GNG: accuracy, MRT; Switch & Stroop: errors, RT incongruent vs. congruent)	No	Yes
Shafritz et al. (2008)	Switch	ASD < TD (Accuracy, RT)	Yes	Yes
Shafritz et al. (2015)	GNG	ASD = TD (Errors, MRT)	No	Yes
Solomon et al. (2014)	Switch	ASD < TD (Errors)	Yes	Yes
Vaidya et al. (2011)	Stroop	ASD < TD (RT incongruent vs. congruent)	Yes	Yes
Van Hulst et al. (2017)	GNG	ASD < TD (Accuracy, MRT, SDRT)	Yes	Yes
Velasquez et al (2017)	GNG	ASD = TD (Accuracy, MRT)	No	Yes
Yerys et al. (2015)	Switch	ASD < TD (Accuracy)	Yes	Yes

From the ADHD studies, 26/41 independent datasets demonstrated poorer performance in the patient group relative to controls. From the ASD studies, 6/18 independent datasets demonstrated poorer performance in the patient group relative to controls. Abbreviations: TD = typically developing controls, GNG = Go/No-Go, omissions = omission errors, commissions = commission errors, RT = response time, MRT= mean RT, SDRT = standard deviation of RT, SSRT = stop-signal reaction time. *, **, *** Datasets with largely overlapping participants, combined to control shared variance.

Comparing Task Type and Performance in ADHD and ASD *vs.* TD

A trend for an interaction between task type (motor response inhibition, cognitive interference, switch, combination of tasks) and diagnostic groups was observed overall, $\chi^2(3, N = 60) = 7.7$, $p = .06$, and in subgroups matched on age, sex and IQ, $\chi^2(3, N = 51) = 6.7$, $p = .08$. Furthermore, a significant interaction was found between performance (clinical group is impaired or unimpaired) and diagnostic groups in the overall sample, $\chi^2(1, N = 60) = 5.7$, $p = .02$, and in the subgroups matched on age, sex and IQ, i.e., fewer studies showed that people with ASD were impaired than

ADHD on the cognitive control tasks $\chi^2(1, N = 51) = 6.3$, $p = .02$. The interaction was also observed when motor response inhibition tasks only were included in the analyses using all available data, $\chi^2(1, N = 42) = 14.1$, $p < .001$ and in age-, sex- and IQ-matched subgroups $\chi^2(1, N = 29) = 15.2$, $p < .001$.

Influences of Task Type and Performance in the Disorder-differentiating Findings during Cognitive Control

To assess the influence of task type, a meta-analysis comparing the functional impairment during cognitive control, covarying separately for task type and performance, in ASD and ADHD was conducted in the overall sample and matched subgroups. Covarying for task type, ASD-differentiating reduced activation in the ACC/midcingulate/dmPFC (overall = BA32/24/9/8/10; MNI coordinates: 0, 32, 22; $Z = 2.44$, $p < .00001$, 3065 voxels; matched subgroups = BA32/24/9/10; MNI coordinates: 2, 28, 20; $Z = 2.30$, $p < .00001$, 2994 voxels); and increased activations in precuneus (overall = BA5/4/23; MNI coordinates: 0, -42, 50; $Z = 1.88$, $p = .00002$, 1203 voxels; matched subgroups = BA5/4; MNI coordinates: 0, -42, 50; $Z = 1.82$, $p = .0001$, 706 voxels) and right inferior occipital lobe (overall = BA19; MNI coordinates: 36, -70, -8; $Z = 1.28$, $p = .0003$, 51 voxels; matched subgroups = BA19; MNI coordinates: 36, -68, -8; $Z = 1.43$, $p = .002$, 66 voxels) relative to ADHD remained significant.

Covarying for behavioural performance, the disorder-differentiating impairment in the ASD relative to the ADHD group remained in the above regions, i.e., precuneus (overall = BA5/4; MNI coordinates: 0, -42, 50; $Z = 1.32$, $p = .0001$, 960 voxels; matched subgroups = BA5/4; MNI coordinates: 0, -42, 50; $Z = 1.09$, $p = .0001$, 281 voxels), right inferior occipital lobe (overall = BA19; MNI coordinates: 36, -70, -8; $Z = 1.17$, $p = .0004$, 119 voxels; matched subgroups = BA5/23/4; MNI coordinates: 38, -68, -8; $Z = 1.36$, $p = .0002$, 244 voxels) and ACC/midcingulate/dMPFC (overall = BA32/24/9/8/ 10; MNI coordinates: 0, 32, 22; $Z = 2.69$, $p < .00001$, 3214 voxels; matched subgroups = BA32/24/9/10/8; MNI coordinates: 0, 32, 22; $Z = 2.72$, $p < .00001$, 3286 voxels).

Influences of Performance in the Disorder-differentiating Findings during Motor Response Inhibition

When covarying for performance during motor response inhibition data, we observed ASD-differentiating underactivation in left lingual gyrus/FFG/cerebellum lobule (overall = BA19/37/30/18; MNI coordinates: -10, -58, -14; Z = 1.13, p = .001, 388 voxels; matched subgroups = BA19/37/30/18; MNI coordinates: -16, -48, -12; Z = 1.01, p = .0004, 747 voxels), rACC/dmPFC (overall data only = BA5/4/23; MNI coordinates: 4, 34, 20; Z = 1.23, p = .0008, 587 voxels); and left MFG/dlPFC (overall data only = BA45/48; MNI coordinates: -46, 34, 16; Z = 1.24, p = .0007, 261 voxels) and right MFG/dlPFC (overall data only = BA9/6/44; MNI coordinates: 42, 10, 48; Z = 1.09, p = .002, 49 voxels). We also observed overactivation in right IOG/FFG (overall = BA19/37; MNI coordinates: 36, -68, -8; Z = 1.57, p = .000002, 434 voxels; matched subgroups = BA19/37/18; MNI coordinates: 34, -68, -6; Z = 1.35, p =. 0000002, 524 voxels), left vlPFC/OFC (overall data only = BA11/10/47/46; MNI coordinates: -28, 38, -16; Z = 1.30, p = .00002, 868 voxels) and left posterior MTG (overall data only = BA37/21; MNI coordinates: -48, -54, 4; Z = 1.41, p = .00002, 289 voxels). The ADHD-differentiating underactivation in right IFG and caudate did not survive covarying for task performance.

Supplement 8: Jack-knife Analyses in Brain Structure and Function Abnormalities

Table S8a. Jack-knife Analyses of Reduced GMV Clusters among ADHD VBM Studies

Study excluded	L/R vmOFC/vmPFC/rACC R caudate	R putamen/posterior insula/STG	L pre-CG	R rostrolateral PFC	L vlPFC
Ahrendts et al. (2011)	Yes	Yes	Yes	Yes	Yes
Montes et al. (2010)	Yes	Yes	Yes	Yes	Yes
Amico et al. (2011)	Yes	Yes	Yes	Yes	Yes
Bonath et al. (2016)	Yes	Yes	Yes	Yes	Yes
Bralten et al. (2016)	Yes	Yes	**No**	**No**	Yes
Brieber et al. (2007)	Yes	Yes	Yes	Yes	Yes
Carmona et al. (2005)	Yes	Yes	Yes	Yes	Yes
Depue et al. (2010)	Yes	Yes	Yes	Yes	Yes
Gehricke et al. (2017)	Yes	Yes	Yes	Yes	Yes
He et al. (2015)	Yes	Yes	Yes	Yes	Yes
Iannaccone et al. (2015a)	Yes	Yes	Yes	**No**	Yes
Jagger-Rickels et al. (2018)	Yes	Yes	Yes	Yes	Yes
Johnston et al. (2014)	Yes	Yes	Yes	Yes	Yes
Kappel et al. (2015) – pediatric	Yes	Yes	Yes	Yes	Yes
Kappel et al. (2015) – adult	Yes	Yes	Yes	Yes	Yes
Kaya et al. (2018)	Yes	Yes	Yes	Yes	Yes
Kobel et al. (2010)	Yes	Yes	Yes	Yes	Yes
Kumar et al. (2017)	Yes	Yes	Yes	Yes	Yes
Li et al. (2015)	Yes	Yes	Yes	Yes	Yes
Lim et al. (2015)	Yes	Yes	Yes	Yes	Yes
Maier et al. (2015)	Yes	Yes	Yes	Yes	Yes
McAlonan et al. (2007)	Yes	Yes	Yes	Yes	Yes
Moreno-Alcázar et al. (2016)	Yes	Yes	Yes	Yes	Yes
Onnink et al. (2014)	Yes	Yes	Yes	Yes	Yes
Overmeyer et al. (2001)	Yes	Yes	Yes	Yes	Yes
Ramesh and Rai (2013)	Yes	Yes	Yes	Yes	Yes
Roman-Urrestarazu et al. (2016)	Yes	Yes	Yes	Yes	Yes
Saad et al. (2017)	Yes	Yes	Yes	Yes	Yes
Sasayama et al. (2010)	Yes	Yes	Yes	Yes	Yes
Seidman et al. (2011)	Yes	Yes	Yes	Yes	Yes
Sethi et al. (2017)	Yes	Yes	Yes	Yes	Yes
Shimada et al. (2015)	Yes	Yes	Yes	Yes	Yes
Stevens and Haney-Caron (2012)	Yes	Yes	Yes	Yes	Yes
van Wingen et al. (2013)	Yes	**No**	Yes	Yes	Yes
Vilgis et al. (2016)	Yes	Yes	Yes	Yes	Yes
Villemonteix et al. (2015)	Yes	Yes	Yes	Yes	Yes
Wang et al. (2007)	Yes	Yes	Yes	Yes	Yes
Yang et al. (2008)	Yes	Yes	Yes	Yes	Yes

L/R= left/right, vmOFC = ventromedial orbital prefrontal cortex, vmPFC = ventromedial prefrontal cortex, rACC = rostral anterior cingulate cortex, , STG = superior temporal gyrus, pre-CG = precentral gyrus, vlPFC = ventrolateral prefrontal cortex.

Table S8b. Jack-knife Analyses of GMV Abnormalities among ASD VBM Studies

Study excluded	Reduced				Enhanced		
	L/R dACC/dmPFC	L cerebellum	R hippocampus/PHG/FG	Dorsomedial thalamus	L ITG/MTG/STG/posterior insula	L/R PCC/precuneus	R MFG/SFG/dlPFC
Abell et al. (1999)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Boddaert et al. (2004)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bonilha et al. (2008)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Brieber et al. (2007)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cai et al. (2018)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cheng et al. (2011)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Contarino et al. (2016)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Craig et al. (2007)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
D'Mello et al. (2015)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ecker et al. (2012)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Foster et al. (2015)	Yes	**No**	Yes	Yes	Yes	Yes	Yes
Freitag et al. (2008)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Greimel et al. (2013)	**No**	Yes	Yes	Yes	Yes	Yes	Yes
Groen et al. (2011)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hyde et al. (2010)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Itahashi et al. (2015)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Katz et al. (2016)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kaufmann et al. (2013)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ke et al. (2008)	Yes	Yes	**No**	Yes	Yes	Yes	Yes
Kosaka et al. (2010)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kurth et al. (2011)	Yes	Yes	Yes	**No**	Yes	Yes	Yes
Kwon et al. (2004)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Langen et al. (2009)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lim et al. (2015)	Yes	**No**	Yes	Yes	Yes	Yes	Yes
Lin et al. (2015) – pediatric (child)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lin et al. (2015) – pediatric (adolescent)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lin et al. (2015) – adult	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lin et al. (2017)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
McAlonan et al. (2002)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
McAlonan et al. (2008)	Yes	**No**	Yes	**No**	Yes	Yes	Yes
Mengotti et al. (2011)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mueller et al. (2013)	Yes	Yes	Yes	**No**	Yes	Yes	Yes
Ni et al. (2018)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pereira et al. (2018)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Poulin-Lord et al. (2014)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Poustka et al. (2012)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Radeloff et al. (2014)	Yes	Yes	**No**	Yes	Yes	Yes	Yes
Retico et al. (2016)	Yes	Yes	Yes	Yes	Yes	**No**	**No**
Riedel et al. (2014)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Riva et al. (2013)	Yes	Yes	**No**	Yes	Yes	Yes	Yes
Rojas et al. (2006)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sato et al. (2017)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Schmitz et al. (2006)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Toal et al. (2010)	Yes	Yes	**No**	Yes	Yes	Yes	Yes
Waiter et al. (2004)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wang et al. (2017)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wilson et al. (2009)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yang et al. (2018)	Yes	Yes	Yes	Yes	Yes	Yes	Yes

L/R = left/right, dACC = dorsal anterior cingulate cortex, dmPFC = dorsomedial prefrontal cortex, PHG = parahippocampal gyrus, FG = fusiform gyrus, ITG/MTG/STG = inferior/middle/superior temporal gyrus, PCC= posterior cingulate cortex, MFG/SFG = middle/superior frontal gyrus

Table S8c. Jack-knife Analyses of Abnormal Brain Function during Cognitive Control among ADHD fMRI Studies

	R thalamus/caudate	L M/STG/superior temporal pole	L/R SMA/dorsal cingulate	L IFG/AI/temporal pole	R AI/putamen	L post-CG	L MFG/dlPFC	R MTG
Banich et al. (2009)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bhaijiwala et al. (2014)	Yes	**No**	Yes	Yes	Yes	Yes	Yes	Yes
Booth et al. (2005)	Yes	Yes	**No**	Yes	Yes	Yes	Yes	**No**
Carmona et al. (2012)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	**No**
Chantiluke et al. (2015)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Chen et al. (2015)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Chou et al. (2015)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
(Congdon et al., 2014)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cubillo et al. (2010), Cubillo et al. (2011)*	Yes	Yes	Yes	Yes	**No**	Yes	Yes	Yes
Cubillo et al. (2014)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dibbets et al. (2010), Dibbets et al. (2009)*	Yes	Yes	Yes	Yes	**No**	Yes	Yes	Yes
Durston et al. (2006)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fan et al. (2017)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fan et al. (2018)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hwang et al. (2015)	Yes	Yes	**No**	Yes	Yes	Yes	Yes	Yes
Iannaccone et al. (2015b)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Janssen et al. (2015)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Konrad et al. (2006)	Yes	Yes	Yes	Yes	**No**	Yes	Yes	Yes
Kooistra et al. (2010)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ma et al. (2012)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ma et al. (2016)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Massat et al. (2018)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Passarotti et al. (2010)	Yes	Yes	Yes	**No**	Yes	Yes	Yes	Yes
Peterson et al. (2009)	Yes	Yes	**No**	Yes	Yes	Yes	Yes	Yes
Rasmussen et al. (2016)	Yes	Yes	Yes	Yes	**No**	**No**	**No**	Yes
Rubia et al. (2005)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	**No**
Rubia et al. (2011a), Rubia et al. (2011b)*	Yes	Yes	**No**	**No**	**No**	Yes	Yes	Yes
Schulz et al. (2004)	Yes	Yes	Yes	Yes	Yes	**No**	Yes	**No**
Schulz et al. (2014)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Schulz et al. (2017)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	**No**
Sebastian et al. (2012)	Yes	Yes	Yes	**No**	**No**	Yes	Yes	**No**
Shang et al. (2018)	Yes	Yes	Yes	**No**	Yes	Yes	Yes	Yes
Siniatchkin et al. (2012)	Yes	Yes	**No**	Yes	Yes	Yes	Yes	Yes
Smith et al. (2006)	Yes	Yes	Yes	**No**	Yes	Yes	Yes	Yes
Spinelli et al. (2011)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Szekely et al. (2018)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Tamm et al. (2004)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Thornton et al. (2018)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
van Hulst et al. (2017)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
van Rooij et al. (2015) – pediatric	Yes	Yes	Yes	Yes	Yes	**No**	Yes	Yes
van Rooij et al. (2015) – adult	Yes	Yes	Yes	**No**	Yes	Yes	Yes	**No**
Zamorano et al. (2017)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

L/R = left/right, M/STG = middle/superior temporal gyrus, SMA = supplementary motor area, IFG = interior frontal gyrus, AI = anterior insula, post-CG = post-cingulate gyrus and MFG = middle frontal gyrus, dlPFC = dorsolateral prefrontal cortex. * Data sets were combined as they were collected from the same participants

Table S8d. Jack-knife Analyses of Abnormal Brain Function during Cognitive Control among ASD fMR

Study excluded	Underactivation						
	L/R ACC/midcingulate/dmPFC	L MFG/ dlPFC	R MFG/ dlPFC	L IPL	L lingual gyrus/cerebellum IV/V	L precuneus/ midcingulate	R IOG
Ambrosino et al. (2014)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Chantiluke et al. (2015)	Yes	**No**	**No**	Yes	**No**	Yes	Yes
Daly et al. (2014)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Denisova et al. (2017)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Duerden et al. (2013)	Yes	Yes	No	Yes	Yes	Yes	**No**
Fan et al. (2012)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Gooskens et al. (2018)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kana et al. (2007)	Yes	Yes	Yes	**No**	**No**	Yes	Yes
Kennedy et al. (2006)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Prat et al. (2016)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Schmitz et al. (2006)	Yes	Yes	Yes	Yes	Yes	**No**	Yes
Shafritz et al. (2008)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Shafritz et al. (2015)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Solomon et al. (2014)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vaidya et al. (2011)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
van Hulst et al. (2017)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Velasquez et al. (2017)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yerys et al. (2015)	Yes	Yes	Yes	Yes	Yes	Yes	Yes

L/R = left/right, ACC = anterior cingulate cortex, dmPFC = dorsomedial prefrontal cortex, MFG = middle frontal gyrus, dlPFC = dorso
parietal lobe, IOG = inferior occipital gyrus, vlPFC = ventrolateral prefrontal cortex, OFC = orbitofrontal cortex, IFG = inferior frontal g

Table S8e. Jack-knife Analyses of Abnormal Brain Function during Motor Response Inhibition among ADHD fMRI Studies

Study excluded	L MFG/ dlPFC	L anterior MTG/STG	L post-CG	R IFG	R vlPFC/ OFC/AI	R caudate
Bhaijiwala et al. (2014)	Yes	Yes	Yes	Yes	Yes	Yes
Booth et al. (2005)	Yes	Yes	Yes	Yes	Yes	**No**
Carmona et al. (2012)	Yes	Yes	Yes	Yes	Yes	Yes
Chantiluke et al. (2015)	Yes	Yes	Yes	Yes	Yes	Yes
Chen et al. (2015)	Yes	Yes	Yes	Yes	Yes	Yes
Congdon et al. (2014)	Yes	Yes	Yes	Yes	Yes	Yes
Cubillo et al. (2010)	Yes	Yes	Yes	Yes	Yes	Yes
Cubillo et al. (2014)	Yes	Yes	Yes	Yes	Yes	Yes
Dibbets et al. (2009)	Yes	Yes	Yes	Yes	Yes	Yes
Durston et al. (2006)	Yes	Yes	Yes	Yes	Yes	Yes
Iannaccone et al. (2015b)	Yes	Yes	Yes	Yes	Yes	Yes
Janssen et al. (2015)	Yes	Yes	Yes	Yes	Yes	Yes
Kooistra et al. (2010)	Yes	Yes	Yes	Yes	Yes	Yes
Ma et al. (2012)	Yes	Yes	Yes	Yes	Yes	Yes
Massat et al. (2018)	Yes	Yes	Yes	Yes	Yes	Yes
Passarotti et al. (2010)	Yes	Yes	Yes	Yes	Yes	Yes
Rasmussen et al. (2016)	Yes	Yes	**No**	**No**	Yes	**No**
Rubia et al. (2005)	Yes	Yes	Yes	Yes	Yes	Yes
Rubia et al. (2011b)	Yes	Yes	Yes	Yes	Yes	Yes
Schulz et al. (2004)	Yes	Yes	Yes	Yes	Yes	Yes
Schulz et al. (2014)	Yes	Yes	Yes	Yes	Yes	Yes
Sebastian et al. (2012)	Yes	Yes	Yes	Yes	Yes	Yes
Siniatchkin et al. (2012)	Yes	Yes	Yes	Yes	Yes	**No**
Smith et al. (2006)	Yes	Yes	Yes	Yes	Yes	Yes
Spinelli et al. (2011)	Yes	Yes	Yes	Yes	Yes	Yes
Szekely et al. (2018)	Yes	Yes	Yes	Yes	Yes	Yes
Tamm et al. (2004)	Yes	Yes	Yes	Yes	Yes	Yes
Thornton et al. (2018)	Yes	Yes	Yes	Yes	Yes	Yes
van Hulst et al. (2017)	Yes	Yes	Yes	Yes	Yes	Yes
van Rooij et al. (2015) **–** pediatric	Yes	Yes	**No**	Yes	Yes	Yes
van Rooij et al. (2015) **–** adult	**No**	Yes	Yes	Yes	Yes	Yes

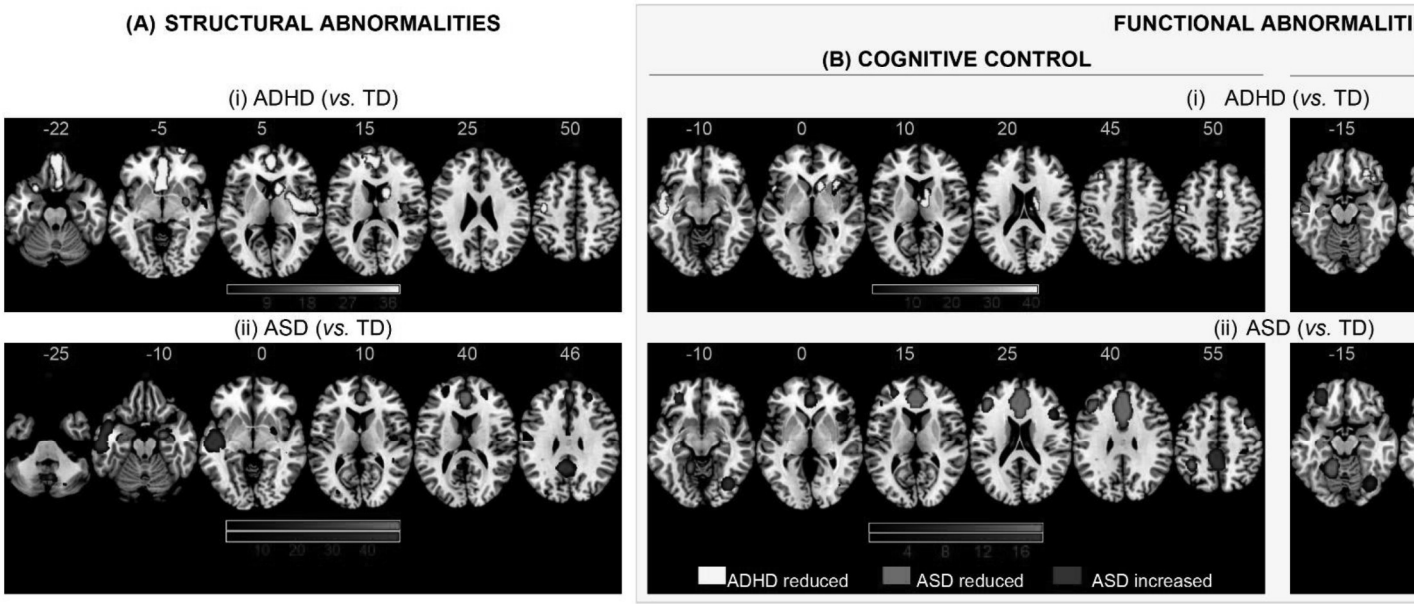
L/R = left/right, MFG = middle frontal gyrus, dlPFC = dorsolateral prefrontal gyrus, M/STG = middle/superior temporal gyrus, post-CG = post-cingulate gyrus, IFG = interior frontal gyrus, vlPFC = ventrolateral prefrontal cortex, OFC = orbitofrontal cortex, AI = anterior insula.

Table S8f. Jack-knife Analyses of Abnormal Brain Function during Motor Response Inhibition among A

Study excluded	Underactivation				Overactivation	
	R AI/vlPFC	L cerebellum/ lingual gyrus/ FFG	R MFG/ dlPFC	R PCC/ precuneus	L vlPFC/ OFC	R IOG/FFG/ ITG
Ambrosino et al. (2014)	Yes	Yes	Yes	Yes	Yes	Yes
Chantiluke et al. (2015)	Yes	**No**	**No**	Yes	Yes	**No**
Daly et al. (2014)	Yes	Yes	Yes	Yes	Yes	Yes
Duerden et al. (2013)	Yes	Yes	**No**	Yes	Yes	**No**
Gooskens et al. (2018)	Yes	Yes	Yes	Yes	Yes	Yes
Kana et al. (2007)	Yes	**No**	Yes	**No**	Yes	Yes
Prat et al. (2016)	Yes	Yes	Yes	Yes	Yes	Yes
Schmitz et al. (2006)	Yes	Yes	Yes	Yes	**No**	Yes
Shafritz et al. (2015)	**No**	Yes	Yes	Yes	Yes	Yes
van Hulst et al. (2017)	Yes	Yes	Yes	Yes	Yes	Yes
Velasquez et al. (2017)	Yes	Yes	Yes	**No**	Yes	Yes

L/R = left/right, AI = anterior insula, vlPFC = ventrolateral prefrontal cortex, FFG = fusiform gyrus, MFG= middle frontal gyrus, dlPFC = dorsolateral prefrontal cortex, PCC= posterior cingulate cortex, OFC = orbitofrontal cortex, IOG =inferior occipital gyrus, ITG = inferior temporal gyrus.

Figure S8. Pictorial Representation of the Jack-knife Analyses



Pictorial representation of jack-knife reliability analyses for structural and functional abnormalities in ASD and ADHD. Colormap indicate the level of
number of study combinations, ranging from 0 to maximum number of study combination for each comparison (see Tables 6a-f). Darker colours indicat
studies.

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