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Meta-analytische Untersuchung des Einflusses der Aufgabenkomplexität auf das neuronale Netzwerk der motorischen Antwortsinhibition

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Zusammenfassung

Exekutive Funktionen (EF) umfassen eine weite Reihe von kognitiven Prozessen, wie zum Beispiel die Inhibition, kognitive Flexibilität oder auch Prozesse des Arbeitsgedächtnisses deren Zusammenspiel uns flexibles, zielgerichtetes Verhalten ermöglichen. Vorangegangene funktionelle MRT (fMRT)-Studien zur Untersuchung der neuronalen Korrelate von EF haben dabei gezeigt, dass bei der Durchführung verschiedenster kognitiver Aufgaben zur Untersuchung der EF ein fronto-insulo-parietales Netzwerk rekrutiert wird. Dieses Netzwerk wird als Multiple Demand Netzwerk (MDN) bezeichnet und kann unter anderem durch Aufgabenkomplexität moduliert werden. Der Go/No-Go Test (GNGT), welcher die Unterdrückung motorischer Reaktionen untersucht und der Stop Signal Test (SST) zur Untersuchung von Abbrüchen einer bereits initiierten motorischen Reaktion sind die beiden wohl am häufigsten verwendeten Paradigmen zur Untersuchung von motorischer Antwortsinhibition. Obwohl die beiden Paradigmen verschiedene Aspekten der motorischen Inhibition untersuchen, wurden sie in vorangegangen fMRT-Studien und Meta-Analysen oft als gleichwertig betrachtet. Erschwerend kommt dazu, dass über die Zeit eine große Vielfalt an Testdesigns beim GNGT und SST mit variabler Aufgabenkomplexität verwendet wurde, was die Vergleichbarkeit vorangegangener fMRT-Studien zusätzlich erschwert.

Zentrales Ziel dieser meta-analytischen Arbeit ist es mittels des *„activation likelihood estimation“* (ALE) Algorithmus jene Hirnregionen zu identifizieren, die in der klassischen Testvariante und solche die in der komplexen Variante dieser beiden Inhibitionsparadigmen konsistent aktiviert werden.

Um ein besseres Verständnis über den Einfluss der Aufgabenkomplexität auf das MDN zu bekommen, wird zudem untersucht, ob die Aufgabenschwierigkeit in den klassischen und komplexen Varianten des GNGT und SST die Rekrutierung der neuralen Netzwerke eher quantitativ oder qualitativ (d.h. durch Rekrutierung zusätzlicher, insbesondere weiter frontal gelegener Hirnregionen) beeinflusst.

Die Meta-Analysen umfassen fMRT-Studien, die in Ganzhirn-Analysen von gesunden Teilnehmern die Unterdrückung (No-Go) bzw. das Abbrechen (Stop) einer motorischen Antwort mit deren Ausführung (Go) verglichen haben. Die eingeschlossenen Studien werden zudem als klassisch (d.h. Standardtestdesigns) oder komplex (d.h. Testdesigns, die zur Involvierung zusätzlicher kognitive Prozesse führen) kategorisiert. Insgesamt sind 26 klassische und 27 komplexe GNGT-Experimente sowie 33 klassische und 25 komplexe SST-Experimente eingeschlossen worden. Es werden jeweils separate Meta-Analysen für die klassischen und komplexen GNGT- bzw. SST-Versionen sowie zusätzliche Konjunktionsanalysen durchgeführt.

Die Meta-Analyse der klassischen GNGT-Varianten zeigte dabei Konvergenz in der rechten anterioren Insel (aI), dem rechten inferioren parietalen Cortex (IPC), dem (prä-)supplementären motorischen Areal ((pre-)SMA), dem rechten superioren temporalen Sulcus (STS) und dem bilateralen lateralen okzipitalen Cortex (LOC). Im Gegensatz dazu zeigte sich in der Meta-Analyse der komplexen GNGT-Varianten eine konsistente Aktivierung des rechten inferioren frontalen Gyrus (IFG), des rechten dorsolateralen präfrontalen Cortex (DLPFC), der rechten inferioren-frontalen Übergangszone (IFJ), der bilateralen aI, des bilateralen intraparietalen Sulcus (IPS), des anterioren midcingulären Cortex (aMCC) und des rechten superioren parietalen Lobulus (SPL).

Für die klassischen Varianten des SST fand sich Konvergenz in der bilateralen aI und im angrenzenden IFG, im aMCC, im preSMA, im rechten DLPFC, in der bilateralen temporalen-parietalen Übergangsregion (TPJ), im rechten IPS und im rechten Nucleus caudatus. Die Analyse der komplexen SST-Varianten zeigte ein ähnliches Kovergenzmuster mit zusätzlicher Beteiligung der bilateralen IFJ sowie des rechten Thalamus.

In den Konjunktionsanalysen zwischen den beiden Paradigmen fand sich für die klassischen Aufgabenvarianten des GNGT und SST lediglich übereinstimmende Konvergenz in der rechten aI und im rechten STS, während die komplexen SST- und GNGT-Varianten überlappende Konvergenz in der bilateralen aI, der rIFJ und dem aMCC zeigten.

Die Meta-Analyse der klassischen GNGT-Varianten zeigte zusammenfassend Konvergenz vor allem in *„low-level“* und heteromodalen Hirnregionen,

wohingegen die klassischen SST-Varianten bereits das MDN in seiner Gänze rekrutierten.

Obwohl vorangegangene Studien die GNGT- und SST-Paradigmen bisher oft als vollkommen gleichwertig bzw. austauschbar behandelt haben, zeigen die vorliegenden Ergebnisse signifikante Unterschiede in der Rekrutierung von Hirnregionen bei der Durchführung des klassischen GNGT und SST. Dies lässt schlussfolgern, dass diese beiden Paradigmen auf grundlegend unterschiedlichen neuronalen Mechanismen beruhen. Die geringen Unterschieden in der Konvergenz der Hirnregionen in den Meta-Analysen der klassischen und komplexen SST-Varianten lassen schlussfolgern, dass eine erhöhte Aufgabenkomplexität das MDN vor allem quantitativ und weniger qualitativ moduliert.

Die Ergebnisse dieser Meta-Analyse deuten in Zusammenschau mit vorangegangen Verhaltensstudien darauf hin, dass die Inhibitionsprozesse im GNGT nach einem Lernprozess automatisch ablaufen, während die Inhibition bei Anwendung des SST kontinuierlich *„top-down“* kontrolliert erfolgt. Zusammenfassend deuten diese Ergebnisse drauf hin, dass nur der SST effektiv motorische Antwortsinhibition (und weiter gefasst exekutive Funktionen) untersucht, während dies für den klassischen GNGT jedoch fraglich erscheint.

Abstract

Executive functions (EF) encompass different cognitive processes such as inhibition, working memory and cognitive flexibility, which enable flexible, goal-directed behavior. Tasks probing EF reported the involvement of a domain-general fronto-insulo-parietal multiple demand network (MDN), which can be modulated by varying levels of task complexity. Two classic response inhibition paradigms, the Go/No-Go (GNGT) and the Stop Signal task (SST), are frequently implemented paradigms to investigate the neural correlates of response inhibition. Using neuroimaging meta-analyses, we here aim to delineate brain regions showing convergence in the standard and in complex versions of these two tasks, with particular interest in whether task complexity affects the results more quantitatively or qualitatively (i.e. with recruitment of additional brain regions).

Meta-analyses are performed using the revised activation likelihood estimation algorithm on fMRI studies that analyzed whole-brain data from healthy participants contrasting No-Go or Stop trials with Go trials, respectively.

Eligible experiments are categorized as standard (classic task versions) or complex (task versions imposing additional cognitive processing), resulting in 26 standard and 27 complex GNGT experiments as well as 33 standard and 25 complex SST experiments. Separate meta-analyses are performed for standard and complex versions of GNGT and SST, respectively, using a cluster-level family-wise error-corrected threshold of $p<.05$. Additionally, conjunction analyses are performed.

Analysis across standard GNGT versions revealed convergence in right anterior insula (aI), right inferior parietal cortex (IPC), (pre-)supplementary motor area ((pre-)SMA), right superior temporal sulcus (STS) and bilateral lateral occipital cortex (LOC). In contrast, the complex versions showed consistent involvement of right inferior frontal gyrus (rIFG), right dorsolateral prefrontal cortex (DLPFC), right inferior frontal junction (IFJ), bilateral aI, bilateral intraparietal sulcus (IPS), anterior midcingulate cortex (aMCC) and right superior parietal cortex.

Standard SST versions showed convergence in bilateral aI and adjacent inferior frontal gyrus (IFG), aMCC/preSMA, right DLPFC, bilateral temporoparietal junction (TPJ), right IPS and right caudate nucleus. The complex SST versions showed a similar pattern with additional involvement of bilateral IFJ and right thalamus.

Conjunction analyses between the tasks showed overlap only in right aI and right STS for simple versions and in bilateral aI, right IFJ and aMCC for complex versions.

While both tasks have been previously used rather interchangeably to probe inhibitory control, this study demonstrates broad differences in the brain regions involved in the GNGT versus SST, which shows that these two task rely on fundamental distinct neural mechanisms. Furthermore, task complexity has a significant impact on the brain regions involved in standard versus complex GNGT versions, while there was not such a qualitative difference in the meta-analyses of the SST.

Summarizing, response inhibition in the standard GNGT versions resulted in convergence of lower-level and heteromodal areas, with the MDN coming into play only when task complexity increases. Yet, both standard and complex SST recruited a very similar set of brain patterns, indicating that already the standard SST recruits the whole MDN and that task complexity is rather reflected in quantitative than qualitative variations within the MDN.

Taken together, in accordance with previous behavioral studies this study suggests that inhibitory control rather quickly becomes automatic in the GNGT but is continuously performed in a top-down controlled way in the SST. In sum, these results suggest that solely SST effectively probes response inhibition (and in a broader context EF), while this is more questionably for standard GNGT.

Abkürzungsverzeichnis

aI	anteriore Insel
ALE	activation likelihood estimation
aMCC	anteriorer midcingulärer Cortex
BOLD	blood oxygenation level dependent
DLPFC	dorsolateraler präfrontaler Cortex
EEG	Elektroenzephalographie
EF	exekutive Funktionen
fMRT	funktionelle MRT
FOC	frontales Operculum
GNGT	Go/No-Go Test
IFG	inferiorer frontaler Gyrus
IFJ	inferiore-frontale Übergangszone
IPC	inferiorer parietaler Cortex
IPL	inferiorer parietaler Lobus
IPS	intraparietaler Sulcus
LOC	lateraler okzipitaler Cortex
MDN	Multiple Demand Netzwerk
mid-STS	Mittlerer Anteil des Sulcus temporalis superior
PFC	präfrontaler Cortex
(pre-)SMA	(prä-)supplementäres motorisches Areal
SPL	superiorer parietaler Lobus
SSD	Stop-Signal-Verzögerung (engl. „stop signal delay“)
SST	Stop Signal Test
STS	superiorer temporaler Sulcus
TPJ	temporale-parietale Übergangsregion

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1 Einleitung

1.1 Exekutive Funktionen

Exekutive Funktionen (EF) umfassen eine weite Reihe von komplexen, "top-down" kontrollierten kognitiven Fähigkeiten und Prozessen, die uns ermöglichen Handlungsziele zu verarbeiten und unser Verhalten unter den sich ständig ändernden Umweltbedingungen neu zu bewerten und entsprechend anzupassen (Diamond et al., 2013; Niendam et al., 2012; Jurado and Rosselli, 2007). Die EF sind dabei aus vielen verschiedenen Subprozessen aufgebaut und werden meist in drei übergreifende Hauptfunktionen kategorisiert: Inhibition, Arbeitsgedächtnis und kognitive Flexibilität (Diamond et al. 2013).

Die Inhibition, die weiter unterteilt werden kann in die Interferenzkontrolle und Antwortsinhibition, ermöglicht es uns, unsere Aufmerksamkeit auf relevante Informationen zu lenken und unerwünschte Handlungen zu unterdrücken (Diamond et al. 2013). Die Inferenzkontrolle erlaubt es uns, durch gezielte Aufmerksamkeitsallokation, irrelevante Informationen oder Ablenkungen auszublenden und sich auf ein spezifisches Ziel zu konzentrieren (Diamond et al., 2013). Bei der Antwortsinhibition dagegen geht es um einen Prozess auf der Handlungsebene, der es uns ermöglicht unerwünschte, impulsive bzw. automatische Handlungen zu unterdrücken (Diamond et al., 2013). Dazu zählt auch die motorische Antwortsinhibition, die speziell die Unterdrückung vorgeplanter, motorischer Handlungsstränge erlaubt (Diamond et al., 2013).

Das Arbeitsgedächtnis fungiert als eine Art mentaler Notizblock, in dem wir temporäre Informationen speichern und manipulieren können, um komplexe Aufgaben auszuführen. Es erlaubt uns, Informationen im Gedächtnis zu behalten, während wir gleichzeitig andere Informationen verarbeiten oder abrufen (Diamond et al. 2013).

Die kognitive Flexibilität ermöglicht es uns, unsere Denkweise und unser Verhalten den Anforderungen der jeweiligen Situation anzupassen. Dies ist entscheidend, um sich beispielsweise an neue Regeln anzupassen,

unerwartete Probleme zu lösen und alternative Lösungsstrategien zu entwickeln (Diamond et al. 2013).

Diese verschiedenen Facetten von EF sind entscheidend für unser zielgerichtetes Verhalten, da sie die Grundlage für Fähigkeiten wie Problemlösung, Planung und logisches Denken bilden. In ihrem Zusammenspiel ermöglichen uns Exekutivfunktionen und insbesondere Inhibitionsprozesse die Bewältigung von alltäglichen Situationen, die eine starke Selbstkontrolle verlangen, wie zum Beispiel das Anhalten des Autos am Zebrastreifen oder das Stehenbleiben an einer roten Ampel.

In den Neurowissenschaften wurden in Rahmen von neuropsychologischen und neurobildgebenden Studien über die Zeit verschiedenste Aufgabenmodelle entwickelt und angewendet, um die verschiedenen Facetten von Exekutivfunktionen näher zu beleuchten und zu charakterisieren. Zu diesen Aufgabenmodellen gehören beispielweise der Stroop- oder Flanker-Test (zur Messung von Interferenzkontrolle), der n-back Test (zur Testung des Arbeitsgedächtnisses) sowie der Wisconsin Card Sorting Test (zur Messung von kognitiver Flexibilität).

In den Studien zu den verschiedenen Aufgabenmodellen zur Untersuchung der EF wurde der präfrontale Cortex (PFC) meist als eine wichtige Schlüsselregion für Exekutivfunktionen diskutiert (Koechlin and Summerfield, 2007; Yuan and Raz, 2014). Der PFC ist Teil des Frontallappens und wird in anatomisch sowie funktionell unterschiedlichen Subregionen wie den dorsolateralen, dorsomedialen, ventrolateralen und ventromedialen PFC sowie den orbitofrontalen Cortex unterteilt (Friedman & Robbins, 2022; Haber et al., 2022). Der präfrontale Cortex ist dabei eine umfangreich vernetzte Hirnregion, welche unter anderem im kontinuierlichen Austausch von afferenten und efferenten Informationen mit dem Assoziationskortex als auch subkortikal mit der Basalganglienschleife, mit dem limbischen System und dem Thalamus ist (Friedman & Robbins, 2022; Haber et al., 2022). Die Funktionen des präfrontalen Kortex umfassen höherrangige, kognitive Prozesse wie die Entscheidungsfindung, Problemlösung und Handlungskontrolle, welche durch die einzigartige Konnektivität des präfrontalen Cortex ermöglicht werden.

Über die Zeit wurde jedoch die Theorie, dass eine einzelne Hirnregion als die Schlüsselregion für Exekutivfunktionen agiert, zunehmend in Frage gestellt. So

wurde gezeigt, dass verschiedenste Aufgabenmodelle zur Testung von kognitiven Funktionen ein gemeinsames, ausgedehntes fronto-insulo-parietales Netzwerk an Hirnregionen rekrutieren, welches unter anderem als Multiple Demand Netzwerk (MDN) bezeichnet wird (Duncan, 2010). Das MDN umfasst dabei die Regionen um den inferioren frontalen Sulcus, die anteriore Insula (aI), das frontale Operculum (FOC), das (prä-)supplementäre motorische Areal (preSMA), die dorsalen Anteile der anterioren Cingula sowie den intraparietalen Sulcus (IPS) (Duncan, 2010). Auch Meta-Analysen zu den verschiedenen Exekutivfunktionen zeigten die Rekrutierung des MDN (Inhibitionskontrolle: Cieslik et al., 2015; Arbeitsgedächtnis: Rottschy et al., 2012; Aufgabenwechsel: Worringer et al., 2019; Daueraufmerksamkeit: Langner & Eickhoff 2013). Daraus schließend sollten Aufgabenmodelle, welche zur Testung von Exekutivfunktionen geeignet sind, eben dieses MDN rekrutieren. Allerdings existieren verschiedene Ansätze über Art und Weise der Rekrutierung des MDN. So berichtet Shashidhara et al. 2019, dass in relativ einfachen Aufgabendesigns zunächst nur hintere Anteile des MDN rekrutiert werden und mit zunehmender Aufgabenkomplexität, Zeitdruck und Belohnung weitere anterior gelegene Anteile des MDN ins Spiel kommen, während Crittenden and Duncan (Crittenden and Duncan, 2014) zeigten, dass bereits relativ einfache Aufgabedesigns das MDN in seiner Gänze rekrutieren und eine zunehmende Aufgabenkomplexität vor allem zu einer steigenden Aktivität in den Hirnregionen des MDN führt, aber keine zusätzlichen Regionen rekrutiert werden. So bleibt zum jetzigen Stand unklar, ob eine steigende Komplexität in der Testung von Exekutivfunktionen zu qualitativen (d.h. progressiv zunehmender Rekrutierung von anterioren Anteilen des MDN) oder quantitativen Änderungen (Rekrutierung des MDN als Ganzes bei niedriger und hoher Aufgabenkomplexität, aber mit Variabilität der Aktivierung innerhalb der Regionen) führt.

1.2 Motorische Antwortsinhibition

Die Antwortsinhibition ist eine der Hauptkomponenten der Exekutivfunktionen, mit der Funktion impulsive oder automatisierte Verhaltensweisen, insbesondere in Situationen, in denen eine zurückhaltende Reaktion erforderlich ist, zu unterdrücken oder zu kontrollieren, obwohl ein Antwortreiz präsent ist. Der Go/No-Go-Test (GNGT) und Stop-Signal-Test (SST) sind dabei die beiden am häufigsten verwendeten Paradigmen zur Untersuchung von motorischer Antwortsinhibition (Diamond et al., 2013; Senderecka et al., 2012; Jonkmann et al., 2003; Wöstmann et al., 2013).

Der GNGT ist ein häufig angewendetes Aufgabenmodell, das die Fähigkeit der Unterdrückung einer motorischen Handlung testet. Den Probanden wird entweder ein Go-Stimulus, auf das der Proband zum Beispiel mittels Drücken einer Taste reagieren soll oder ein No-Go-Stimulus, auf die keine Reaktion erfolgen soll, präsentiert. Diese Stimuli werden in zufälliger Reihenfolge gezeigt, um sicherzustellen, dass die Teilnehmer nicht vorhersehen können, welcher Stimulus als nächstes erscheint. Dabei wird meist ein Testdesign mit einem höheren Anteil an Go-Stimuli verwendet, um eine starke Antworttendenz zu erzeugen. Dadurch dass die No-Go-Stimuli und die Notwendigkeit der motorischen Inhibition verhältnismäßig seltener vorkommen, wird insbesondere die Inhibitionsfähigkeit der Probanden herausgefordert und getestet (Donders et al., 1969).

Der SST dagegen testet die Fähigkeit, eine laufende, beziehungsweise begonnene, motorische Handlung zu stoppen, sobald ein Stop-Signal präsentiert wird. Ähnlich wie beim GNGT werden die Probanden instruiert eine Taste zu drücken, wenn ein Go-Stimulus gezeigt wird, jedoch muss die initiierte Reaktion sofort gestoppt werden, wenn dem Go-Stimulus anschließend ein Stop-Stimulus folgt (Logan & Cowan, 1984).

Die Leistung der Probanden wird beim GNGT und SST anhand verschiedener Maße bewertet, darunter beispielsweise die Reaktionszeit als auch Erfolgs- bzw. Fehlerrate der Inhibition. Längere Reaktionszeiten und eine höhere Fehlerquote bei der motorischen Inhibition zeigen so eine Beeinträchtigung der inhibitorischen Kontrolle und so auch der Exekutivfunktionen, wie es bei zum

Beispiel bei neurologischen und psychiatrischen Erkrankungen der Fall ist (Schachar et al., 2007; 2011).

Verbruggen und Logan (Verbruggen and Logan, (2008a;/b) konnten in ihren Verhaltensstudien zeigen, dass der Inhibitionsmechanismus beim GNGT nach einiger Zeit automatisiert ablaufen kann, da beim GNGT eine feste Stimulus-Antwort-Verknüpfung verwendet wird. Demgegenüber läuft beim SST auch nach längerer Übungszeit der Inhibitionsprozess in kontrollierter Weise ab. Als weitere Evidenz für unterschiedliche Inhibitionsprozesse konnten z.B. Littman und Tak´acs (2017) zeigen, dass der Einsatz von affektiven Stimuli die Performanz von Probanden nicht im GNGT, jedoch im SST beeinflusst. Auch pharmakologische Studien zeigten bereits, dass verschiedene chemische Einflüsse die beiden Aufgabenmodelle unterschiedlich beeinflussen (Eagle et al., 2008).

Auch in den bildgebenden Neurowissenschaften wurden die beiden Aufgabenmodelle über die Jahre in einer Vielzahl von funktionellen MRT (fMRT)-Studien verwendet, um die neuralen Korrelate der inhibitorischen Kontrolle zu charakterisieren. Ein Großteil dieser fMRT-Studien berichten meist von der Aktivierungen von Hirnregionen innerhalb eines rechts-lateralisierten Netzwerks, in dem der dorsolaterale präfrontale Cortex (DLPFC), der inferiore frontale Gyrus (IGF), der anteriore midcinguläre Cortex (aMCC), das preSMA, die aI, der inferiore parietale Lobus (IPL), der IPS sowie die Basalganglien involviert sind (z.B. Aron und Poldrack, 2006; Garavan et al., 1999; Steele et al., 2013). Der GNGT und SST werden dabei oft in den einzelnen fMRT-Studien als auch in Meta-Analysen als gleichwertig behandelt, Ergebnisse über beide Aufgaben zusammengefasst und als auch einheitlich diskutiert (z.B. Puiu et al., 2020; Hung et al.,2018).

Die Aufgabendesigns des GNGT und SST wurden zudem über die Jahre in den verschiedenen Studien deutlich modifiziert, um den Einfluss beispielsweise von Stimulus-Modalität oder -Salienz, als auch die Interaktion mit anderen Interferenzaufgaben oder Arbeitsgedächtnisprozessen zu testen. Diese Vielzahl an Einflussfaktoren macht es schwierig, die neuronalen Korrelate von Inhibition innerhalb der beiden Aufgaben, unabhängig von Stimulus- als auch Aufgabenkomplexität zu untersuchen, was die Vergleichbarkeit der beiden Tests sowie der einzelnen fMRT-Studien zusätzlich erschwert.

Um die Ergebnisse der unterschiedlichen GNGT und SST fMRT-Studien miteinander zu vergleichen, wurden diese bereits in mehreren vorangegangen Meta-Analysen untersucht (Isherwood et al., 2021; Puiu et al. 2020, Clark et al., 2020, Hung et al., 2018; Ardila et al., 2018, Zhang et al., 2017; Cieslik et al. 2015; Cai et al., 2014; Criaud and Boulinguez, 2013; Swick et al., 2011; Levy et al., 2011; Simmonds et al. 2008; Nee et al., 2007). Dabei wurde teils nicht nur auf ein Augenmerk auf die Gemeinsamkeiten der beiden Tests und ihren neuronalen Korrelaten geworfen, sondern erste Meta-Analysen haben sich unter anderem mit den Unterschieden zwischen dem GNGT und dem SST sowie den unterschiedlichen Aufgabendesigns auseinandergesetzt.

So hat Simmonds et al. (2008) den Einfluss der Aufgabenkomplexität auf den GNGT insbesondere in Bezug auf die Rekrutierung des Arbeitsgedächtnisses untersucht und klassifizierte dabei die eingeschlossenen Experimente als einfach und komplex, wobei die Ergebnisse der Meta-Analyse jedoch nur auf einer sehr beschränkten Anzahl von eingeschlossenen Experimenten basieren. Für den komplexen GNGT zeigte sich Konvergenz in einem rechts-lateralisierten fronto-insulo-parietalen Netzwerk, welches von dem klassischen GNGT nicht rekrutiert wurde. Eine Überlappung zwischen den beiden GNGT-Kategorien konnte lediglich im preSMA nachgewiesen werden, was bereits auf einen starken Einfluss der Aufgabenkomplexität auf die Rekrutierung von Hirnregionen im GNGT hindeutet.

Die Meta-Analyse von Swick et al. (2011) demonstrierte in einer Gegenüberstellungen des SST und GNGT, dass der GNGT vor allem ein frontoparietales Netzwerk (dabei insbesondere den rechte DLPFC und IPL) konsistent aktivierte, während der SST ein cingulo-opeculäres Netzwerk mit Beteiligung des Thalamus und der anterioren Insel rekrutierte. Diese Unterschiede in der konsistenten Aktivierung der Hirnregionen im SST und GNGT konnten in weiteren aktuelleren Meta-Analysen, welche sich zwar andere inhaltliche Schwerpunkte setzten, ebenfalls repliziert werden (Cieslik et al., 2015).

Insgesamt zeigen die bereits vorangegangenen Verhaltensstudien und Meta-Analysen bereits Hinweise dafür, dass der SST und GNGT auf unterschiedliche

Mechanismen basieren und durch die Aufgabenkomplexität beeinflusst werden. Jedoch sind die Ergebnisse in der Vielzahl der durchgeführten fMRT-Studien und Meta-Analysen teils stark divergierend, was teils durch eine niedrige Anzahl an eingeschlossenen Probanden bzw. Experimenten liegen mag als auch an der Tatsache, dass nur wenige Studien den Effekt der Aufgabenschwierigkeit in die Interpretation ihrer Ergebnisse miteinbeziehen.

1.3 Neuroimaging Meta-Analysen

Bildgebende Studien sind eines der wichtigsten nicht-invasiven Mittel zur Untersuchung der Hirnregionen, die an der Ausführung von Exekutivfunktionen beteiligt sind. Dabei wurden neben der fMRT, auch andere bildgebende Verfahren wie die Positronen-Emissions-Tomographie und Single-Photon-Emissions-Computertomographie eingesetzt. Trotz der immensen Bedeutung der bildgebenden Studien haben sie auch einige Einschränkungen. Dazu zählen beispielsweise eine oft niedrige Probandenanzahl sowie die Tatsache, dass bei der fMRT die neuronale Aktivität nur indirekt über die hämodynamischen Reaktionen der Hirnareale gemessen wird.
Aktive Hirnareale sind metabolisch aktiver, was bedeutet, dass der zerebrale Blutfluss der Region im Sinne einer funktionellen Hyperämie erhöht wird, um den steigenden Glukoseverbrauch und Sauerstoffbedarf zu decken. Die Erhöhung des zerebralen Blutflusses setzt jedoch erst mit einen geringen Verzögerung nach der Aktivierung der Hirnareale ein. Dadurch steigt zunächst verhältnismäßig in den aktiven Arealen das Level an paramagnetischen Desoxyhämoglobin, welches entsteht, wenn die Sauerstoffabgabe vom diamagnetischen Oxyhämoglobin erfolgt. Die kurzzeitige Erhöhung des Desoxyhämoglobin führt zu einer Störung der Magnetfelds, welche Suszeptibilitätsunterschiede verursachen, die sehr sensitiv mittels T2*-Gradientenechosequenzen erfasst werden können. Diese Methode zur indirekten Darstellung der Hirnaktivität wird als *„Blood oxygenation level dependent*“ (BOLD)-Effekt bezeichnet. Nach einer kurzen Latenzperiode setzt darauffolgend die Erhöhung des zerebralen Blutflusses ein. In diesen Rahmen kommt es in dem aktivierten Areal durch die neurovaskuläre Kopplung zu einem deutlichen Anstieg des Oxyhämoglobins und einer relativen Abnahme des paramagnetischen Desoxyhämoglobin und somit einer deutlichen Reduktion der Störung des Magnetfelds. (Glover, 2011).

Im Laufe der Zeit wurden eine Vielzahl von fMRT-Studien zur Untersuchung der neuronalen Korrelate der Inhibitionskontrolle durchgeführt, mit teils deutlichen Abwandlungen des GNGT sowie des SST und infolgedessen auch teilweise stark variierenden Ergebnissen. Diese Varianz kann einschränkend in der

Interpretation der individuellen Ergebnisse sein, aber sie bietet auch eine Gelegenheit. So kann man diese Vielzahl an Studien mit Hilfe von quantitativen Meta-Analysen zusammenfassen und somit die Konvergenz der Ergebnisse der eingeschlossenen Experimente beurteilen. Diese Methode erlaubt es, Trends und Muster in den Ergebnissen zu erkennen, die in einer einzelnen fMRT-Studie möglicherweise nicht offensichtlich zu interpretieren sind und ermöglicht so ein umfassenderes Verständnis der konsistent in den Studien aktivierten Hirnregionen und ihrer Rolle, beispielsweise bei der Ausführung von Exekutivfunktionen.

Der erste Schritt bei der Durchführung einer quantitativen Meta-Analyse über Bildgebungsstudien ist die Sichtung und Einschluss aller geeignet Studien im Rahmen einer umfassenden Literaturrecherche. Als Hilfestellung zur Planung und Organisation der Literaturrecherche und der Rohdaten dienen dabei unter anderem Leitfäden zur standardisierten Durchführung von Bildgebungs-Meta-Analysen (Müller et al., 2018).

Die aus der Literaturrecherche gewonnen Koordinaten der einzelnen fMRT-Experimente bilden die Ausgangsdaten für die koordinatenbasierte, voxelweise *„activation likelihood estimation“* (ALE) Meta-Analyse (Eickhoff et al., 2012; Eickhoff et al., 2009; Laird et al., 2009a; Laird et al., 2009b; Turkeltaub et al., 2002). ALE behandelt dabei die eingepflegten Koordinaten nicht als fixierte Koordinate, sondern als das Zentrum einer dreidimensionalen Gaußschen Wahrscheinlichkeitsverteilung, um die räumliche Unsicherheit jeder einzelnen Koordinate zu berücksichtigen. Diese räumliche Unsicherheit resultiert aus der Zwischensubjektvarianz und der Varianz aufgrund von unterschiedlichen verwendeten Normalisierungsstrategien in den einzelnen Studien (Eickhoff et al., 2009). Die Breite der Gaußschen Wahrscheinlichkeitsverteilung und damit das Maß der Unsicherheit wird aus empirischen Daten berechnet und entsprechend angepasst. Eine höhere Anzahl von Probanden führt zu größerer Zuverlässigkeit, wodurch die Gaußkurve höher und schmaler wird, während niedrige Probandenzahlen zu einer breiteren und niedrigeren Kurve führen. Diese Anpassungen erlauben es die einzelnen räumlichen Ungenauigkeiten der fMRT-Studien auszugleichen und mittels der ALE-Meta-Analyse die konsistente Aktivierung von Hirnregionen, die beispielsweise in den kognitiven Prozessen der motorischen Antwortsinhibition involviert sind, zuverlässig zu beurteilen.

1.4 Ziele der Arbeit

Dieser Arbeit liegen mehrere Ziele zu Grunde:

(1) Angesichts vorangegangener Meta-Analysen, die bereits Unterschiede in den neuronalen Netzwerken für die klassischen und komplexen GNGT-Versionen gezeigt haben, soll hier untersucht werden, ob ähnliche Unterschiede auch in den neuronalen Korrelaten des SST zu finden sind. Dies wurde bisher in keiner der vorangegangenen Meta-Analysen untersucht, wobei es Hinweise gibt, dass sowohl klassische als auch komplexe SST-Varianten dasselbe Netzwerk rekrutieren (Wessel and Aron, 2014). Darüber hinaus soll in dieser Arbeit untersucht werden, ob die in der Meta-Analyse von Simmonds et al., 2008 berichtete, geringe Konvergenz in der Meta-Analyse der klassischen GNGT-Experimente auf eine zu geringe Anzahl an eingeschlossenen Experimenten zurückzuführen ist.
(2) Als weiterer Punkt soll zudem der Einfluss der Aufgabenkomplexität auf die Rekrutierung des MDN näher beleuchtet werden. Sollte erhöhte Aufgabenkomplexität zu quantitativen Veränderungen innerhalb des MDN führen, sollten die klassischen und komplexen Aufgabenversionen das gleiche neuronale Netzwerk rekrutieren, während qualitative Veränderungen sich in einer zusätzlichen Rekrutierung, insbesondere von weiter frontal gelegenen Hirnregionen, widerspiegeln würde.

Um die ersten beiden Fragestellungen zu beantworten, werden insgesamt sechs Meta-Analysen gerechnet. Dabei wird je eine generelle Meta-Analyse, die alle vorhandenen GNGT- bzw. SST-Experimente einschließt, als Vergleich zu den bereits vorangegangen Meta-Analysen gerechnet. Zudem wird für beide Paradigmen jeweils eine Meta-Analyse nur über die klassischen Aufgabenversionen, als auch eine über die komplexen Versionen gerechnet. Hiermit kann untersucht werden, ob die klassischen und komplexen Aufgabenversionen dasselbe Netzwerk konsistent rekrutieren und ob die komplexen Varianten zusätzlich weitere, insbesondere frontale, Regionen des MDN rekrutieren.

(3) Des Weiteren soll untersucht werden, ob sich ein paradigmen-unspezifisches Inhibitionsnetzwerk finden lässt, welches konsistent beim GNGT und SST involviert ist. Hierzu wird eine Konjunktionsanalyse über die Ergebnisse der Meta-Analysen der klassischen GNGT- und SST-Versionen gerechnet, um die Regionen zu identifizieren, die sowohl für den klassischen GNGT als auch den klassischen SST konsistente Aktivität zeigen. Eine zweite Konjunktionsanalyse über die Ergebnisse der Meta-Analysen der komplexen GNGT- und komplexen SST-Versionen soll die Regionen identifizieren, die den generellen Effekt von Aufgabenkomplexität vermitteln.

2 Publikation

The effect of task complexity on the neural network for response inhibition: an ALE meta-analysis

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Review article

The effect of task complexity on the neural network for response inhibition: An ALE meta-analysis

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ABSTRACT

Response inhibition is classically investigated using the go/no-go (GNGT) and stop-signal task (SST), which conceptually measure different subprocesses of inhibition. Further, different task versions with varying levels of additional executive control demands exist, making it difficult to identify the core neural correlates of response inhibition independent of variations in task complexity. Using neuroimaging meta-analyses, we show that a divergent pattern of regions is consistently involved in the GNGT versus SST, arguing for different mechanisms involved when performing the two tasks. Further, for the GNGT a strong effect of task complexity was found, with regions of the multiple demand network (MDN) consistently involved particularly in the complex GNGT. In contrast, both standard and complex SST recruited the MDN to a similar degree. These results complement behavioral evidence suggesting that inhibitory control becomes automatic after some practice and is performed without input of higher control regions in the classic, standard GNGT, but continues to be implemented in a top-down controlled fashion in the SST.

1. Introduction

Executive functions (EF) refer to a complex set of top-down control processes which allow us to process current objectives and to reevaluate and adjust our behavior according to changing environmental conditions (Jurado and Rosselli, 2007). Together with working memory and cognitive flexibility, inhibitory control has been suggested to be one of the key components of EF (Diamond et al., 2013; Niendam et al., 2012). Under the rubric of inhibitory control two major components have been proposed: response inhibition (i.e., the ability to suppress or cancel prepotent but inappropriate motor reactions), and attentional inhibition (i.e., the ability to resist interference from stimuli in the external environment (Friedman and Miyake, 2004; Diamond, 2013; Tiego, 2018). Response inhibition thus is crucial for self-control (cf. Diamond et al., 2013; Langner et al., 2018). If we want to cross the street but at the exact same moment the light changes from green to red, we need to be able to detect this environmental change to discard the tendency to walk on and to stop our current action plan. In order to investigate the process of response inhibition, most functional magnetic resonance imaging (fMRI) studies have relied on two classic response inhibition tasks: the go/no-go task (GNGT) and the stop-signal task (SST) (Diamond et al., 2013; Aron et al., 2007a; Senderecka et al., 2012; Jonkman et al., 2003; Wöstmann et al., 2013). In the classic GNGT participants are instructed to respond to a go stimulus and to withhold their motor response if a no-go stimulus is presented. Usually, the proportion of go stimuli is much higher than the proportion of no-go stimuli to achieve a strong prepotency towards responding (Donders et al., 1969). In contrast, the stop-signal task investigates the cancellation of an already initiated motor response (Logan et al., 1984). Similar to the go/no-go task participants are asked to respond as quickly as possible to a go stimulus. However, in some trials, a stop-signal is presented briefly after the go stimulus telling the participant to cancel the motor response.

Even though both tasks probe conceptually different aspects of response inhibition, that is response withholding versus action cancellation, inhibitory control has often been investigated by pooling together results from both tasks (e.g. Puiu et al., 2020; Hung et al., 2018). Interestingly, a behavioral study showed performance in GNGT and SST to load on a single factor (Bender et al., 2016). Other behavioral

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studies, however, suggested that the SST triggers controlled inhibition, while the standard GNGT, if using a consistent stimulus–response (S-R) mapping, can be operated through automatic inhibitory processes once S-R contingencies have been learned (Verbruggen and Logan, 2008a; b). Schachar et al. (2007, 2011) developed an adapted version of the SST to overcome limitations of the standard go/no-go task and be able to investigate action withholding versus action cancellation within one paradigm. They found that patients with ADHD show deficits in both aspects of inhibitory control. Studies focusing on a potential interaction between emotions and inhibition, revealed that negative affective stimuli affect performance in the SST but not in the GNGT, providing further evidence that the two tasks rely on different mechanisms (Littman and Takács, 2017). Pharmacological investigations also suggest different anatomic and chemical modulations involved in the two tasks (Eagle et al., 2008).

Functional neuroimaging studies commonly reported a network consisting of the dorsolateral prefrontal cortex (DLPFC) and inferior frontal gyrus (IFG), as well as additional activation within the anterior midcingulate cortex (aMCC), pre-supplementary motor area (preSMA), anterior Insula (aI), inferior parietal lobe (IPL), intraparietal sulcus (IPS) and the basal ganglia to be involved in response inhibition (e.g. Aron et al., 2011; Garavan et al., 1999; Steele et al., 2013). However, single fMRI studies as well as neuroimaging meta-analyses have also revealed some differences in the neural correlates of the two tasks (e.g. Cieslik et al., 2015; Sebastian et al., 2013a; b), especially within the lateral prefrontal cortex and the parietal lobe. Moreover, a host of fMRI studies have reported mainly right-hemispheric activations (Garavan et al., 1999; Kawashima et al., 1996; Konishi et al., 1998; Aron et al., 2004; Aron et al., 2014) in these tasks, but only few studies have performed direct comparisons between the hemispheres (but see some exceptions, e.g. Aron and Poldrack, 2006; Cai and Leung, 2009). On the other hand, there are also numerous fMRI studies reporting bilateral prefrontal activations for the GNGT (Baumeister et al., 2014; Watanabe et al., 2002; Rubia et al., 2001; Liddle et al., 2000) and the SST (Berkman et al., 2014; Cai and Leung et al., 2009; Rubia et al., 2001; Schel et al., 2014; Leunissen et al., 2016; Congdon et al., 2014), questioning the theory of a right-lateralization of the response inhibition network.

The picture is complicated by the fact that many different variations of these two tasks have evolved over time, with varying levels of involvement of other EF aspects, such as increased WM demands or anticipation effects, leading to increased task complexity and, hence, an involvement of different or additional brain regions. These variations have made it difficult to identify the key neural correlates of inhibitory control. While some authors support the theory of a bilateral response inhibition network (Mazzola-Pomietto et al., 2009; Schel et al., 2014; Tabu et al., 2012), others have argued that the activity in left lateral frontal cortex may not be directly associated with response inhibition but rather result from differences in task design (Rubia et al., 2001; Watanabe et al., 2002; Fassbender et al., 2004), the contrasts used to isolate the inhibition process (Watanabe et al., 2002; Rubia et al., 2001), or the processing of salient cues (like a rare no-go or stop stimulus; Fuentes-Claramonte et al., 2016). Likewise, differences in efficiency of response inhibition (Hirose et al., 2012) or task difficulty (Bellgrove et al., 2004) have been discussed as potential reasons for left-hemispheric involvement.

Different research groups have already used neuroimaging meta-analyses to investigate the core neural network consistently involved in the two tasks, irrespective of different task implementations. This line of research started with Nee and colleagues (Nee et al., 2007), who, while acknowledging that both tasks are conceptually different, performed a meta-analysis across both paradigms due to a limited number of studies. Simmonds et al. (2008) went on to examine the effect of task complexity on GNGT-related brain activity, albeit based on only a small number of studies, providing first evidence that particularly the complex versions recruit a fronto-insula-parietal network, while this does not seem to be the case for standard task versions. Not considering task complexity, Swick et al. (2011) focused on differences between GNGT and SST and found that the GNGT recruits the frontoparietal network to a greater extent, while the SST leads to more involvement of the cingulo-opercular network. While not focusing specifically on differences between the two tasks, a meta-analysis of our own group confirmed this finding (Cieslik et al., 2015). Levy and colleagues (Levy et al., 2011) investigated the effect of stimulus probability in inhibitory control, by pooling together GNGT and SST experiments with rare no-go or stop-signal stimulus probabilities and comparing the results to a meta-analysis of the GNGT using equiprobable go and no-go stimuli. They found that both analyses yielded convergence in right middle frontal gyrus and anterior insula. Furthermore, posterior ventrolateral PFC (VLPFC) revealed convergence only when inhibition trials were rarely presented, while mid-VLPFC showed convergence for equiprobable stimulus presentation in the GNGT, i.e., when there is increased uncertainty of which response has to be made. In a critical review and meta-analysis of the GNGT, Criaud and Boulinguez (2013) evaluated the influence of different complexity levels, specifically the effect of stimulus complexity, no-go probability, as well as working memory load. They argued that most parietal and prefrontal regions showing convergence in the GNGT are actually not specialized for inhibitory control but rather associated with more general functions, such as attentional processing or maintaining relevant information in working memory. Later on, Zhang et al. (2017) reported separate meta-analyses on interference resolution, action withholding (GNGT), and action cancellation (SST). Furthermore, they conducted several sub-analyses, including a comparison of high (~ 50% no-go stimuli) vs. low probability (< 50% no-go stimuli) no-go conditions and a comparison of SST and GNGT, both of which did not show any significant differences. Finally, one of the most recent meta-analyses on inhibitory control (Isherwood et al., 2021) emphasized the importance of subcortical regions in response inhibition and inference resolution, revealing a crucial role of the putamen for inhibitory control. Taken together, although there is already quite some meta-analytic work comparing the GNGT and SST, the results are diverging, possibly due to the different numbers and varieties of included experiments and the fact that some analyses have taken complexity into account and others have not. However, there is evidence for a strong effect of task complexity on the network involved in the GNGT, while this has not been examined in the SST yet. In particular, divergent results across meta-analyses might be due to interactions between task type (GNGT, SST) and complexity (standard /complex task).

In general, brain regions involved in the GNGT and SST have also been found to be recruited in tasks probing other EFs (Duncan, 2010; Camilleri et al., 2018), such as WM (Rottschy et al., 2012) or task switching (Worringer et al., 2019). Therefore, this domain-general fronto-insular-parietal network is commonly referred to as the multiple-demand-network (MDN) (Duncan and Owen, 2000; Duncan, 2010; Fedorenko et al., 2013). While there is evidence that the MDN is recruited whenever a difficult condition, potentially demanding a higher degree of top-down control, is contrasted against an easier one, such as high versus low working memory load or response-conflict versus no-conflict trials, it is still not clear how exactly this network is modulated by increasing task complexity. On the one hand, there is evidence that the MDN is recruited in a progressive fashion with more posterior regions of the network (i.e., IPS, preSMA and posterior lateral frontal cortex) already involved in easy tasks, whereas more anterior frontal regions and aI are only recruited when complexity, time pressure, or reward increases (Shashidhara et al., 2019). On the other hand, there is also evidence showing that increasing task complexity leads to quantitative rather than qualitative changes in MDN recruitment. Crittenden and Duncan (Crittenden and Duncan, 2014) used a relatively easy visual discrimination task and manipulated task complexity in three ways. Importantly, all manipulations of complexity led to activation within the MDN, with increases in activity with increasing complexity, suggesting that the MDN is recruited as a whole even by comparatively simple tasks

(cf. Crittenden and Duncan, 2014). Thus, there is little and inconsistent information on the effects of task complexity on the recruitment of the MDN and on the question of whether task complexity leads to qualitative changes (in particular, more anterior activation with increased task complexity) or, rather, to quantitative changes (stronger activation within MDN regions but not additional regions coming into play with increased task complexity).

The aim of the current meta-analysis is to investigate if action withholding and action cancellation as measured by the GNGT and SST respectively share a common response inhibition network and if there is a (differential) modulation by task complexity. While previous neuroimaging (meta-analytic) evidence suggests that there is a relevant effect of task complexity on the network recruited by the GNGT, this has not yet been investigated in the SST. We therefore aimed to compare the network recruited in standard versus complex versions of the GNGT and SST, respectively. Furthermore, if there is an effect of task complexity, how does task complexity modulate the recruitment of the MDN in these two paradigms? Does increased task complexity lead to quantitative changes in MDN recruitment, as reflected in the same neural network being involved in both standard and complex versions? Or is increased task complexity reflected in qualitative changes, so that complex versions show additional convergence of particularly more anterior frontal regions, as compared to standard task versions? To this end, we used coordinate-based activation likelihood estimation (ALE) meta-analyses (Eickhoff et al., 2012; Eickhoff et al., 2009; Turkeltaub et al., 2012) and conducted separate meta-analyses of neuroimaging studies on GNGT and SST to identify the core neural correlates of action withholding and action cancellation, respectively. Importantly, we also performed separate meta-analyses for both tasks differentiating between the classic, i.e. standard, task design (using standard or symbolic stimuli such as letters, geometrical shapes or colored stimuli) and complex task design (e.g. paradigms with additional increased WM demand or complex stimuli such as faces or battleships). This enabled testing if increased task complexity leads to quantitative or rather qualitative changes within the associated neural networks consistently involved in GNGT and SST. Conjunction analyses were conducted across standard versions of the GNGT and SST and across complex versions, respectively, to test for a common neural network associated with response inhibition and general effects of task complexity across the two paradigms. We hypothesized that if both tasks probe similar aspects of response inhibition a very similar set of regions should be found in the meta-analysis for standard GNGT and standard SST. Moreover, if task complexity leads to quantitative changes in neuronal recruitment, standard and complex versions should recruit the same neural network, while qualitative changes should be reflected in additional convergence of particularly more anterior frontal regions for the complex task versions.

2. Methods

2.1. Selection criteria for the experiments included in the meta-analysis

Since this meta-analytic study focused on the neural correlates of response inhibition, we included the two most commonly tasks used to investigate the exertion of inhibitory control, the GNGT and the SST. Our meta-analyses were conducted according to the standards of our institute (cf. e.g. Cieslik et al., 2015; Müller et al., 2017) and followed the guidelines for conducting coordinate-based neuroimaging meta-analyses as outlined in Müller et al. (2018).

To identify eligible experiments, we performed a PubMed database (https://pubmed.ncbi.nlm.nih.gov/) search using the following search strings: “go/no-go task”, “stop-signal task”, “response inhibition / action inhibition / motor inhibition / inhibition / inhibitory control”, “action cancellation” “action withholding” together with either “fMRI” or “neuroimaging”; the Google Scholar database was queried using the same search strings. Additional studies were obtained by reference tracing of already identified studies and comparison with a previous meta-analysis from our group (Cieslik et al., 2015) as well as other meta-analyses on response inhibition (Simmonds et al., 2008; Swick et al., 2011; Criaud et al., 2013; Puiu et al., 2020; Hung et al., 2018; Ardila et al., 2018; Zhang et al., 2017; Levy et al., 2011; Nee et al., 2007). We furthermore contacted authors to retrieve additional results if the outcome of the contrast of interest was not included in the publication. Further information about the search steps and exclusion criteria can be found in the flowchart shown in Fig. 1.

A checklist used here as a guidance for neuroimaging meta-analyses as recommended by Müller et al. (2018) can be found in table S1.

Only whole-brain fMRI analyses reporting peak activation coordinates in a standard reference space – Montreal Neurological Institute (MNI) or Talairach-Tournoux (TAL) system – were considered for inclusion. Reported coordinates of experiments using FSL or SPM were treated as MNI coordinates as this is the standard space in these softwares. Only in cases when authors explicitly reported a transformation of MNI in TAL space, the coordinates were considered to be in TAL space when using FSL or SPM. Otherwise, the coordinate space was treated as MNI (cf. Müller et al., 2018). Results from region-of-interest analyses were excluded. Likewise, results from fMRI studies in which only part of the brain was scanned were also excluded.

We included data from healthy adults ($\geq$ 18 years old) without any diagnosed neurological or psychiatric diseases, while data from children, patients as well as healthy subjects with increased risk for neurological or psychiatric disorders, such as healthy relatives, were discarded. When patient studies reported the results of the control and patient groups individually, the results from the healthy control group were included. Moreover, data from pharmacology or transcranial magnetic stimulation studies were excluded, even if the coordinates of the sham/placebo group were separately published, in order to avoid the potential influence of anticipation effects on the results.

With respect to the contrasted task conditions, we only included contrasts representing increased cognitive control during the inhibition condition as compared with an active control condition, i.e. no-go > go and stop > go trials. The reverse contrast (i.e. go > no-go or go > stop, representing deactivations) as well as inhibitory effects compared with a resting baseline (e.g. no-go > rest or stop-signal > rest) were excluded. However, in some experiments, only no-go trials were explicitly modeled for analysis, while brain activity during go trials was not modeled explicitly but included in the implicit baseline. Here, the contrast no-go > active baseline was included in our meta-analysis, as we considered such contrasts rather comparable with no-go > go contrasts. In order to account for differences in the coordinate space, the coordinates of experiments reported in the TAL system were converted into MNI using linear transformation (Lancaster et al., 2007).

When a publication reported several eligible contrasts for the same task (for example, when both standard and complex task versions were used in the same sample), the results reported for the different contrasts were pooled into one experiment for the overall analysis (e.g. Ko et al., 2016; Czapla et al., 2017). This was done in order to prevent a single study group from having a predominant effect on our results (Turkeltaub et al., 2012). Experiments taken from the same publication which reported coordinates obtained from different participants (e.g. two different age groups) were not pooled. Finally, when a given sample was used in different publications, only one of the publications and its corresponding experiments were included in our analysis to avoid systematic biases induced by one particular study sample (e.g. Sebastian et al., 2016, 2017; van der Meer et al., 2011; 2013).

As we were specifically interested in the cognitive processes taking place when inhibiting a prepotent motor response, we decided to only include experiments using an event-related design. It has been suggested that event-related designs are better suited to capture the specific activity related to response inhibition during no-go trials (cf. Criaud et al., 2013). Already Liddle and colleagues (Liddle et al., 2000) suggested that block designs are not optimal to isolate brain activity specifically related to response inhibition but rather also include aspects of decision making

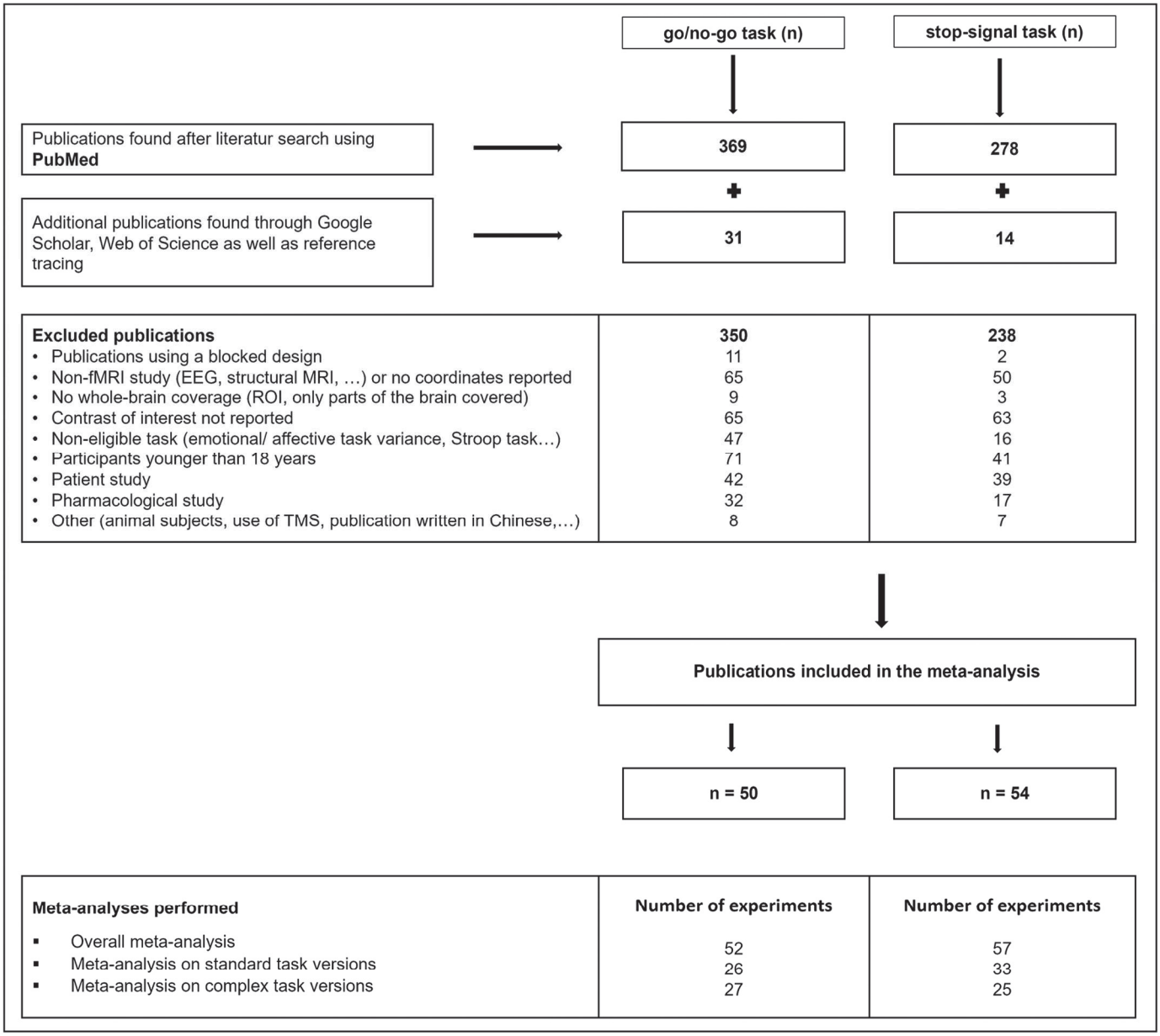

Fig. 1. Flowchart of the search steps and exclusion criteria used in the literature search. Abbreviations: fMRI: functional magnetic resonance imaging, EEG: electroencephalography, MRI: magnetic resonance imaging, ROI: region of interest, TMS: transcranial magnetic stimulation.

and monitoring. As go blocks require low decision making demands compared to mixed go/no-go blocks where participants have to choose between two response options, contrasting no-go with go blocks most likely also reflects aspects of decision making and monitoring rather than pure response inhibition.

2.2. Definition of standard versus complex task versions

Similar to Simmonds et al. (2008), we categorized those versions of the GNGT or SST as standard that used one or more specific stimuli as a go signal (e.g., the letter O for go in the GNGT, or left vs. right pointing arrows as go stimuli in the SST) and another stimulus as no-go or stop-signal (e.g., the letter X for withholding responses in the GNGT or an acoustic stop signal in the SST). If the standard paradigm was adapted to the effect that additional processing demands were needed to process the task at hand, the given experiment was categorized as complex. In particular, if the experiment used a combination of two tasks (e.g. a flanker task and GNGT, e.g. Baumeister et al., 2014), included a switch component or an additional rare/ oddball go stimulus (e.g. Kenner et al., 2010 and McNab et al., 2008), or when the correct response depended on whether the stimulus was presented in an alternating or non-alternating manner (Garavan et al., 1999), the experiment was categorized as complex as these task variations most likely lead to more complex S-R associations, higher working memory load, or a need for increased attentional control. A recent behavioral study demonstrated that additional cognitive processing negatively affects inhibitory control: higher working memory load resulted in longer stop-signal reaction time (Boucher et al., 2020). Additionally, task versions such as the moving bar stop-signal task – an anticipatory stop-signal task – were classified as complex, because such alternative designs may prompt additional activation in regions related to attentional control (see Zandbelt et al., 2010).

Tasks were also labeled as complex when they did not employ the standard, classically used stimuli as go and no-go or stop-signals (e.g., letters, shapes, tones etc.) but employed starkly different and visually more complex stimuli (e.g., bombs or airplanes, elaborate pictures or

faces). The reason behind this approach was that recent studies have shown that complex stimuli lead to stronger activation and workload within visual short-term working memory than do more basic stimuli (Luria et al., 2010) and that increased visual complexity can also trigger emotional, perceptual, and semantic processing dependent on aspects such as coloring and realism (Schlochtermeier et al., 2013). Furthermore, an investigation regarding phobic and threatening stimuli suggested that due to the automatic emotional processing of these stimuli, additional activation in regions such as the amygdala can be expected, which may interfere with, for instance, perceptual learning processes (Schmidt et al., 2011). In regard to this, some of the stimuli used in GNG paradigms, such as airplanes and bombs (see Rubia et al., 2001), superheroes/ villains (see Meffert et al., 2016) or battlefield scenarios (see Chikara et al., 2018) could also be considered as threatening. As alluded to above, Littman and Takács (2017) recently showed that the use of negative emotional stimuli impairs performance in the SST. Based on the above-mentioned possible interactions between more complex or emotionally charged stimuli and response inhibition processes, we included experiments with that kind of stimuli in the complex category. In Tables S8b and S9b, we provide a short description of each paradigm, together with a label indicating if the paradigm was standard ("S") or if it carried increased complexity on the stimulus ("C-stimulus") or task ("C-task") level, or both ("C-both").

2.3. Number of experiments included

Based on these inclusion and exclusion criteria, 50 studies with 52 individual go/no-go experiments were identified to be eligible for the main analysis. For the meta-analyses focusing on task complexity, 26 standard and 27 complex go/no-go experiments were included. For more information regarding the GNGT experiments included, please see Tables S8a-c. Likewise, 54 studies with 57 individual SST experiments were included in the SST main analysis. For the meta-analysis on the standard SST, 33 experiments were included, while 25 experiments were included in the complex SST meta-analysis. For more information regarding the SST experiments included, please see Tables S9a-c.

2.4. Activation likelihood estimation

To identify areas showing significant convergence across experiments, we conducted ALE meta-analyses (Eickhoff et al., 2012; Eickhoff et al., 2009; Laird et al., 2009a; Laird et al., 2009b; Turkeltaub et al., 2002) according to the standard procedures of our institute (e.g. Langner and Eickhoff, 2013; Rottschy et al., 2012). ALE models the coordinates as centers of 3-D Gaussian probability distributions instead of single foci in order to account for the spatial uncertainty of each single focus. The width of the Gaussian probability distribution is based on empirical data on between-subject and between-template variance and adjusted accordingly. A higher number of subjects reflects greater reliability and thus the Gaussian curve is modeled tighter, while a smaller number of subjects is modeled by a wider and lower Gaussian curve (Eickhoff et al., 2009).

The distribution probabilities of all foci in a given experiment were combined for each voxel and a modeled activation (MA) map derived (Turkeltaub et al., 2012). At the next step, a union MA map was calculated across all individual MA maps of the experiments included, resulting in voxel-wise ALE scores that reflect the convergence of results across experiments at each location of the brain. To identify 'true' from 'random' convergence across experiments, ALE scores were compared against an empirical null-distribution that reflects random spatial association between experiments. This null-distribution was created by taking a voxel at random from each of the individual MA maps and taking the union of these values in the same manner as done for the spatially contingent voxels in the true analysis, which was then repeated 10.000 times.

The p-value of the "true" ALE is then derived by the proportion of equal or higher values obtained under the null-distribution. The resulting non-parametric p-values for each individual meta-analysis were thresholded at cluster-level $p < 0.05$, family-wise error-corrected for multiple comparisons, with a cluster-forming threshold at voxel level of $p < 0.001$, and then transformed into z-scores for display. Conjunction analyses were performed by using the conservative minimum statistic (Nichols et al., 2005) to identify voxels that showed a significant effect in each of the individual meta-analyses. A detailed description of the contrast analysis is provided in the supplementary material.

The resulting coordinates were anatomically labeled by reference to the SPM Anatomy Toolbox, version 3.0 (Eickhoff et al., 2007; Eickhoff et al., 2005). Please see Tables S2 -S7 for a full overview of the study contributions.

3. Results

3.1. Action withholding

3.1.1. General analysis across go/no-go experiments independent of task complexity (n = 52)

The general meta-analysis across all experiments using an event-related GNGT version, independent of task complexity, revealed consistent activity in bilateral IPS and inferior parietal cortex (IPC), left lateral occipital cortex, the right superior temporal sulcus (STS) extending into right middle temporal gyrus (MTG), anterior midcingulate cortex (aMCC), pre-supplementary motor area (preSMA) extending into SMA, bilateral aI, right inferior frontal junction (IFJ), and right mid-DLPFC. Subcortical convergence was found in bilateral putamen (Fig. 2A, Table S10).

3.1.2. Standard go/no-go experiments (n = 26)

The meta-analysis across experiments using a standard event-related GNGT version revealed consistent activity in bilateral lateral occipital cortex (in particular hOc41a), right STS, right IPC (area PGa), preSMA/ SMA, and right aI (Fig. 2B, Table S11).

3.1.3. Complex go/no-go experiments (n = 27)

The meta-analysis across complex event-related GNGT experiments revealed consistent activity in right IFG (pars opercularis), bilateral aI extending into putamen, right IFJ and right mid-DLPFC as well as a cluster covering anterior DLPFC (aDLPFC) extending into the frontal pole, right superior occipital cortex extending into superior parietal lobule (SPL), bilateral IPS and anterior midcingulate cortex (aMCC) (Fig. 2C, Table S12).

Importantly, the meta-analyses on standard versus complex GNGT versions included a comparable number of experiments (i.e., 26 versus 27 experiments, respectively), ruling out the possibility that differences in the network involved were simply driven by a different number of included experiments.

3.2. Action cancellation

3.2.1. General analysis of stop-signal task experiments independent of task complexity (n = 57)

The general meta-analysis across experiments using an event-related SST version, independent of task complexity, revealed consistent activity in bilateral aI extending into IFG (pars opercularis / triangularis) in the right hemisphere, in right DLPFC, right dorsal premotor cortex (dPMC), aMCC extending into preSMA, bilateral temporoparietal junction (TPJ) zone extending from IPC into bilateral middle temporal gyrus, bilateral IPS, and bilateral IFJ extending into precentral gyrus. Subcortical convergence was found in right caudate nucleus and right thalamus (Fig. 3A, Table S13).

3.2.2. Standard stop-signal task experiments (n = 33)

The meta-analysis of standard event-related SST experiments

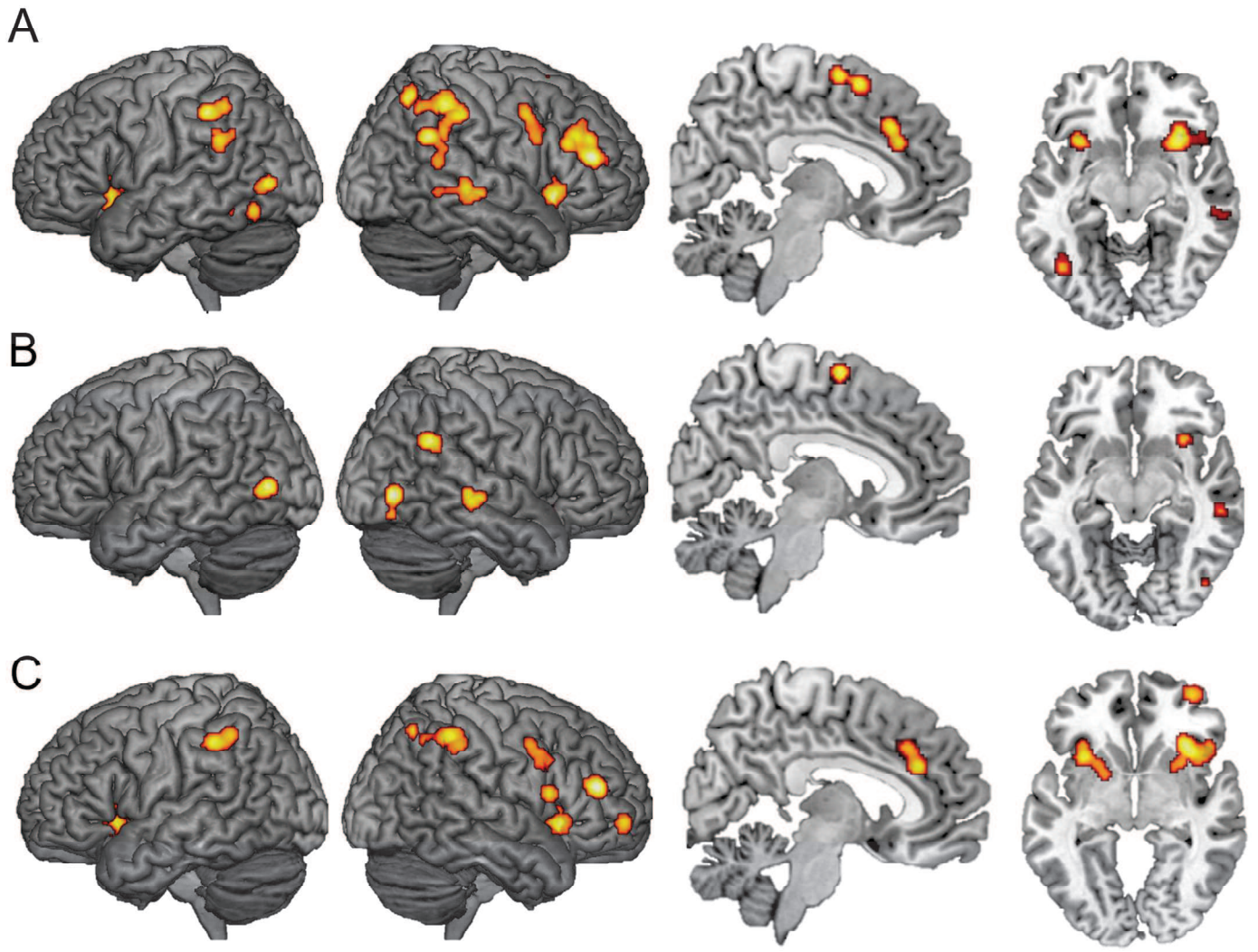

Fig. 2. Meta-analyses across go/no-go task experiments. Brain regions showing significant convergence of brain activity (cluster-level $p < 0.05$ family-wise error-corrected for multiple comparisons, cluster-forming threshold $p < 0.001$ at voxel level) across event-related fMRI experiments including (A) all go/no-go task experiments independent of task complexity, (B) only experiments with standard go/no-go task versions, and (C) only experiments with complex go/no-go task versions.

revealed convergence in bilateral TPJ, spanning from IPC over superior temporal gyrus (STG) into STS, left IPC (area PFcm, PFm), right IPS, right dPMC, aMCC extending into preSMA, bilateral aI extending into IFG (pars opercularis/ triangularis) in the right hemisphere, and right DLPFC. Subcortical convergence was found in right caudate nucleus (Fig. 3B, Table S14).

3.2.3. *Complex stop-signal task experiments (n = 25)*

The meta-analysis of complex event-related SST experiments revealed convergence in bilateral TPJ, aMCC/ pre-SMA, bilateral aI extending into IFG (pars opercularis/ triangularis) in the right hemisphere, and bilateral IFJ extending into precentral gyrus on the left side. Subcortical convergence was found in right thalamus (Fig. 3C, Table S15).

3.3. *Commonalities of Action withholding and Action cancellation*

3.3.1. *Conjunction analysis across standard go-/no-go experiments and standard stop-signal experiments*

The conjunction analysis across the ALE maps of the standard GNGT and standard SST revealed convergence in right aI and right STS (Fig. 4A).

3.3.2. *Conjunction analysis across complex go-/no-go experiments and complex stop-signal experiments*

The conjunction analysis across the complex GNGT and complex SST revealed convergence in bilateral aI, aMCC, and right IFJ (Fig. 4B).

The results of the meta-analytic contrasts between standard GNGT and standard SST and between complex GNGT and complex SST, respectively, are provided in the supplementary material (Fig. S1 and S2).

4. Discussion

In this series of ALE meta-analyses, we investigated the commonalities and differences between the go/no-go and stop-signal tasks and to which degree regions of convergence are affected by task complexity. While results of both tasks have often been pooled together when discussing the neural correlates of response inhibition, our results revealed a divergent pattern of brain regions consistently involved in standard GNGT versus standard SST, providing evidence for different underlying mechanisms. Further, task complexity strongly affected the pattern of regions involved in withholding responses in no-go trials, with key regions of the MDN particularly recruited in the complex task version. In contrast, no such pronounced difference was found for canceling

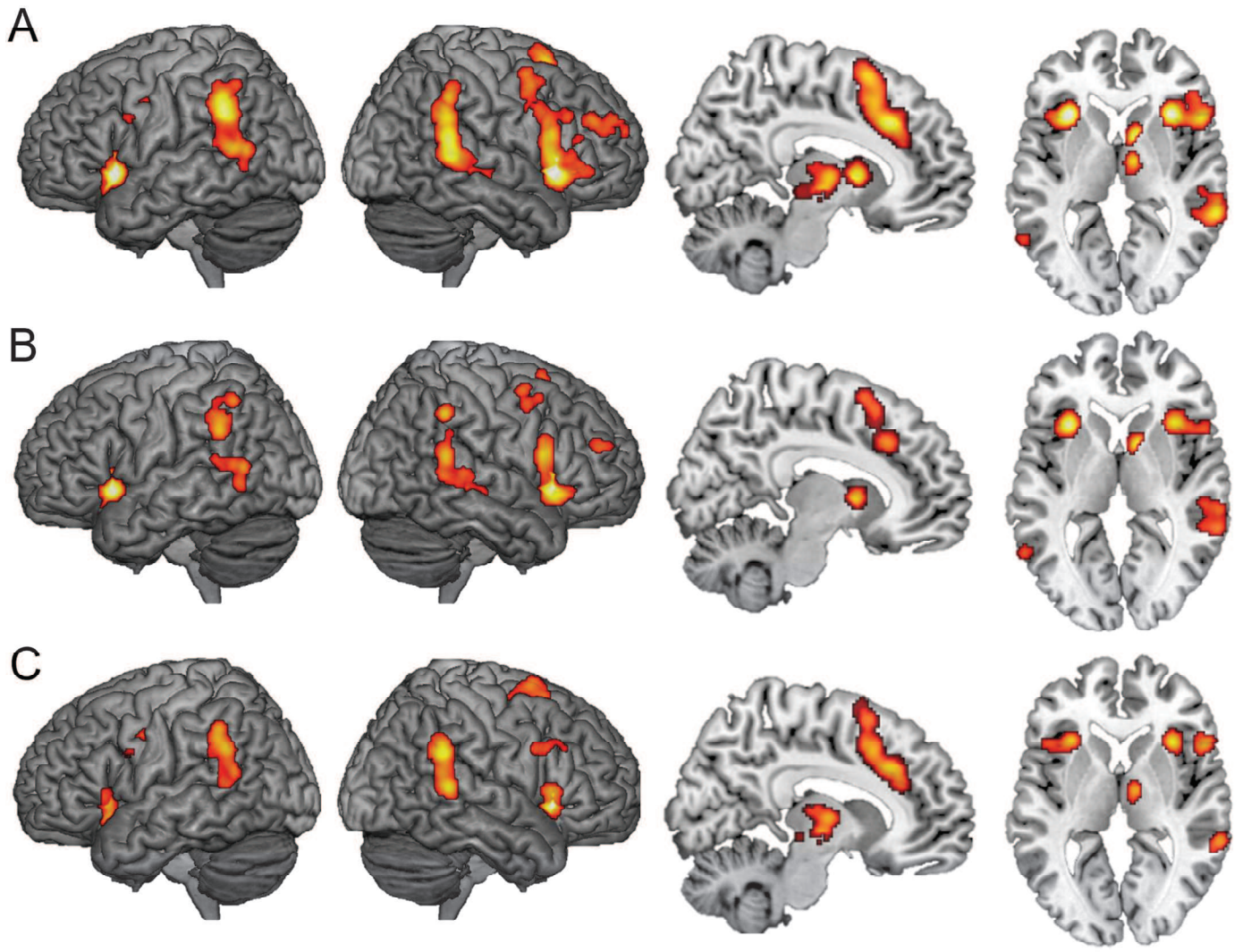

Fig. 3. Meta-analyses across stop-signal task experiments. Brain regions showing significant convergence of brain activity (cluster-level $p < 0.05$ family-wise error-corrected for multiple comparisons, cluster forming threshold $p < 0.001$ at voxel-level) across event-related fMRI experiments including (A) all stop-signal task experiments independent of task complexity, (B) only experiments with standard stop-signal task versions, and (C) only experiments with complex stop-signal task versions.

responses in stop-signal trials, where both – standard and complex – task versions recruited the MDN. In line with behavioral evidence we therefore propose that in classic (standard) GNGT versions, inhibitory control rather quickly becomes automatic after some practice but continues to be implemented in a top-down controlled fashion in the SST (Verbruggen and Logan, 2008a). While the SST thus clearly probes EF processes, this is more questionable for the classic GNGT version (see also Criaud et al., 2013), possibly explaining why performance in one task can deteriorate without an apparent deficit in the other (Krämer et al., 2013; Littman et al., 2017).

4.1. The effect of task complexity on response inhibition

Interestingly, the meta-analysis across the simple GNGT did not reveal convergence in fronto-insular-parietal regions of the classic MDN, with the exception of the right aI and the posterior preSMA/SMA. Besides these two regions, a network consisting of the right IPC, right STS, and bilateral lateral occipital cortex was found. While the finding of mainly lower-level and heteromodal areas outside the classical MDN network being involved in no-go versus go responses in the standard task version may seem to contradict findings from previous meta-analyses (Cieslik et al., 2015; Swick et al., 2011; Puiu et al., 2020; Hung et al., 2018), it has to be considered that all those earlier meta-analyses did not distinguish between different levels of task complexity. One previous meta-analysis of Simmonds et al. (2008), which included only a very low number of experiments (5 standard, 6 complex experiments), however, also found involvement of higher cognitive areas only for the complex version and thus provided first evidence that the brain network subserving GNGT inhibition strongly depends on the complexity of the paradigm used.

Interestingly, there is behavioral evidence that associations between a stimulus and a no-go response can be established through practice and that these learned associations can be automatically retrieved later on (cf. Verbruggen and Logan, 2008a, Verbruggen et al., 2014, Best et al., 2016; Liefooghe et al., 2016). Verbruggen and Logan (2008a) for example found that responding was slowed when a go-stimulus had been consistently associated with a no-go-response in a previous training phase, and that response inhibition benefited from consistent stimulus–no-go associations. Hence, the authors concluded that consistent mapping may result in the development of automatic inhibition through the retrieval of established stimulus–no-go associations and that the GNGT may rather probe associative learning than controlled response inhibition. Taking a closer look at the experiments included in the meta-analysis of standard GNGT versions revealed that most designs

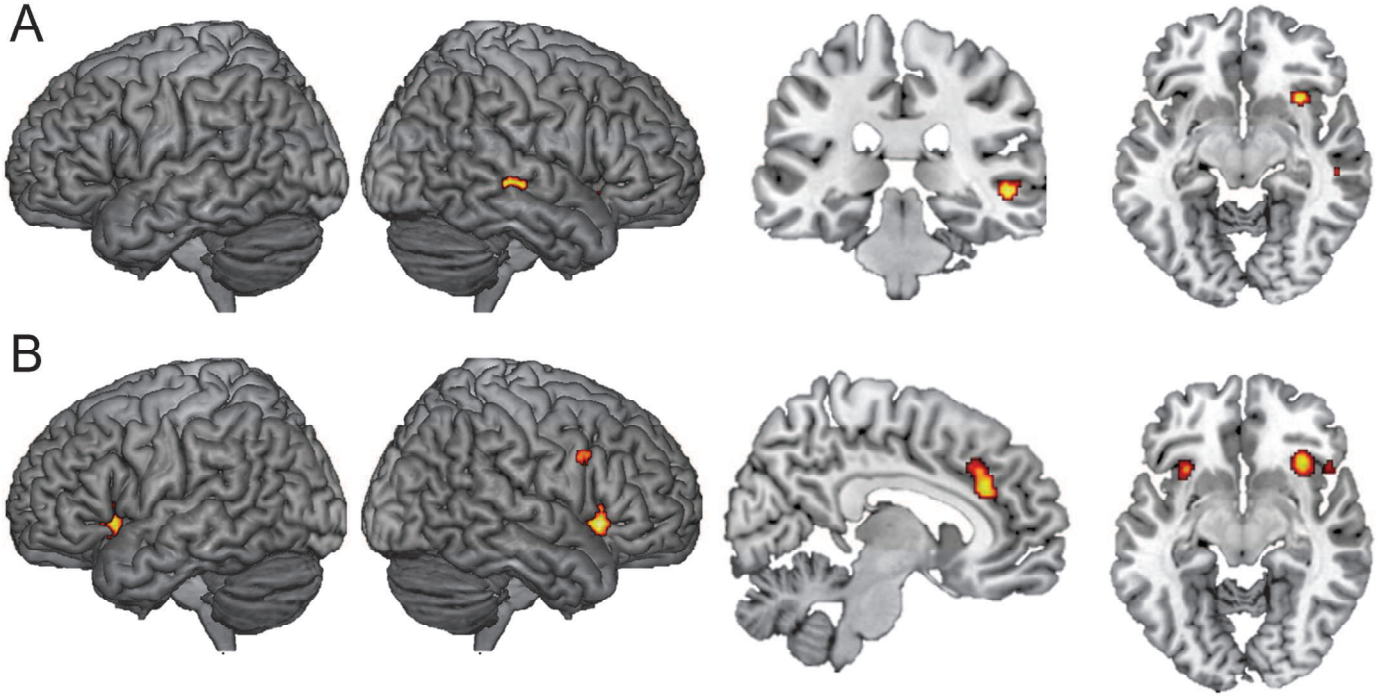

Fig. 4. Conjunction analysis across go/no-go and stop-signal task experiments. (A) Results of the minimum conjunction analysis across the results from the meta-analyses on standard versions of the go/no-go task and stop-signal task respectively, revealing significant conjoint convergence in right anterior insula and right superior temporal sulcus. (B) Results of the minimum conjunction analysis across the results from the meta-analyses on complex versions of the go/no-go task and stop-signal task respectively, revealing significant conjoint convergence in bilateral anterior insula, right inferior frontal junction, and anterior midcingulate cortex.

used one go signal and one no-go signal and thus used a consistent S-R mapping. This allowed participants to learn to react in an automatic manner over time with more practice, and this automatic inhibition may have resulted in reducing the need for top-down executive control. Thus, in combination with these behavioral results, we conclude that in standard GNGT versions with consistent S-R associations, the selection of the go or no-go response is performed in an increasingly automatic manner with practice and, therefore, fewer differences in activity levels between no-go and go trials can be found in brain regions linked to cognitive control.

Further, a recent (electroencephalography) EEG study (Wessel, 2017) using a GNGT version with consistent S-R mapping and varying the stimulus–stimulus interval and the probability of no-go trials, found that only a fast-paced setup with rare no-go trials evoked prepotent motor activity. In the present study, we therefore specifically looked at the probabilities for no-go trials and the stimulus-stimulus intervals as the effect of task complexity may be confounded by trial probability or trial duration (see Table S8b for detailed information on trial probabilities and Table S8b/c for information on trial duration). Overall, there were comparable numbers of standard or complex GNGT experiments using an equiprobable design (five vs. three studies for standard vs. complex GNGT, respectively). Moreover, in the standard GNGT sample, there were three additional studies using varying no-go probabilities, while in the group of complex GNGT versions four experiments included a contrast of rare no-go versus rare go stimuli, in which the probability effect should have been cancelled out. Therefore, we would argue that stronger frontal involvement in complex versus standard go/no-go tasks cannot simply be explained by a trial probability effect. Interestingly, studies comparing no-go versus rare go trials also revealed increased activation in right lateral and inferior PFC (Chikazoe et al., 2009; Fuentes-Claramonte et al., 2016; McNab et al., 2008), even though using equiprobable no-go and rare go trials. Further, we also tested for a difference in mean trial duration between simple and complex GNGT using the Mann-Whitney-U test. Thereby, no significant difference in mean trial duration ($U = 338.5$, $p = 0.21$) was found. In conclusion, it is unlikely that the stronger frontal convergence observed for complex compared to standard GNGT versions is simply driven by a stimulus probability effect or a difference in trial length. However, future studies should more specifically test for potential interactions between trial probability as well as trial length and task complexity.

In contrast to the GNGT, in the classic SST participants have to cancel an already initiated go response, i.e. reprogram the current action plan, thus requiring top-down control processes. Moreover, in the SST usually a staircase design is used to adapt the stop-signal delay to individual performance, resulting in a 50% success rate for inhibiting the prepotent motor response. Hence, the task is continuously adjusted to individual performance improvements, keeping it sufficiently difficult to ensure continued demand for top-down control in cancellation trials, even in standard task versions. In line with this notion, EEG studies showed reliable inhibition-related activity, in particular the stop-signal P3, for the standard SST (Wessel, 2017; Wessel and Aron, 2015), with the same response inhibition network being recruited in the standard SST and more complex inhibitory control tasks (Wessel and Aron, 2014). The results of our meta-analyses on the SST are in line with those previous findings showing that already the standard SST version consistently recruits key regions of the MDN and that for the complex SST only small variations in the recruitment of MDN regions are found. Thus, it seems that the MDN is already recruited as a whole even in relatively simple versions of tasks effectively probing EF. The finding of rather quantitative variations within the MDN with increasing task complexity or task difficulty is well in line with original fMRI findings indicating that increased task difficulty mainly leads to a different level of involvement within the MDN, rather than to an additional recruitment of more anterior regions in lateral prefrontal cortex (cf. Crittenden and Duncan, 2014).

In conclusion, our meta-analytic results on task complexity in the GNGT and SST indicate that already the standard SST versions recruit the MDN, which can be taken as further indirect evidence that all flavors of the SST probe executive functioning – in particular controlled response inhibition. This, however, is evidently not the case for standard

GNGT versions, which more likely measure automatic response inhibition after some practice and thus do not effectively tax EF-related processing. This also has crucial implications when interpreting behavioral data from patients, as deficits in the GNGT might not reflect difficulties in top-down controlled inhibition but rather difficulties in learning the appropriate S-R contingencies and, therefore, more likely reflect associative learning deficits (cf. Verbruggen and Logan, 2008a). In line with that, it has been shown that schizophrenia patients show deteriorated behavior compared to healthy controls in the GNGT (e.g. Sun et al., 2021; Ertekin et al., 2017; Weisbrod et al., 2000) but also deficits in associative learning (Brambilla et al., 2011; Hall et al., 2009), which might prevent them from learning the correct S-R associations and result in an increased and continued need for top-down control processes over the course of the task.

4.2. Go/no-go and stop-signal tasks: commonalities

4.2.1. Commonalities of standard GNGT and SST versions

The conjunction analysis across the standard task versions revealed conjoint convergence only within the right aI and the right STS. Recruitment of the aI can be observed across a diversity of tasks. In particular, the right aI is thought to play a causal role in activating task-relevant and deactivating task-unrelated regions (Sridharan et al., 2008) and to control activity in other brain regions across different tasks and stimulus modalities to initiate and adjust cognitive control mechanisms (cf. Dosenbach et al., 2006; Sridharan et al., 2008). As a meta-analysis from our group (Cieslik et al., 2015) also found the right aI, together with the right IFJ, to be conjointly involved in Stroop and S-R compatibility tasks as well as GNGT and SST, we would argue that our results further corroborate the notion that the right aI is a key region for monitoring the activation of the relevant task set and sending control signals to other task-relevant regions whenever necessary to enable correct task performance. These processes are evidently not only crucial for very complex cognitive tasks performed in a full-blown top-down mode but also support correct performance in standard tasks, such as the classic GNGT, which increasingly rely on automatic inhibition processes after some practice.

The right STS has less often been discussed in the context of inhibiting a prepotent motor response and is not considered in theories of inhibition (cf. e.g. Stevens et al., 2007; Chambers et al., 2009; Munakata et al., 2011 ; Wiecki and Frank, 2013). The region within the STS that was found in this meta-analysis most probably corresponds to the mid-STS (Erickson et al., 2017), which has been associated with spoken and written language processing (Wilson et al., 2018) but also with the processing of letters per se (van Atteveldt et al., 2004; Raij et al., 2000). It might thus be speculated that, given that letter stimuli are quite common for GNGT and SST, convergence in mid-STS might reflect processing of those stimuli. A stronger response to no-go and stop stimuli hence might reflect more intense local stimulus processing due to reduced expectancy effects (and thus larger surprise) or higher saliency, as the no-go and stop stimulus are usually presented less often to induce a high response tendency and therefore present a relatively less expected and highly salient stimulus input (cf. Kolodny et al., 2017).

Summarizing, only the right aI and right STS showed common recruitment across both standard task versions, indicating that performance in these two tasks is supported by largely different brain networks, further questioning the practice of pooling results across these two paradigms or using them interchangeably in diagnostic contexts or individual-differences research.

4.2.2. Commonalities of complex GNGT and SST versions

The conjunction analysis across the complex task versions revealed a consistent recruitment of bilateral aI, aMCC, and right IFJ. These regions have been proposed as domain-general regions for supervisory attentional control (cf. Cieslik et al., 2015), mediating controlled activation and maintenance of adequate task schemata necessary to implement non-routine, goal-oriented behavior.

Like the conjunction across the standard task versions, the investigation across the complex versions revealed convergence in the aI, but with the difference that here convergence was found in both hemispheres. Resting-state functional connectivity (RS-FC) fMRI and task-fMRI studies on functional lateralization suggested that the right aI plays a more general role in attentional control processes and attention reorientation for actions, whereas the left aI has a crucial role in cognitive control important for subsequent behavioral adaptation processes (Kann et al., 2016; Späti et al., 2014). In line with this, our results provide further evidence that the right aI may be more generally involved, with left aI coming into play only when tasks require higher degrees of executive control.

The right IFJ, on the other hand, has been associated with the continuous reactivation of the relevant task rule that links relevant stimulus features and corresponding responses in a task-specific manner (Cieslik et al., 2015). When looking at the contributions of experiments to the right IFJ cluster, we found that primarily tasks with S-R associations that changed depending on context (e.g. GNGT: Garavan et al., 1999; Garavan et al., 2002; Hester et al., 2004a; b; Mander et al., 2010; SST: Lavallee et al., 2014) and the stop-signal anticipation task, where the ever-changing probability of a stop-signal to occur in a given trial is pre-cued (Zandbelt et al., 2010; Zandbelt et al., 2011; Coxon et al., 2016), contributed to convergence in the right IFJ. Hence, consistent involvement of right IFJ in the complex task versions may be explained by the need to continuously update the relevant non-dominant S-R rule (cf. Cieslik et al., 2015), which is particularly needed when stimulus-stop associations change or when stop-signal probabilities are varied across trials.

The other region that was consistently involved in both complex task versions was the aMCC. It has long been argued that the aMCC detects conflict in information processing and concurrently – through interaction with other task-relevant prefrontal areas – leads to adaptation of behavioral action plans according to the current task demand (e.g. MacDonald et al., 2000; see also Botvinick et al., 2004, for a review). Furthermore, aMCC activation has been reported for conditions of free-choice (choice of which hand to use and the specific time point of the movement) where high-level intentional movement control is needed (Hoffstaedter et al., 2013). While the standard SST also consistently recruited the aMCC, involvement across both inhibition tasks was only found for the complex versions. This is well in line with the hypothesis that the aMCC detects conflicting response plans on a higher cognitive level (cf. Cieslik et al., 2015) which arises whenever a prepotent motor plan is in conflict with a task-specific one. This is specifically the case in standard and complex SST when an already initiated motor response has to be canceled. However, as explained above, standard GNGT with consistent S-R mapping may not always elicit a prepotency towards responding (cf. Wessel, 2017) and hence no conflict between concurrent response plans may evolve in the no-go condition, providing a potential explanation for why the aMCC was consistently found only for the complex GNGT.

Besides these three regions, other lateral prefrontal and parietal regions were recruited in a task-specific manner for the complex task versions but did not survive the conjunction analysis. This is well in line with previous data showing that the MDN consists of a core network including bilateral aI, IFJ and posterior medial frontal cortex that together support performance in most EF task, while other parts of the MDN are additionally recruited depending on specific task demands (cf. Camilleri et al., 2018). We here complement these findings by showing that even the complex versions of two tasks designed to tax response inhibition show common recruitment of only the core MDN, with other lateral prefrontal and parietal regions recruited in a more task-specific manner.

4.3. Go/no-go tasks

4.3.1. Standard GNGT versions

Besides the right STS and right aI, which were also found in the conjunction analysis across standard GNGT and standard SST version, bilateral lateral occipital gyrus, right angular gyrus, and a cluster in posterior preSMA, right at the intersection to the SMA, were found to be consistently activated for the standard GNGT version. The bilateral occipital clusters were specifically located in the cytoarchitectonic area hOc41a. A previous study (Malikovic et al., 2016) that functionally decoded this region using the Brainmap database revealed this region to be specifically involved in the processing of shape and orthography. Looking into the contributions in our data, we found that specifically experiments using letters and often infrequent no-go stimuli drove the effect within bilateral hOc41a. This led us to assume that increased convergence for no-go (vs. go) trials in the lateral parts of the occipital cortex may be due to increased visual attention to the specific characteristics of the rare and salient no-go stimuli (cf. also Boehler et al., 2011).

Furthermore, the standard GNGT showed convergence in the angular gyrus, particularly in cytoarchitectonic area PGa (Caspers et al., 2008; Caspers et al., 2006). Interestingly, Wager et al. (2005) revealed specific activation of the right angular gyrus for the GNGT compared to other interference paradigms, such as flanker or S-R compatibility tasks. In accordance with the role of the angular gyrus in the learning, processing, and retrieval of learned schemas and episodic memory (Rugg et al., 2018; van der Linden et al., 2017; Kuhl et al., 2014), convergence in PGa for the GNGT might hence reflect recruitment of learned automatic memory-based S-R representations (e.g. X = no-go and O = go).

The preSMA/SMA, on the other hand, has been associated with selecting the appropriate motor response from different alternatives (for a review, see Nachev et al., 2008) and is strongly related to tasks requiring cognitive control of motor responses, such as task switching or word generation (Eickhoff et al., 2011). In comparison to the higher-level preSMA, the SMA is thought to be more directly related to generating motor output, especially to action execution processes in relatively simple paradigms such as finger tapping, saccades or imagined movements (Nachev et al., 2008). Previous investigations that distinguished between standard and complex GNGT also revealed a crucial role for the posterior preSMA/ SMA for response selection processes in standard task versions (Mostofsky et al., 2003; Mostofsky and Simmonds, 2008; Simmonds et al., 2008). Thus, given previous results of its involvement in motor selection in relatively simple tasks, we suggest that the convergence we observed in posterior preSMA/ SMA reflects response selection processes that can be performed in a relatively automatic manner in the standard GNGT version.

In summary, a neural network outside the classical MDN network was found to be consistently involved in the standard GNGT. This finding may be somewhat surprising at first sight but most likely reflects the fact that responding in standard GNGT versions may become more automatic with practice, hence reducing the need for higher cognitive control regions usually found in other tasks probing inhibitory control or EFs in general.

4.3.2. Complex GNGT versions

In contrast to standard GNGT versions, more complex versions of the paradigm were consistently associated with the classic MDN. That is, besides the three supervisory attentional control regions that showed common involvement in the complex GNGT and SST (cf. 4.2.2), additional convergence was found in the parietal cortex, two regions of the right DLPFC, and rIFG. Moreover, subcortical convergence was found in bilateral anterior putamen.

While recruitment of the right DLPFC is frequently reported in studies investigating response inhibition, its role remains controversial (cf. e.g. Criaud et al., 2013). It has been suggested that the DLPFC is involved in rule-based selection of responses with a fundamental role in linking memory representations to goal directed motor behavior (c.f. Ridderinkhof et al., 2004). In line with this notion a lot of experiments that contributed to convergence within the mid-DLPFC exhibited increased WM demands, that is, when the no-go response was defined by a rule referring to preceding events, such that participants had to withhold their responses when the order of an alternating stimulus presentation was broken (e.g. Garavan et al., 1999, 2003; Hester et al., 2004a; b). Thus, participants could not learn a specific S-R association but had to activate the no-go response depending on a rule and a trial-by-trial adjustment if the current stimulus differed from the one presented before.

Little is known about the role of the anterior portion of the DLPFC in tasks requiring conflict monitoring and response selection (cf. Badre and Wagner, 2004). Previous studies have proposed a hierarchical organization within the LPFC, with the frontopolar cortex implementing the highest level of executive control, involving evaluation of information that has been generated at lower levels of executive processing within the DLPFC (cf. Christoff and Gabrieli, 2000). Looking at the contributions, we see that especially task variants with an oddball component or an additional interfering stimulus component (such as the word “PRESS” in red colors used as the no-go stimulus) contributed to the aDLPFC cluster. These variants may exacerbate the selection of the correct response and hence result in the activation of more anterior prefrontal areas in order to select the right response to a specific stimulus in more complex task conditions. This is most likely performed together with the parietal cortex (particularly IPS and SPL), which plays a crucial role in the integration of visuo-spatial, motor, and memory information into S-R associations under the control of the DLPFC (Corbetta and Shulman, 2002; Gottlieb, 2007), and which showed consistent involvement in the present study but also previous meta-analyses of GNGT-related brain activity (Cieslik et al., 2015; Simmonds et al., 2008; Swick et al., 2011).

Furthermore, we also found convergence in the right IFG, which was also found for the standard SST, but not the standard GNGT. As mentioned in the introduction and further discussed in Section 4.4.1. the right IFG is commonly discussed as the key region of controlled response inhibition. The lack of convergence of the right IFG in the standard version of the GNGT could be attributed to a lack of top-down control needed in these task versions. Increased task difficulty due to e.g. complex stimuli or higher working memory load in the complex GNGT version may contribute to a higher cognitive effort, resulting in involvement of the right IFG.

Subcortically, the complex GNGT revealed consistent activity in bilateral anterior putamen. Previous fMRI studies suggest that the putamen plays a critical role in the prediction of stimuli or targets especially in uncertain situations and thus also reflect predictions errors, which may result in the optimization and learning of the S-R association involved in the response selection process (Ouden et al., 2009; Sommer et al., 2016). In line with this, investigation of the influence of antagonists on dopamine receptors in the putamen of monkeys showed that dopamine receptors play a critical role in response selection (Ueda et al., 2017). The putamen may hence play a pivotal role for selecting the correct response in the complex GNGT as increased task difficulty results in higher risk for a prediction error and thus additional control is needed.

In conclusion, we have shown that the neural network commonly associated with action withholding in the GNGT crucially depends on stimulus complexity and particular design features of the variant used. Hence, activity in lateral prefrontal and superior/ intra-parietal regions more likely reflect higher executive processes that come into play whenever the task cannot be performed in an automatic manner and increased executive control mechanisms are needed to enable correct task performance.

4.4. Stop-signal tasks

4.4.1. Standard SST versions

In addition to convergence in the STS and right aI, that were already discussed in Section 4.2.1, the meta-analysis across standard SST versions revealed significant convergence in left IPC, right IPS, bilateral TPJ and STS, aMCC/preSMA, right dPMC, bilateral aI extending into IFG particularly in the right hemisphere, right IFJ, and right DLPFC. Moreover, subcortical convergence was found in right caudate nucleus.

Neural models of response inhibition classically include cortical regions, in particular the IFG and preSMA, that project to the globus pallidus pars interna/externa via either the striatum or the subthalamic nucleus (STN) and then back to the cortex via the thalamus (see Jahfari et al., 2011; Aron et al., 2007a; Aron, 2007b). It has been argued that within this network the right IFG plays a crucial role for the cancellation of the prepotent motor plan, with greater activity during stopping in right IFG and STN in participants with quicker stop-signal reaction times (i.e., in people showing more efficient inhibitory control; Aron and Poldrack et al., 2006). However, the specific functional role of this region is still a matter of debate. In particular, TMS over right IFG not only leads to disturbed SST performance (Chambers et al., 2007) but also increased dual-task costs, providing evidence that the right posterior IFG may implement control processes by updating actions plans according to changes in behaviorally relevant stimuli (Verbruggen et al., 2010). Supporting this view, a recent comparison of human fMRI and electrophysiological findings in primates in a context-dependent SST proposed that the ventral part of the IFG, comparable to our rIFG convergence cluster, is responsible for registering the intention to stop, or updating the current action plan, given the present context and stimulus (Xu et al., 2017). Concluding, the right IFG most likely supports reactive inhibitory control by updating action plans after presentation of the stop-signal.

Interestingly, the DLPFC cluster showing convergence for the SST was localized between the two DLPFC cluster showing convergent activity for the complex GNGT. It hence seems to play a specific role in the context of SST performance. This DLPFC cluster overlapped with an anterior DLPFC cluster defined by a previous co-activation based parcellation study that revealed specific connectivity with the anterior cingulate cortex (Cieslik et al., 2013). Moreover, the study argued that this region is involved in the monitoring of motor responses and subsequent behavioral adjustments, if necessary. As the SST requires to cancel the already initiated go-response once the stop-stimulus is identified, we argue that the DLPFC cluster that showed consistent increased activity for stop versus go responses in our meta-analysis may be involved in mediating the required behavioral adjustment processes.

The other region within the frontal cortex that was consistently recruited in the standard SST versions was the right dPMC. The dMPC is a key region for movement planning and execution (Nakayama et al., 2016; Cisek et al., 2005), but has frequently also been associated with inhibition processes during reaching movements in investigations of the SST in primates (Mirabella et al., 2011; Giarrocco et al., 2021). In line with this, TMS-induced disturbance of the dPMC resulted in a significant rise of errors in stop trials (Parmigiani and Cattaneo, 2018). Strong connectivity between the dPMC and motor areas (Koch et al., 2006; Nakayama et al., 2016) and evidence from TMS studies showing that the dPMC exerts control over the primary motor cortex (Bestmann et al., 2008; Parmigiani et al., 2015) lead us to conclude that the dMPC plays a key role for the stopping of initiated motor plans more at the output level, through its direct inhibitory influence on primary motor areas.

Within the medial frontal cortex, the preSMA has been associated with successful inhibition of motor responses (cf. Sharp et al., 2010) and hypothesized to closely interact with the IFG during SST performance (Swann et al., 2012). The preSMA most likely exerts an active role in the selection between different response alternatives (see above). Dynamic causal modeling analyses have suggested that the preSMA resolves competition between concurrent motor plans by exerting inhibitory and excitatory executive control over the motor cortices (Cieslik et al., 2011). Interestingly, the cluster showing convergence for standard SST versions lay anterior to the posterior preSMA/SMA region that was found for standard GNGT versions, providing further evidence for a functional gradient along the rostro-caudal axis, with more anterior regions being involved in cognitively more demanding control processes for selecting the correct response alternative. In contrast, response selection processes relying on automatic inhibition, as presumably occurring in standard GNGT versions, are subserved by more posterior regions.

Standard SST versions furthermore showed convergent activity in the TPJ, a central region in the ventral attentional control network involved in reorienting attention to task-relevant, currently unattended, stimuli (Corbetta et al., 2008). It was furthermore suggested that the TPJ takes part in the contextual updating of behavior in order to choose appropriate actions in regard to changing environmental inputs (Geng and Vossel, 2013). Both attention reorientation and contextual updating are crucial for correct performance in the SST suggesting that the TPJ is associated with attention orientation to the stop-stimulus, signaling participants to update the current action plan such that the action program is canceled.

Subcortically, significant convergence of activity was found within the caudate nucleus. The caudate is part of the indirect pathway of the basal ganglia circuit and proposed to be particularly involved in proactive inhibition (Jahfari et al., 2011; Zhang and Iwaki, 2019). However, we here found consistent stronger activity for stop versus go trials, providing evidence that the caudate nucleus is also involved in reactive inhibition, when the stop-signal is presented. fMRI evidence argues for a direct link between caudate activity and behavioral performance. For example, a study in ADHD patients showed that decreased activity in the right caudate for successful versus unsuccessful stopping goes along with decreased behavioral performance in the SST (Sebastian et al., 2012). Further, a recent fMRI study showed that activation within bilateral caudate nucleus covaries with a parameter of selective inhibition derived during the Simon task, pointing to a crucial role of the caudate for the selective inhibition of interfering response tendencies (Schmidt et al., 2020). Concluding, consistently stronger activated for stop versus go trials within the caudate nucleus may reflect increased need for selective inhibition.

4.4.2. Complex version

As shown in Fig. 3, standard and complex SST versions showed convergence in very similar brain regions - with some variation in the exact location and extent of significant clusters, particularly in the lateral frontal cortex. Moreover, compared to the standard version the complex SST additionally recruited the thalamus and IFJ on the left side.

While involvement of the right IFJ, which was also found for the conjunction analysis of the complex GNGT and SST versions, can be attributed to continuous updating of the relevant but non-dominant S-R rule (see Section 4.2.2.), convergence in the left IFJ might reflect additional activity to support this process in more difficult conditions. That is, left IFJ has commonly been reported in task-switching paradigms (Kim et al., 2012; Worringer et al., 2019) that require participants to constantly update and switch the currently relevant task set. In line with this notion, left lateral PFC, including IFJ, has specifically been found during the implementation of novel task rules (Hartstra et al., 2011; Hartstra et al., 2012). Ruge and Wolfensteller (2010) found BOLD signal activity present specifically in the first trials of newly instructed S-R mappings, while its activation level decreased with increasing practice. This effect is well in line with evidence from patients with left lateral PFC lesions, who revealed deficits particularly in the initial stages of learning new tasks (when new task schemas had to be acquired) but showed performance comparable to healthy controls in later trials (Shallice et al., 2008a,b). Additional recruitment of the left IFJ in complex SST versions may hence be explained by the more difficult implementation of S-R associations in more complex task versions.

The thalamus is frequently reported to be part of a frontal-striatal-

thalamic network recruited during stopping of actions (Aron and Poldrack, 2006; Aron, 2011; Congdon et al., 2010; Wilbertz et al., 2014; Hughes et al., 2014; Bellgrove et al., 2004). Comparing our thalamic cluster with parcellations of the thalamus based on structural connectivity (Behrens et al., 2003) and RSFC data (Zhang and Li, 2017) shows that the part of the thalamus showing convergence in our meta-analysis is connected with the prefrontal cortex. Interestingly, the thalamus seems to be specifically involved in the cancellation of actions rather than action withholding (Dambacher et al., 2014; Swick et al., 2011), which is in line with our finding of convergence during complex SST but not GNGT versions. Furthermore, a recent study showed that activation of a frontal-striatal-thalamic circuit correlated negatively with stop-signal reaction time in healthy adults, whereas this was not the case in patients with cocaine addiction, who showed a general slowing (Wang et al., 2018). We hence here provide further evidence that the thalamus, together with the prefrontal cortex, forms a neural circuit recruited when an already initiated motor response has to be canceled.

5. Limitations

There are some limitations of the present study, we would like to discuss.

Unfortunately, our complex category included very different versions of the GNGT and SST, respectively, which differed, for instance, in the perceptual complexity of the stimulus, the selectivity of inhibition, or the involvement of other cognitive processes. It would be interesting to investigate the impact of these different types of complexity. However, for performing robust and valid ALE meta-analyses, a minimum number of 17 to 20 experiments is needed (Eickhoff et al., 2016). As the complex GNGT category included 27 experiments, and the complex SST included 25 experiments, we were not able to perform any sub-analysis focusing on different complexity levels. Interestingly, while there is some literature on the effects of increased task difficulty on the MDN (e.g. Crittenden and Duncan, 2014; Shashidhara et al., 2019), increasing stimulus complexity may sometimes even lead to a reduced involvement of the MDN (cf. Smith et al., 2021). When looking at the contributions of individual experiments to clusters of convergence, we found that experiments featuring increased stimulus complexity particularly contributed to convergence within the IPS, providing further evidence for a specific role of the IPS in the identification and selection of relevant stimulus features for response selection. However, this hypothesis needs to be formally tested and future studies need to further disentangle the specific contribution of, e.g., stimulus versus task complexity on the different regions within the MDN.

Moreover, ALE meta-analyses test for consistency of spatially located effects without considering information on activation strength (i.e., effect size; cf. Müller et al., 2018). Thus, we cannot say exactly how activity is modulated when task difficulty is increased in a stepwise fashion. For instance, evidence from the WM literature points toward differential responding of lateral PFC to increasing WM load, with activity increases with increasing WM load but a reversal of this effect once WM load exceeds a critical level (e.g. van Snellenberg et al., 2015; Linden et al., 2003; Ahmed and Fockert, 2012). Hence, future studies should not only compare two different complexity levels per task but use different modulations of task complexity to better understand the specific neural response of key regions in the MDN.

Furthermore, when looking at potential hemispheric asymmetries in the SST it seems that especially in lateral prefrontal cortex some stronger involvement of the right hemisphere can be observed. As the information of activation strength is lost in ALE meta-analyses, we cannot provide any direct evidence for a differential engagement of the two hemispheres. However, it seems that for the lateral PFC, especially the right side is consistently recruited in the SST, while insular, middle frontal cortex, and temporo-parietal regions are recruited more bilaterally.

Lastly, a comprehensive understanding of the commonalities and differences between the GNGT and SST will not only require results from pooled data across participants, but also calls for investigating the two tasks within the same participants, to account for inter-individual variance when comparing activation patterns. A recent ultra-high field fMRI study compared response inhibition with interference resolution using the SST and a multi-source interference task, respectively (Isherwood et al., 2023). Using a model-based approach they found that behavior in the two tasks relied on distinct brain regions, with little spatial overlap. Further, as there was no strong correlation between modeling parameter estimations, the authors concluded that the two processes are also largely independent on the behavioral level. Thus, future fMRI studies should consider model-based approaches to achieve a more precise representation of the differences between tasks on the behavioral as well as the neural level (cf. Sebastian et al., 2018).

6. Conclusion

While results from the GNGT and SST have often been pooled together when delineating the neural correlates of inhibitory control, we found a divergent set of regions involved in standard GNGT versus SST, suggesting different underlying mechanisms. Task complexity strongly affected the pattern of regions involved in withholding responses in no-go trials, with the MDN coming into play particularly in the complex GNGT versions. We thus argue that the standard GNGT version can be performed in a rather automatic manner once S-R contingencies have been learned. In contrast, both standard and complex SST recruited a very similar set of regions, indicating that increasing task complexity results in quantitative (rather than qualitative) variations within the MDN in tasks which effectively probe EF. Furthermore, the conjunction analysis across the complex task versions revealed common involvement of only bilateral aI, aMCC and right IFJ, regions that have been proposed to mediate supervisory attentional control processes (Cieslik et al., 2015). Other regions of the MDN, such as lateral prefrontal or parietal cortex, hence seem to be less domain-general but recruited depending on specific task demands.

Concluding, we argue that the GNGT and SST test different concepts of inhibition – automatic versus controlled inhibition – and should not be treated interchangeably.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.neubiorev.2024.105544.

References

Ahmed, Lubna, de Fockert, Jan W., 2012. Focusing on attention: the effects of working memory capacity and load on selective attention. PLoS ONE 7 (8), e43101. https://doi.org/10.1371/journal.pone.0043101.

Ardila, Alfredo, Bernal, Byron, Rosselli, Monica, 2018. Executive functions brain system: an activation likelihood estimation meta-analytic study (S). Arch. Clin. Neuropsychol.: Off. J. Natl. Acad. Neuropsychol. 33 (4), 379–405. https://doi.org/10.1093/arclin/acx066.

Aron, Adam R., 2007b. The neural basis of inhibition in cognitive control (S). : Neurosci.: a Rev. J. bringing Neurobiol., Neurol. Psychiatry 13 (3), 214–228. https://doi.org/10.1177/1073858407299288.

Aron, Adam R., 2011. From reactive to proactive and selective control: developing a richer model for stopping inappropriate responses. : Biol. Psychiatry 69 (12), e55–e68. https://doi.org/10.1016/j.biopsych.2010.07.024.

Aron, Adam R., Poldrack, Russell A., 2006. Cortical and subcortical contributions to stop signal response inhibition: role of the subthalamic nucleus (S). : J. Neurosci. 26 (9), 2424. https://doi.org/10.1523/JNEUROSCI.4682-05.2006.
Aron, Adam R., Robbins, Trevor W., Poldrack, Russell A., 2004. Inhibition and the right inferior frontal cortex (S). : Trends Cogn. Sci. 8 (4), 170–177. https://doi.org/10.1016/j.tics.2004.02.010.
Aron, Adam R., Robbins, Trevor W., Poldrack, Russell A., 2014. Right inferior frontal cortex: addressing the rebuttals. S. 905 : Front. Hum. Neurosci. 8. https://doi.org/10.3389/fnhum.2014.00905.
Aron, Adam R., Durston, Sarah, Eagle, Dawn M., Logan, Gordon D., Stinear, Cathy M., Stuphorn, Veit, 2007a. Converging evidence for a fronto-basal-ganglia network for inhibitory control of action and cognition (S). : J. Neurosci. 27 (44), 11860–11864. https://doi.org/10.1523/JNEUROSCI.3644-07.2007.
Badre, David, Wagner, Anthony D., 2004. Selection, integration, and conflict monitoring: assessing the nature and generality of prefrontal cognitive control mechanisms. In (S). Neuron 41 (3), 473–487. https://doi.org/10.1016/S0896-6273(03)00851-1.
Baumeister, Sarah, Hohmann, Sarah, Wolf, Isabella, Plichta, Michael M., Rechtsteiner, Stefanie, Zangl, Maria, et al., 2014. Sequential inhibitory control processes assessed through simultaneous EEG–fMRI (S). : NeuroImage 94, 349–359. https://doi.org/10.1016/j.neuroimage.2014.01.023.
Behrens, T.E.J., Johansen-Berg, H., Woolrich, M.W., Smith, S.M., Wheeler-Kingshott, C. A.M., Boulby, P.A., et al., 2003. Non-invasive mapping of connections between human thalamus and cortex using diffusion imaging (S). : Nat. Neurosci. 6 (7), 750–757. https://doi.org/10.1038/nn1075.
Bellgrove, Mark A., Hester, Robert, Garavan, Hugh, 2004. The functional neuroanatomical correlates of response variability: evidence from a response inhibition task (S). : Neuropsychol. 42 (14), 1910–1916. https://doi.org/10.1016/j.neuropsychologia.2004.05.007.
Bender, Angela D., Filmer, Hannah L., Garner, K.G., Naughtin, Claire K., Dux, Paul E., 2016. On the relationship between response selection and response inhibition: An individual differences approach. Atten Percept Psychophys. 78 (8), 2420–2432. https://doi.org/10.3758/s13414-016-1158-8.
Berkman, Elliot T., Kahn, Lauren E., Merchant, Junaid S., 2014. Training-induced changes in inhibitory control network activity (S). : J. Neurosci. 34 (1), 149. https://doi.org/10.1523/JNEUROSCI.3564-13.2014.
Best, Maisy, Lawrence, Natalia S., Logan, Gordon D., McLaren, Ian P.L., Verbruggen, Frederick, 2016. Should I stop or should I go? The role of associations and expectancies (S). : J. Exp. Psychol.: Hum. Percept. Perform. 42 (1), 115–137. https://doi.org/10.1037/xhp0000116.
Bestmann, Sven, Swayne, Orlando, Blankenburg, Felix, Ruff, Christian C., Haggard, Patrick, Weiskopf, Nikolaus, et al., 2008. Dorsal premotor cortex exerts state-dependent causal influences on activity in contralateral primary motor and dorsal premotor cortex (S). : Cereb. Cortex 18 (6), 1281–1291. https://doi.org/10.1093/cercor/bhm159.
Boehler, Carsten N., Appelbaum, Lawrence G., Krebs, Ruth M., Chen, Ling-Chia, Woldorff, Marty G., 2011. The role of stimulus salience and attentional capture across the neural hierarchy in a stop-signal task. : PLoS ONE 6 (10), e26386. https://doi.org/10.1371/journal.pone.0026386.
Botvinick, Matthew M., Cohen, Jonathan D., Carter, Cameron S., 2004. Conflict monitoring and anterior cingulate cortex: an update (S). : Trends Cogn. Sci. 8 (12), 539–546. https://doi.org/10.1016/j.tics.2004.10.003.
Boucher, Leanne, Viparina, Brandi, Collins, W.Matthew, 2020. Working memory load selectively influences response inhibition in a stop signal task (S). : Psychol. Rep. 124 (3), 1268–1281. https://doi.org/10.1177/0033294120928271.
Brambilla, Paolo, Cerruti, Stefania, Bellani, Marcella, Perlini, Cinzia, Ferro, Adele, Marinelli, Veronica, et al., 2011. Shared impairment in associative learning in schizophrenia and bipolar disorder (S). : Prog. Neuro-Psychopharmacol. Biol. Psychiatry 35 (4), 1093–1099. https://doi.org/10.1016/j.pnpbp.2011.03.007.
Cai, Weidong, Leung, Hoi-Chung, 2009. Cortical activity during manual response inhibition guided by color and orientation cues (S). : Brain Res. 1261, 20–28. https://doi.org/10.1016/j.brainres.2008.12.073.
Camilleri, J.A., Müller, V.I., Fox, P., Laird, A.R., Hoffstaedter, F., Kalenscher, T., Eickhoff, S.B., 2018. Definition and characterization of an extended multiple-demand network (S). : NeuroImage 165, 138–147. https://doi.org/10.1016/j.neuroimage.2017.10.020.
Caspers, Svenja, Geyer, Stefan, Schleicher, Axel, Mohlberg, Hartmut, Amunts, Katrin, Zilles, Karl, 2006. The human inferior parietal cortex: Cytoarchitectonic parcellation and interindividual variability (S). : NeuroImage 33 (2), 430–448. https://doi.org/10.1016/j.neuroimage.2006.06.054.
Caspers, Svenja, Eickhoff, Simon B., Geyer, Stefan, Scheperjans, Filip, Mohlberg, Hartmut, Zilles, Karl, Amunts, Katrin, 2008. The human inferior parietal lobule in stereotaxic space (S). : Brain Struct. Funct. 212 (6), 481–495. https://doi.org/10.1007/s00429-008-0195-z.
Chambers, Christopher D., Garavan, Hugh, Bellgrove, Mark A., 2009. Insights into the neural basis of response inhibition from cognitive and clinical neuroscience (S). : Neurosci. Biobehav. Rev. 33 (5), 631–646. https://doi.org/10.1016/j.neubiorev.2008.08.016.
Chambers, Christopher D., Bellgrove, Mark A., Gould, Ian C., English, Therese, Garavan, Hugh, McNaught, Elizabeth, et al., 2007. Dissociable mechanisms of cognitive control in prefrontal and premotor cortex (S). : J. Neurophysiol. 98 (6), 3638–3647. https://doi.org/10.1152/jn.00685.2007.
Chikara, Rupesh K., Chang, Erik C., Lu, Yi-Chen, Lin, Dar-Shong, Lin, Chin-Teng, Ko, Li-Wei, 2018. Monetary reward and punishment to response inhibition modulate activation and synchronization within the inhibitory brain network (S.). : Front. Hum. Neurosci. 12, 27. https://doi.org/10.3389/fnhum.2018.00027.
Chikazoe, Junichi, Jimura, Koji, Tomoki, Asari, Yamashita, Ken-ichiro, Hiroki, Morimoto, Hirose, Satoshi, Miyashita, Yasushi, Konishi, Seiki, 2009. Functional dissociation in right inferior frontal cortex during performance of go/no-go task (S). Cereb. Cortex 19 (1), 146–152. https://doi.org/10.1093/cercor/bhn065.
Christoff, Kalina, Gabrieli, John D.E., 2000. The frontopolar cortex and human cognition: evidence for a rostrocaudal hierarchical organization within the human prefrontal cortex (S). : Psychobiol. 28 (2), 168–186. https://doi.org/10.3758/BF03331976.
Cieslik, Edna C., Zilles, Karl, Grefkes, Christian, Eickhoff, Simon B., 2011. Dynamic interactions in the fronto-parietal network during a manual stimulus-response compatibility task (S). : NeuroImage 58 (3), 860–869. https://doi.org/10.1016/j.neuroimage.2011.05.089.
Cieslik, Edna C., Mueller, Veronika I., Eickhoff, Claudia R., Langner, Robert, Eickhoff, Simon B., 2015. Three key regions for supervisory attentional control: evidence from neuroimaging meta-analyses (S). : Neurosci. Biobehav. Rev. 48, 22–34. https://doi.org/10.1016/j.neubiorev.2014.11.003.
Cieslik, Edna C., Zilles, Karl, Caspers, Svenja, Roski, Christian, Kellermann, Tanja S., Jakobs, Oliver, et al., 2013 (S). Is. there "One" DLPFC Cogn. Action Control? Evid. Heterog. Co. -Act. -Based Parcel. : Cereb. Cortex 23 (11), 2677–2689. https://doi.org/10.1093/cercor/bhs256.
Cisek, Paul, Kalaska, John F., 2005. Neural correlates of reaching decisions in dorsal premotor cortex: specification of multiple direction choices and final selection of action (S). : Neuron 45 (5), 801–814. https://doi.org/10.1016/j.neuron.2005.01.027.
Congdon, Eliza, Mumford, Jeanette A., Cohen, Jessica R., Galvan, Adriana, Aron, Adam R., Xue, Gui, et al., 2010. Engagement of large-scale networks is related to individual differences in inhibitory control (S). : NeuroImage 53 (2), 653–663. https://doi.org/10.1016/j.neuroimage.2010.06.062.
Congdon, Eliza, Altshuler, Lori L., Mumford, Jeanette A., Karlsgodt, Katherine H., Sabb, Fred W., Ventura, Joseph, et al., 2014. Neural activation during response inhibition in adult attention-deficit/hyperactivity disorder: Preliminary findings on the effects of medication and symptom severity (S). : Psychiatry Res.: Neuroimaging 222 (1), 17–28. https://doi.org/10.1016/j.pscychresns.2014.02.002.
Corbetta, Maurizio, Shulman, Gordon L., 2002. Control of goal-directed and stimulus-driven attention in the brain (S). : Nat. Rev. Neurosci. 3 (3), 201–215. https://doi.org/10.1038/nrn755.
Corbetta, Maurizio, Patel, Gaurav, Shulman, Gordon L., 2008. The reorienting system of the human brain: from environment to theory of mind (S). : Neuron 58 (3), 306–324. https://doi.org/10.1016/j.neuron.2008.04.017.
Coxon, James P., Goble, Daniel J., Leunissen, Inge, van Impe, Annouchka, Wenderoth, Nicole, Swinnen, Stephan P., 2016. Functional brain activation associated with inhibitory control deficits in older adults (S). : Cereb. Cortex 26 (1), 12–22. https://doi.org/10.1093/cercor/bhu165.
Criaud, Marion, Boulinguez, Philippe, 2013. Have we been asking the right questions when assessing response inhibition in go/no-go tasks with fMRI? A meta-analysis and critical review (S). : Neurosci. Biobehav. Rev. 37 (1), 11–23. https://doi.org/10.1016/j.neubiorev.2012.11.003.
Crittenden, Ben M., Duncan, John, 2014. Task difficulty manipulation reveals multiple demand activity but no frontal lobe hierarchy (S). Cereb. Cortex 24 (2), 532–540. https://doi.org/10.1093/cercor/bhs333.
Czapla, Marta, Baeuchl, Christian, Simon, Joe J., Richter, Barbara, Kluge, Matthias, Friederich, Hans-Christoph, et al., 2017. Do alcohol-dependent patients show different neural activation during response inhibition than healthy controls in an alcohol-related fMRI go/no-go-task? (S). : Psychopharmacol. 234 (6), 1001–1015. https://doi.org/10.1007/s00213-017-4541-9.
Dambacher, Franziska, Sack, Alexander T, Lobbestael, Jill, Arntz, Arnoud, Brugmann, Suzanne, Schuhmann, Teresa, 2014. The role of right prefrontal and medial cortex in response inhibition: interfering with action restraint and action cancellation using transcranial magnetic brain stimulation (S). J. Cogn. Neurosci. 26 (8), 1775–1784. https://doi.org/10.1162/jocn_a_00595.
den Ouden, Hanneke E.M., Friston, Karl J., Daw, Nathaniel D., McIntosh, Anthony R., Stephan, Klaas E., 2009. A dual role for prediction error in associative learning (S). Cereb. Cortex 19 (5), 1175–1185. https://doi.org/10.1093/cercor/bhn161.
Diamond, Adele, 2013. Executive functions (S). : Annu. Rev. Psychol. 64, 135–168. https://doi.org/10.1146/annurev-psych-113011-143750.
Donders, F.C., 1969. On the speed of mental processes (S). : Acta Psychol. 30, 412–431. https://doi.org/10.1016/0001-6918(69)90065-1.
Dosenbach, Nico U.F., Visscher, Kristina M., Palmer, Erica D., Miezin, Francis M., Wenger, Kristin K., Kang, Hyunseon C., et al., 2006. A Core System for the Implementation of Task Sets (S). : Neuron 50 (5), 799–812. https://doi.org/10.1016/j.neuron.2006.04.031.
Duncan, J., Owen, A.M., 2000. Common regions of the human frontal lobe recruited by diverse cognitive demands (S). : Trends Neurosci. 23 (10), 475–483. https://doi.org/10.1016/s0166-2236(00)01633-7.
Duncan, John, 2010. The multiple-demand (MD) system of the primate brain: mental programs for intelligent behaviour (S). : Trends Cogn. Sci. 14 (4), 172–179. https://doi.org/10.1016/j.tics.2010.01.004.
Eagle, Dawn M., Bari, Andrea, Robbins, Trevor W., 2008. The neuropsychopharmacology of action inhibition: cross-species translation of the stop-signal and go/no-go tasks (S). : Psychopharmacol. 199 (3), 439–456. https://doi.org/10.1007/s00213-008-1127-6.
Eickhoff, Simon B., Bzdok, Danilo, Laird, Angela R., Kurth, Florian, Fox, Peter T., 2012. Activation likelihood estimation meta-analysis revisited (S). : NeuroImage 59 (3), 2349–2361. https://doi.org/10.1016/j.neuroimage.2011.09.017.
Eickhoff, Simon B., Laird, Angela R., Grefkes, Christian, Wang, Ling E., Zilles, Karl, Fox, Peter T., 2009. Coordinate-based activation likelihood estimation meta-analysis of neuroimaging data: a random-effects approach based on empirical estimates of

spatial uncertainty (S). : Hum. brain Mapp. 30 (9), 2907–2926. https://doi.org/10.1002/hbm.20718.
Eickhoff, Simon B., Nichols, Thomas E., Laird, Angela R., Hoffstaedter, Felix, Amunts, Katrin, Fox, Peter T., et al., 2016. Behavior, sensitivity, and power of activation likelihood estimation characterized by massive empirical simulation (S). : NeuroImage 137, 70–85. https://doi.org/10.1016/j.neuroimage.2016.04.072.
Eickhoff, Simon B., Stephan, Klaas E., Mohlberg, Hartmut, Grefkes, Christian, Fink, Gereon R., Amunts, Katrin, Zilles, Karl, 2005. A new SPM toolbox for combining probabilistic cytoarchitectonic maps and functional imaging data (S). : NeuroImage 25 (4), 1325–1335. https://doi.org/10.1016/j.neuroimage.2004.12.034.
Eickhoff, Simon B., Paus, Tomas, Caspers, Svenja, Grosbras, Marie-Helene, Evans, Alan C., Zilles, Karl, Amunts, Katrin, 2007. Assignment of functional activations to probabilistic cytoarchitectonic areas revisited (S). : NeuroImage 36 (3), 511–521. https://doi.org/10.1016/j.neuroimage.2007.03.060.
Eickhoff, Simon B., Bzdok, Danilo, Laird, Angela R., Roski, Christian, Caspers, Svenja, Zilles, Karl, Fox, Peter T., 2011. Co-activation patterns distinguish cortical modules, their connectivity and functional differentiation (S). : NeuroImage 57 (3), 938–949. https://doi.org/10.1016/j.neuroimage.2011.05.021.
Erickson, Laura C., Rauschecker, Josef P., Turkeltaub, Peter E., 2017. Meta-analytic connectivity modeling of the human superior temporal sulcus (S). : Brain Struct. Funct. 222 (1), 267–285. https://doi.org/10.1007/s00429-016-1215-z.
Ertekin, Erhan, Üçok, Alp, Keskin-Ergen, Yasemin, Devrim-Üçok, Müge, 2017. Deficits in Go and NoGo P3 potentials in patients with schizophrenia (S). : Psychiatry Res. 254, 126–132. https://doi.org/10.1016/j.psychres.2017.04.052.
Fassbender, C., Murphy, K., Foxe, J.J., Wylie, G.R., Javitt, D.C., Robertson, I.H., Garavan, H., 2004. A topography of executive functions and their interactions revealed by functional magnetic resonance imaging (S). : Cogn. Brain Res. 20 (2), 132–143. https://doi.org/10.1016/j.cogbrainres.2004.02.007.
Fedorenko, Evelina, Duncan, John, Kanwisher, Nancy, 2013. Broad domain generality in focal regions of frontal and parietal cortex (S). : PNAS 110 (41), 16616–16621. https://doi.org/10.1073/pnas.1315235110.
Friedman, Naomi P., Miyake, Akira, 2004. The relations among inhibition and interference control functions: a latent-variable analysis (S). : J. Exp. Psychol.: Gen. 133, 101–135. https://doi.org/10.1037/0096-3445.133.1.101.
Fuentes-Claramonte, Paola, Ávila, C.ésar, Rodríguez-Pujadas, Aina, Costumero, V.íctor, Ventura-Campos, Noelia, Bustamante, Juan Carlos, et al., 2016. Inferior frontal cortex activity is modulated by reward sensitivity and performance variability (S). : Biol. Psychol. 114, 127–137. https://doi.org/10.1016/j.biopsycho.2016.01.001.
Garavan, H., Ross, T.J., Stein, E.A., 1999. Right hemispheric dominance of inhibitory control: an event-related functional MRI study (S). : Proc. Natl. Acad. Sci. USA 96 (14), 8301–8306. https://doi.org/10.1073/pnas.96.14.8301.
Garavan, H., Ross, T.J., Kaufman, J., Stein, E.A., 2003. A midline dissociation between error-processing and response-conflict monitoring (S). : NeuroImage 20 (2), 1132–1139. https://doi.org/10.1016/S1053-8119(03)00334-3.
Garavan, H., Ross, T.J., Murphy, K., Roche, R.A.P., Stein, E.A., 2002. Dissociable executive functions in the dynamic control of behavior: inhibition, error detection, and correction (S). : NeuroImage 17 (4), 1820–1829. https://doi.org/10.1006/nimg.2002.1326.
Geng, Joy J., Vossel, Simone, 2013. Re-evaluating the role of TPJ in attentional control: contextual updating? (S). : Neurosci. Biobehav. Rev. 37 (10 Pt 2), 2608–2620. https://doi.org/10.1016/j.neubiorev.2013.08.010.
Giarrocco, Franco, Bardella, Giampiero, Giamundo, Margherita, Fabbrini, Francesco, Brunamonti, Emiliano, Pani, Pierpaolo, Ferraina, Stefano, 2021. Neuronal dynamics of signal selective motor plan cancellation in the macaque dorsal premotor cortex (S). : Cortex; a J. devoted Study Nerv. Syst. Behav. 135, 326–340. https://doi.org/10.1016/j.cortex.2020.09.032.
Gottlieb, Jacqueline, 2007. From thought to action: the parietal cortex as a bridge between perception, action, and cognition (S). : Neuron 53 (1), 9–16. https://doi.org/10.1016/j.neuron.2006.12.009.
Hall, Jeremy, Romaniuk, Liana, McIntosh, Andrew M., Steele, J.Douglas, Johnstone, Eve C., Lawrie, Stephen M., 2009. Associative learning and the genetics of schizophrenia (S). : Trends Neurosci. 32 (6), 359–365. https://doi.org/10.1016/j.tins.2009.01.011.
Hartstra, Egbert, Waszak, Florian, Brass, Marcel, 2012. The implementation of verbal instructions: dissociating motor preparation from the formation of stimulus–response associations (S). : NeuroImage 63 (3), 1143–1153. https://doi.org/10.1016/j.neuroimage.2012.08.003.
Hartstra, Egbert, Kühn, Simone, Verguts, Tom, Brass, Marcel, 2011. The implementation of verbal instructions: an fMRI study (S). : Hum. Brain Mapp. 32 (11), 1811–1824. https://doi.org/10.1002/hbm.21152.
Hester, Robert, Murphy, Kevin, Garavan, Hugh, 2004a. Beyond common resources: the cortical basis for resolving task interference (S). : NeuroImage 23 (1), 202–212. https://doi.org/10.1016/j.neuroimage.2004.05.024.
Hester, Robert L., Murphy, Kevin, Foxe, John J., Foxe, Deirdre M., Javitt, Daniel C., Garavan, Hugh, 2004b. Predicting success: patterns of cortical activation and deactivation prior to response inhibition (S). : J. Cogn. Neurosci. 16 (5), 776–785. https://doi.org/10.1162/089892904970726.
Hirose, Satoshi, Chikazoe, Junichi, Watanabe, Takamitsu, Jimura, Koji, Kunimatsu, Akira, Abe, Osamu, Ohtomo, Kuni, Miyashita, Yasushi, Konishi, Seiki, 2012. Efficiency of go/no-go task performance implemented in the left hemisphere (S). J. Neurosci. 32 (26), 9059–9065. https://doi.org/10.1523/JNEUROSCI.0540-12.2012.
Hoffstaedter, Felix, Grefkes, Christian, Zilles, Karl, Eickhoff, Simon B., 2013. The "what" and "when" of self-initiated movements (S). : Cereb. Cortex 23 (3), 520–530. https://doi.org/10.1093/cercor/bhr391.
Hughes, M.E., Budd, T.W., Fulham, W.R., Lancaster, S., Woods, W., Rossell, S.L., Michie, P.T., 2014. Sustained brain activation supporting stop-signal task performance (S). : Eur. J. Neurosci. 39 (8), 1363–1369. https://doi.org/10.1111/ejn.12497.
Hung, Yuwen, Gaillard, Schuyler L., Yarmak, Pavel, Arsalidou, Marie, 2018. Dissociations of cognitive inhibition, response inhibition, and emotional interference: voxelwise ALE meta-analyses of fMRI studies (S). : Hum. brain Mapp. 39 (10), 4065–4082. https://doi.org/10.1002/hbm.24232.
Isherwood, S.J.S., Keuken, M.C., Bazin, P.L., Forstmann, B.U., 2021. Cortical and subcortical contributions to interference resolution and inhibition - an fMRI ALE meta-analysis (S). : Neurosci. Biobehav. Rev. 129, 245–260. https://doi.org/10.1016/j.neubiorev.2021.07.021.
Isherwood, S.J.S., Bazin, P.L., Miletić, S., Stevenson, N.R., Trutti, A.C., Tse, D.H.Y., et al., 2023. Investigating intra-individual networks of response inhibition and interference resolution using 7 T MRI. (S). : NeuroImage 271, 119988. https://doi.org/10.1016/j.neuroimage.2023.119988.
Jahfari, Sara, Waldorp, Lourens, van den Wildenberg, Wery P.M., Scholte, H.Steven, Ridderinkhof, K.Richard, Forstmann, Birte U., 2011. Effective connectivity reveals important roles for both the hyperdirect (fronto-subthalamic) and the indirect (fronto-striatal-pallidal) fronto-basal ganglia pathways during response inhibition (S). : J. Neurosci. 31 (18), 6891–6899. https://doi.org/10.1523/JNEUROSCI.5253-10.2011.
Jonkman, L.M., Lansbergen, M., Stauder, J.E.A., 2003. Developmental differences in behavioral and event-related brain responses associated with response preparation and inhibition in a go/nogo task (S). : Psychophysiol. 40 (5), 752–761. https://doi.org/10.1111/1469-8986.00075.
Jurado, María Beatriz, Rosselli, M.ónica, 2007. The elusive nature of executive functions: a review of our current understanding (S). : Neuropsychol. Rev. 17 (3), 213–233. https://doi.org/10.1007/s11065-007-9040-z.
Kann, Sarah, Zhang, Sheng, Manza, Peter, Leung, Hoi-Chung, Li, Chiang-Shan R., 2016. Hemispheric Lateralization of Resting-State Functional Connectivity of the Anterior Insula: Association with Age, Gender, and a Novelty-Seeking Trait (S). : Brain Connect. 6 (9), 724–734. https://doi.org/10.1089/brain.2016.0443.
Kawashima, R.; Satoh, K.; Itoh, H.; Ono, S.; Furumoto, S.; Gotoh, R. et al. (1996): Functional anatomy of GO/NO-GO discrimination and response selection–a PET study in man. In: Brain research 728 (1), S. 79–89. https://doi.org/10.1016/0006-8993(96)00389-7.
Kenner, Naomi M., Mumford, Jeanette A., Hommer, Rebecca E., Skup, Martha, Leibenluft, Ellen, Poldrack, Russell A., 2010. Inhibitory Motor Control in Response Stopping and Response Switching (S). J. Neurosci. 30 (25), 8512. https://doi.org/10.1523/JNEUROSCI.1096-10.2010.
Kim, Chobok, Johnson, Nathan F., Gold, Brian T., 2012. Common and distinct neural mechanisms of attentional switching and response conflict (S). : Brain Res. 1469, 92–102. https://doi.org/10.1016/j.brainres.2012.06.013.
Ko, Li-Wei; Shih, Yi-Cheng; Chikara, Rupesh Kumar; Chuang, Ya-Ting; Chang, Erik C.2016: Neural Mechanisms of Inhibitory Response in a Battlefield Scenario: A Simultaneous fMRI-EEG Study. In: Frontiers in Human Neuroscience 10. https://doi.org/10.3389/fnhum.2016.00185.
Koch, Giacomo, Franca, Michele, Del Fernandez Olmo, Miguel, Cheeran, Binith, Milton, Rosemary, Alvarez Sauco, Maria, Rothwell, John C., 2006. Time course of functional connectivity between dorsal premotor and contralateral motor cortex during movement selection (S). : J. Neurosci. 26 (28), 7452. https://doi.org/10.1523/JNEUROSCI.1158-06.2006.
Kolodny, Tamar, Mevorach, Carmel, Shalev, Lilach, 2017. Isolating response inhibition in the brain: parietal versus frontal contribution (S). : Cortex; a J. devoted Study Nerv. Syst. Behav. 88, 173–185. https://doi.org/10.1016/j.cortex.2016.12.012.
Konishi, S., Nakajima, K., Uchida, I., Sekihara, K., Miyashita, Y., 1998. No-go dominant brain activity in human inferior prefrontal cortex revealed by functional magnetic resonance imaging (S). : Eur. J. Neurosci. 10 (3), 1209–1213. https://doi.org/10.1046/j.1460-9568.1998.00167.x.
Krämer, Ulrike M., Solbakk, Anne-Kristin, Funderud, Ingrid, Løvstad, Marianne, Endestad, Tor, Knight, Robert T., 2013. The role of the lateral prefrontal cortex in inhibitory motor control (S). : Cortex; a J. devoted Study Nerv. Syst. Behav. 49 (3), 837–849. https://doi.org/10.1016/j.cortex.2012.05.003.
Kuhl, Brice A., Chun, Marvin M., 2014. Successful remembering elicits event-specific activity patterns in lateral parietal cortex (S). J. Neurosci. 34 (23), 8051. https://doi.org/10.1523/JNEUROSCI.4328-13.2014.
Laird, Angela R., Eickhoff, Simon B., Li, Karl, Robin, Donald A., Glahn, David C., Fox, Peter T., 2009b. Investigating the functional heterogeneity of the default mode network using coordinate-based meta-analytic modeling (S). : J. Neurosci. 29 (46), 14496–14505. https://doi.org/10.1523/JNEUROSCI.4004-09.2009.
Laird, Angela R., Eickhoff, Simon B., Kurth, Florian, Fox, Peter M., Uecker, Angela M., Turner, Jessica A., Jessica, Turner, Robinson, Jennifer L., Lancaster, Jack L., , et al. Fox, Peter T., 2009a. ALE meta-analysis workflows via the brainmap database: progress towards a probabilistic functional brain atlas (S). S. 23 Front. Neuroinformatics 3. https://doi.org/10.3389/neuro.11.023.2009.
Lancaster, Jack L., Tordesillas-Gutiérrez, Diana, Martinez, Michael, Salinas, Felipe, Evans, Alan, Zilles, Karl, et al., 2007. Bias between MNI and Talairach coordinates analyzed using the ICBM-152 brain template (S). : Hum. Brain Mapp. 28 (11), 1194–1205. https://doi.org/10.1002/hbm.20345.
Langner, Robert, Eickhoff, Simon B., 2013. Sustaining attention to simple tasks: a meta-analytic review of the neural mechanisms of vigilant attention (S). : Psychol. Bull. 139 (4), 870–900. https://doi.org/10.1037/a0030694.
Langner, Robert, Leiberg, Susanne, Hoffstaedter, Felix, Eickhoff, Simon B., 2018. Towards a human self-regulation system: common and distinct neural signatures of

emotional and behavioural control (S). : Neurosci. Biobehav. Rev. 90, 400–410. https://doi.org/10.1016/j.neubiorev.2018.04.022.
Lavallee, Christina F., Herrmann, Christoph S., Weerda, Riklef, Huster, René J., 2014. Stimulus-response mappings shape inhibition processes: a combined EEG-fMRI study of contextual stopping. : PLoS ONE 9 (4), e96159. https://doi.org/10.1371/journal.pone.0096159.
Leunissen, Inge, Coxon, James P., Swinnen, Stephan P., 2016. A proactive task set influences how response inhibition is implemented in the basal ganglia (S). : Hum. Brain Mapp. 37 (12), 4706–4717. https://doi.org/10.1002/hbm.23338.
Levy, Benjamin J., Wagner, Anthony D., 2011. Cognitive control and right ventrolateral prefrontal cortex: reflexive reorienting, motor inhibition, and action updating (S). : Ann. N. Y. Acad. Sci. 1224 (1), 40–62. https://doi.org/10.1111/j.1749-6632.2011.05958.x.
Liddle, Peter F., Kiehl, Kent A., Smith, Andra M., 2000. Event-related fMRI study of response inhibition. Hum. Brain Mapp. 12 (2), 100–109. https://doi.org/10.1002/1097-0193(200102)12:23.0.co;2-6.
Liefooghe, Baptist, Degryse, Jasper, Theeuwes, Marijke, 2016. Automatic effects of no-go instructions (S). : Can. J. Exp. Psychol. /Rev. Can. De. Psychol. expérimentale 70 (3), 232–241. https://doi.org/10.1037/cep0000080.
Linden, David E.J., Bittner, Robert A., Muckli, Lars, Waltz, James A., Kriegeskorte, Nikolaus, Goebel, Rainer, et al., 2003. Cortical capacity constraints for visual working memory: dissociation of fMRI load effects in a fronto-parietal network (S). : NeuroImage 20 (3), 1518–1530. https://doi.org/10.1016/j.neuroimage.2003.07.021.
Littman, Ran, Takács, Ádám, 2017. Do all inhibitions act alike? a study of go/no-go and stop-signal paradigms. : PLoS ONE 12 (10), e0186774. https://doi.org/10.1371/journal.pone.0186774.
Logan, Gordon D., Cowan, William B., 1984. On the ability to inhibit thought and action: a theory of an act of control (S). : Psychol. Rev. 91 (3), 295–327. https://doi.org/10.1037/0033-295X.91.3.295.
Luria, Roy, Sessa, Paola, Gotler, Alex, Pierre, Jolicoeur, Dell'Acqua, Roberto, 2010. Visual short-term memory capacity for simple and complex objects (S). : J. Cogn. Neurosci. 22 (3), 496–512. https://doi.org/10.1162/jocn.2009.21214.
MacDonald, Angus W., Cohen, Jonathan D., Stenger, V.Andrew, Carter, Cameron S., 2000. Dissociating the role of the dorsolateral prefrontal and anterior cingulate cortex in cognitive control (S). : Sci. 288 (5472), 1835–1838. https://doi.org/10.1126/science.288.5472.1835.
Malikovic, Aleksandar, Amunts, Katrin, Schleicher, Axel, Mohlberg, Hartmut, Kujovic, Milenko, Palomero-Gallagher, Nicola, et al., 2016. Cytoarchitecture of the human lateral occipital cortex: mapping of two extrastriate areas hOc4la and hOc4lp (S). : Brain Struct. Funct. 221 (4), 1877–1897. https://doi.org/10.1007/s00429-015-1009-8.
Mander, Bryce A., Reid, Kathryn J., Baron, Kelly G., Tjoa, Tjoson, Parrish, Todd B., Paller, Ken A., et al., 2010. EEG measures index neural and cognitive recovery from sleep deprivation (S). : J. Neurosci. 30 (7), 2686–2693. https://doi.org/10.1523/JNEUROSCI.4010-09.2010.
Mazzola-Pomietto, Pascale, Kaladjian, Arthur, Azorin, Jean-Michel, Anton, Jean-Luc, Jeanningros, R.égine, 2009. Bilateral decrease in ventrolateral prefrontal cortex activation during motor response inhibition in mania (S). : J. Psychiatr. Res. 43 (4), 432–441. https://doi.org/10.1016/j.jpsychires.2008.05.004.
McNab, Fiona, Leroux, Gaëlle, Strand, Fredrik, Thorell, Lisa, Bergman, Sissela, Klingberg, Torkel, 2008. Common and unique components of inhibition and working memory: an fMRI, within-subjects investigation (S). : Neuropsychol. 46 (11), 2668–2682. https://doi.org/10.1016/j.neuropsychologia.2008.04.023.
Meffert, Harma, Hwang, Soonjo, Nolan, Zachary T., Chen, Gang, Blair, James R., 2016. Segregating attention from response control when performing a motor inhibition task: Segregating attention from response control. In (S). NeuroImage 126, 27–38. https://doi.org/10.1016/j.neuroimage.2015.11.029.
Mirabella, G., Pani, P., Ferraina, S., 2011. Neural correlates of cognitive control of reaching movements in the dorsal premotor cortex of rhesus monkeys (S). : J. Neurophysiol. 106 (3), 1454–1466. https://doi.org/10.1152/jn.00995.2010.
Mostofsky, Stewart H., Simmonds, Daniel J., 2008. Response inhibition and response selection: two sides of the same coin (S). : J. Cogn. Neurosci. 20 (5), 751–761. https://doi.org/10.1162/jocn.2008.20500.
Mostofsky, Stewart H., Schafer, Joanna G.B., Abrams, Michael T., Goldberg, Melissa C., Flower, Abigail A., Boyce, Avery, et al., 2003. fMRI evidence that the neural basis of response inhibition is task-dependent (S). : Cogn. Brain Res. 17 (2), 419–430. https://doi.org/10.1016/s0926-6410(03)00144-7.
Müller, Veronika I., Cieslik, Edna C., Serbanescu, Ilinca, Laird, Angela R., Fox, Peter T., Eickhoff, Simon B., 2017. Altered brain activity in unipolar depression revisited: meta-analyses of neuroimaging studies (S). : JAMA Psychiatry 74 (1), 47–55. https://doi.org/10.1001/jamapsychiatry.2016.2783.
Müller, Veronika I., Cieslik, Edna C., Laird, Angela R., Fox, Peter T., Radua, Joaquim, Mataix-Cols, David, et al., 2018. Ten simple rules for neuroimaging meta-analysis (S). : Neurosci. Biobehav. Rev. 84, 151–161. https://doi.org/10.1016/j.neubiorev.2017.11.012.
Munakata, Yuko, Herd, Seth A., Chatham, Christopher H., Depue, Brendan E., Banich, Marie T., O'Reilly, Randall C., 2011. A unified framework for inhibitory control (S). Trends Cogn. Sci. 15 (10), 453–459. https://doi.org/10.1016/j.tics.2011.07.011.
Nachev, Parashkev, Kennard, Christopher, Husain, Masud, 2008. Functional role of the supplementary and pre-supplementary motor areas (S). : Nat. Rev. Neurosci. 9 (11), 856–869. https://doi.org/10.1038/nrn2478.
Nakayama, Yoshihisa, Yamagata, Tomoko, Hoshi, Eiji, 2016. Rostrocaudal functional gradient among the pre-dorsal premotor cortex, dorsal premotor cortex and primary motor cortex in goal-directed motor behaviour (S). : Eur. J. Neurosci. 43 (12), 1569–1589. https://doi.org/10.1111/ejn.13254.
Nee, Derek Evan, Wager, Tor D, Jonides, John, 2007. Interference resolution: insights from a meta-analysis of neuroimaging tasks (S). Cogn., Affect. Behav. Neurosci. 7 (1), 1–17. https://doi.org/10.3758/CABN.7.1.1.
Nichols, Thomas, Brett, Matthew, Andersson, Jesper, Wager, Tor, Poline, Jean-Baptiste, 2005. Valid conjunction inference with the minimum statistic (S). : NeuroImage 25 (3), 653–660. https://doi.org/10.1016/j.neuroimage.2004.12.005.
Niendam, Tara A., Laird, Angela R., Ray, Kimberly L., Dean, Y.Monica, Glahn, David C., Carter, Cameron S., 2012. Meta-analytic evidence for a superordinate cognitive control network subserving diverse executive functions (S). : Cogn., Affect., Behav. Neurosci. 12 (2), 241–268. https://doi.org/10.3758/s13415-011-0083-5.
Parmigiani, Sara, Cattaneo, Luigi, 2018. Stimulation of the dorsal premotor cortex, but not of the supplementary motor area proper, impairs the stop function in a STOP signal task (S). : Neurosci. 394, 14–22. https://doi.org/10.1016/j.neuroscience.2018.10.005.
Parmigiani, Sara, Barchiesi, Guido, Cattaneo, Luigi, 2015. The dorsal premotor cortex exerts a powerful and specific inhibitory effect on the ipsilateral corticofacial system: a dual-coil transcranial magnetic stimulation study (S). : Exp. brain Res. 233 (11), 3253–3260. https://doi.org/10.1007/s00221-015-4393-7.
Puiu, Andrei A., Wudarczyk, Olga, Kohls, Gregor, Bzdok, Danilo, Herpertz-Dahlmann, Beate, Konrad, Kerstin, 2020. Meta-analytic evidence for a joint neural mechanism underlying response inhibition and state anger (S). Hum. brain Mapp. 41 (11), 3147–3160. https://doi.org/10.1002/hbm.25004.
Raij, Tommi, Uutela, Kimmo, Hari, Riitta, 2000. Audiovisual integration of letters in the human brain (S). : Neuron 28 (2), 617–625. https://doi.org/10.1016/S0896-6273(00)00138-0.
Ridderinkhof, K.Richard, van den Wildenberg, Wery P.M., Segalowitz, Sidney J., Carter, Cameron S., 2004. Neurocognitive mechanisms of cognitive control: the role of prefrontal cortex in action selection, response inhibition, performance monitoring, and reward-based learning (S). : Brain Cogn. 56 (2), 129–140. https://doi.org/10.1016/j.bandc.2004.09.016.
Rottschy, C., Langner, R., Dogan, I., Reetz, K., Laird, A.R., Schulz, J.B., et al., 2012. Modelling neural correlates of working memory: a coordinate-based meta-analysis (S). : NeuroImage 60 (1), 830–846. https://doi.org/10.1016/j.neuroimage.2011.11.050.
Rubia, Katya, Russell, Tamara, Overmeyer, Stephan, Brammer, Michael J., Bullmore, Edward T., Sharma, Tonmoy, et al., 2001. Mapping Motor Inhibition: Conjunctive Brain Activations across Different Versions of Go/No-Go and Stop Tasks (S). : NeuroImage 13 (2), 250–261. https://doi.org/10.1006/nimg.2000.0685.
Ruge, Hannes, Wolfensteller, Uta, 2010. Rapid formation of pragmatic rule representations in the human brain during instruction-based learning (S). : Cereb. Cortex 20 (7), 1656–1667. https://doi.org/10.1093/cercor/bhp228.
Rugg, Michael D., King, Danielle R., 2018. Ventral lateral parietal cortex and episodic memory retrieval (S). : Cortex; a J. devoted Study Nerv. Syst. Behav. 107, 238–250. https://doi.org/10.1016/j.cortex.2017.07.012.
Schachar, Russell, Logan, Gordon D., Robaey, Philippe, Chen, Shirley, Ickowicz, Abel, Barr, Cathy, 2007. Restraint and cancellation: multiple inhibition deficits in attention deficit hyperactivity disorder (S). : J. Abnorm. Child Psychol. 35 (2), 229–238. https://doi.org/10.1007/s10802-006-9075-2.
Schachar, Russell J., Forget-Dubois, Nadine, Dionne, Ginette, Boivin, Michel, Robaey, Philippe, 2011. Heritability of response inhibition in children (S). : J. Int. Neuropsychol. Soc.: JINS 17 (2), 238–247. https://doi.org/10.1017/S1355617710001463.
Schel, Margot, Kühn, Simone, Brass, Marcel, Haggard, Patrick, Ridderinkhof, K.Richard, Crone, Eveline, 2014. Neural correlates of intentional and stimulus-driven inhibition: a comparison. S. 27 : Front. Hum. Neurosci. 8. https://doi.org/10.3389/fnhum.2014.00027.
Schlochtermeier, Lorna H., Kuchinke, Lars, Pehrs, Corinna, Urton, Karolina, Kappelhoff, Hermann, Jacobs, Arthur M., 2013. Emotional picture and word processing: an FMRI study on effects of stimulus complexity. : PLOS ONE 8 (2), e55619. https://doi.org/10.1371/journal.pone.0055619.
Schmidt, Claudia C., Timpert, David C., Arend, Isabel, Vossel, Simone, Fink, Gereon R., Henik, Avishai, Weiss, Peter H., 2020. Control of response interference: caudate nucleus contributes to selective inhibition. Sci. Rep. 10 (1), 20977. https://doi.org/10.1038/s41598-020-77744-1.
Schmidt, Thomas, Haberkamp, Anke, Veltkamp, G.Marina, Weber, Andreas, Seydell-Greenwald, Anna, Schmidt, Filipp, 2011. Visual processing in rapid-chase systems: image processing, attention, and awareness. S. 169 : Front. Psychol. 2. https://doi.org/10.3389/fpsyg.2011.00169.
Sebastian, A., Baldermann, C., Feige, B., Katzev, M., Scheller, E., Hellwig, B., et al., 2013a. Differential effects of age on subcomponents of response inhibition (S). : Neurobiol. Aging 34 (9), 2183–2193. https://doi.org/10.1016/j.neurobiolaging.2013.03.013.
Sebastian, A., Pohl, M.F., Klöppel, S., Feige, B., Lange, T., Stahl, C., et al., 2013b. Disentangling common and specific neural subprocesses of response inhibition (S). : NeuroImage 64 (r), 601–615. https://doi.org/10.1016/j.neuroimage.2012.09.020.
Sebastian, Alexandra, Forstmann, Birte U., Matzke, Dora, 2018. Towards a model-based cognitive neuroscience of stopping – a neuroimaging perspective (S). : Neurosci. Biobehav. Rev. 90, 130–136. https://doi.org/10.1016/j.neubiorev.2018.04.011.
Sebastian, Alexandra, Gerdes, Birthe, Feige, Bernd, Klöppel, Stefan, Lange, Thomas, Philipsen, Alexandra, et al., 2012. Neural correlates of interference inhibition, action withholding and action cancelation in adult ADHD (S). : Psychiatry Res.: Neuroimaging 202 (2), 132–141. https://doi.org/10.1016/j.pscychresns.2012.02.010.

Sebastian, Alexandra, Jung, Patrick, Neuhoff, Jonathan, Wibral, Michael, Fox, Peter T., Lieb, Klaus, et al., 2016. Dissociable attentional and inhibitory networks of dorsal and ventral areas of the right inferior frontal cortex: a combined task-specific and coordinate-based meta-analytic fMRI study (S). : Brain Struct. Funct. 221 (3), 1635–1651. https://doi.org/10.1007/s00429-015-0994-y.

Sebastian, Alexandra, Rössler, Kora, Wibral, Michael, Mobascher, Arian, Lieb, Klaus, Jung, Patrick, Tüscher, Oliver, 2017. Neural Architecture of Selective Stopping Strategies: Distinct Brain Activity Patterns Are Associated with Attentional Capture But Not with Outright Stopping (S). : J. Neurosci. 37 (40), 9785–9794. https://doi.org/10.1523/JNEUROSCI.1476-17.2017.

Senderecka, Magdalena, Grabowska, Anna, Szewczyk, Jakub, Gerc, Krzysztof, Chmylak, Roman, 2012. Response inhibition of children with ADHD in the stop-signal task: an event-related potential study (S). : Int. J. Psychophysiol.: Off. J. Int. Organ. Psychophysiol. 85 (1), 93–105. https://doi.org/10.1016/j.ijpsycho.2011.05.007.

Shallice, Tim, Stuss, Donald T., Picton, Terence W., Alexander, Michael P., Gillingham, Susan, 2008b. Mapping task switching in frontal cortex through neuropsychological group studies (S) (S). Front. Neurosci. 2 (1), 79–85. https://doi.org/10.3389/neuro.01.013.2008.

Shallice, Tim, Stuss, Donald T., Picton, Terence W., Alexander, Michael P., Gillingham, Susan., 2008a. Multiple effects of prefrontal lesions on task-switching. In: Frontiers in Human Neuroscience 2. https://doi.org/10.3389/neuro.09.002.2007.

Sharp, D.J., Bonnelle, V., Boissezon, X., de, Beckmann, James, C.F., Patel, S.G., Mehta, M. A, M.C., 2010. Distinct frontal systems for response inhibition, attentional capture, and error processing (S). : PNAS 107 (13), 6106–6111. https://doi.org/10.1073/pnas.1000175107.

Shashidhara, Sneha, Mitchell, Daniel J., Erez, Yaara, Duncan, John, 2019. Progressive recruitment of the frontoparietal multiple-demand system with increased task complexity, time pressure, and reward (S). : J. Cogn. Neurosci. 31 (11), 1617–1630. https://doi.org/10.1162/jocn_a_01440.

Simmonds, Daniel J., Pekar, James J., Mostofsky, Stewart H., 2008. Meta-analysis of Go/No-go tasks demonstrating that fMRI activation associated with response inhibition is task-dependent (S). : Neuropsychol. 46 (1), 224–232. https://doi.org/10.1016/j.neuropsychologia.2007.07.015.

Smith, Verity, Duncan, John, Mitchell, Daniel J., 2021. Roles of the default mode and multiple-demand networks in naturalistic versus symbolic decisions (S). : J. Neurosci. 41, 2214–2228. https://doi.org/10.1523/JNEUROSCI.1888-20.2020.

Sommer, Susanne, Pollmann, Stefan, 2016. Putamen activation represents an intrinsic positive prediction error signal for visual search in repeated configurations (S). : Open Neuroimaging J. 10, 126–138. https://doi.org/10.2174/1874440001610010126.

Späti, Jakub, Chumbley, Justin, Brakowski, Janis, Dörig, Nadja, Grosse Holtforth, Martin, Seifritz, Erich, Spinelli, Simona, 2014. Functional lateralization of the anterior insula during feedback processing (S). : Hum. Brain Mapp. 35 (9), 4428–4439. https://doi.org/10.1002/hbm.22484.

Sridharan, Devarajan, Levitin, Daniel J., Menon, Vinod, 2008. A critical role for the right fronto-insular cortex in switching between central-executive and default-mode networks (S). : Proc. Natl. Acad. Sci. USA 105 (34), 12569–12574. https://doi.org/10.1073/pnas.0800005105.

Steele, Vaughn R., Aharoni, Eyal, Munro, Gillian E., Calhoun, Vince D., Nyalakanti, Prashanth, Stevens, Michael C., et al., 2013. A large scale (N=102) functional neuroimaging study of response inhibition in a Go/NoGo task (S). : Behav. Brain Res. 256, 529–536. https://doi.org/10.1016/j.bbr.2013.06.001.

Stevens, Michael C., Kiehl, Kent A., Pearlson, Godfrey D., Calhoun, Vince D., 2007. Functional neural networks underlying response inhibition in adolescents and adults (S). : Behav. Brain Res. 181 (1), 12–22. https://doi.org/10.1016/j.bbr.2007.03.023.

Sun, Qiaoling; Fang, Yehua; Shi, Yongyan; Wang, Lifeng; Peng, Xuemei; Tan, Liwen , 2021: Inhibitory Top-Down Control Deficits in Schizophrenia With Auditory Verbal Hallucinations: A Go/NoGo Task. In: Frontiers in Psychiatry 12. https://www.frontiersin.org/articles/10.3389/fpsyt.2021.544746.

Swann, Nicole C., Cai, Weidong, Conner, Christopher R., Pieters, Thomas A., Claffey, Michael P., George, Jobi S., et al., 2012. Roles for the pre-supplementary motor area and the right inferior frontal gyrus in stopping action: electrophysiological responses and functional and structural connectivity (S). : NeuroImage 59 (3), 2860–2870. https://doi.org/10.1016/j.neuroimage.2011.09.049.

Swick, Diane, Ashley, Victoria, Turken, U., 2011. Are the neural correlates of stopping and not going identical? quantitative meta-analysis of two response inhibition tasks (S). : NeuroImage 56 (3), 1655–1665. https://doi.org/10.1016/j.neuroimage.2011.02.070.

Tabu, Hayato, Mima, Tatsuya, Aso, Toshihiko, Takahashi, Ryosuke, Fukuyama, Hidenao, 2012. Common inhibitory prefrontal activation during inhibition of hand and foot responses (S). : NeuroImage 59 (4), 3373–3378. https://doi.org/10.1016/j.neuroimage.2011.10.092.

Tiego, Jeggan, Testa, Renee, Bellgrove, Mark A., Pantelis, Christos, Whittle, Sarah, 2018. A hierarchical model of inhibitory control (S). : Front. Psychol. 9, 1339. https://doi.org/10.3389/fpsyg.2018.01339.

Turkeltaub, Peter E., Eden, Guinevere F., Jones, Karen M., Zeffiro, Thomas A., 2002. Meta-analysis of the functional neuroanatomy of single-word reading: method and validation (S). : NeuroImage 16 (3 Pt 1), 765–780. https://doi.org/10.1006/nimg.2002.1131.

Turkeltaub, Peter E., Eickhoff, Simon B., Laird, Angela R., Fox, Mick, Wiener, Martin, Fox, Peter, 2012. Minimizing within-experiment and within-group effects in Activation Likelihood Estimation meta-analyses (S). : Hum. brain Mapp. 33 (1), 1–13. https://doi.org/10.1002/hbm.21186.

Ueda, Yasumasa, Yamanaka, Ko, Noritake, Atsushi, Enomoto, Kazuki, Matsumoto, Naoyuki, Yamada, Hiroshi, et al., 2017. Distinct functions of the primate putamen direct and indirect pathways in adaptive outcome-based action selection (S). : Front. Neuroanat. 11, 66. https://doi.org/10.3389/fnana.2017.00066.

van Atteveldt, Nienke, Formisano, Elia, Goebel, Rainer, Blomert, Leo, 2004. Integration of letters and speech sounds in the human brain (S). : Neuron 43 (2), 271–282. https://doi.org/10.1016/j.neuron.2004.06.025.

van der Linden, Marieke, Berkers, Ruud M.W.J., Morris, Richard G.M., Fernández, Guillén, 2017. Angular gyrus involvement at encoding and retrieval is associated with durable but less specific memories (S). : J. Neurosci. 37 (39), 9474. https://doi.org/10.1523/JNEUROSCI.3603-16.2017.

van der Meer, Lisette, Groenewold, Nynke A., Pijnenborg, Marieke, Aleman, André, 2013. Psychosis-proneness and neural correlates of self-inhibition in theory of mind. : PLoS ONE 8 (7), e67774. https://doi.org/10.1371/journal.pone.0067774.

van der Meer, Lisette, Groenewold, Nynke A., Nolen, Willem A., Pijnenborg, Marieke, Aleman, André, 2011. Inhibit yourself and understand the other: Neural basis of distinct processes underlying Theory of Mind (S). : NeuroImage 56 (4), 2364–2374. https://doi.org/10.1016/j.neuroimage.2011.03.053.

van Snellenberg, Jared X., Slifstein, Mark, Read, Christina, Weber, Jochen, Thompson, Judy L., Wager, Tor D., et al., 2015. Dynamic shifts in brain network activation during supracapacity working memory task performance (S). : Hum. Brain Mapp. 36 (4), 1245–1264. https://doi.org/10.1002/hbm.22699.

Verbruggen, Frederick, Logan, Gordon D., 2008a. Automatic and controlled response inhibition: associative learning in the go/no-go and stop-signal paradigms (S). : J. Exp. Psychol. Gen. 137 (4), 649–672. https://doi.org/10.1037/a0013170.

Verbruggen, Frederick, Logan, Gordon D., 2008b. Response inhibition in the stop-signal paradigm (S). : Trends Cogn. Sci. 12 (11), 418–424. https://doi.org/10.1016/j.tics.2008.07.005.

Verbruggen, Frederick, Aron, Adam R., Stevens, Michaël A., Chambers, Christopher D., 2010. Theta burst stimulation dissociates attention and action updating in human inferior frontal cortex (S). : Proc. Natl. Acad. Sci. USA 107 (31), 13966–13971. https://doi.org/10.1073/pnas.1001957107.

Verbruggen, Frederick, Best, Maisy, Bowditch, William A., Stevens, Tobias, McLaren, Ian P.L., 2014. The inhibitory control reflex (S). : Neuropsychol. 65, 263–278. https://doi.org/10.1016/j.neuropsychologia.2014.08.014.

Wager, Tor D., Sylvester, Ching-Yune C., Lacey, Steven C., Nee, Derek Evan, Franklin, Michael, Jonides, John, 2005. Common and unique components of response inhibition revealed by fMRI (S). : NeuroImage 27 (2), 323–340. https://doi.org/10.1016/j.neuroimage.2005.01.054.

Wang, Wuyi, Worhunsky, Patrick D., Zhang, Sheng, Le, Thang M., Potenza, Marc N., Li, Chiang-Shan R., 2018. Response inhibition and fronto-striatal-thalamic circuit dysfunction in cocaine addiction (S). : Drug Alcohol Depend. 192, 137–145. https://doi.org/10.1016/j.drugalcdep.2018.07.037.

Watanabe, Jobu, Sugiura, Motoaki, Sato, Kazunori, Sato, Yuko, Maeda, Yasuhiro, Matsue, Yoshihiko, et al., 2002. The human prefrontal and parietal association cortices are involved in NO-GO performances: an event-related fMRI study (S). : NeuroImage 17 (3), 1207–1216. https://doi.org/10.1006/nimg.2002.1198.

Weisbrod, Matthias, Kiefer, Markus, Marzinzik, Frank, Spitzer, Manfred, 2000. Executive control is disturbed in schizophrenia: evidence from event-related potentials in a Go/NoGo task (S). : Biol. Psychiatry 47 (1), 51–60. https://doi.org/10.1016/S0006-3223(99)00218-8.

Wessel, Jan R., 2017. Prepotent motor activity and inhibitory control demands in different variants of the go/no-go paradigm. e12871 : Psychophysiol. 55 (3). https://doi.org/10.1111/psyp.12871.

Wessel, Jan R., Aron, Adam R., 2014. Inhibitory motor control based on complex stopping goals relies on the same brain network as simple stopping (S). : NeuroImage 103, 225–234. https://doi.org/10.1016/j.neuroimage.2014.09.048.

Wessel, Jan R., Aron, Adam R., 2015. It's not too late: the onset of the frontocentral P3 indexes successful response inhibition in the stop-signal paradigm. In (S). Psychophysiology 52 (4), 472–480. https://doi.org/10.1111/psyp.12374.

Wiecki, Thomas V., Frank, Michael J., 2013. A computational model of inhibitory control in frontal cortex and basal ganglia (S). : Psychol. Rev. 120 (2), 329–355. https://doi.org/10.1037/a0031542.

Wilbertz, Tilmann, Deserno, Lorenz, Horstmann, Annette, Neumann, Jane, Villringer, Arno, Heinze, Hans-Jochen, et al., 2014. Response inhibition and its relation to multidimensional impulsivity (S). : NeuroImage 103, 241–248. https://doi.org/10.1016/j.neuroimage.2014.09.021.

Wilson, Stephen M., Bautista, Alexa, McCarron, Angelica, 2018. Convergence of spoken and written language processing in the superior temporal sulcus (S). : NeuroImage 171, 62–74. https://doi.org/10.1016/j.neuroimage.2017.12.068.

Worringer, Britta, Langner, Robert, Koch, Iring, Eickhoff, Simon B., Eickhoff, Claudia R., Binkofski, Ferdinand C., 2019. Common and distinct neural correlates of dual-tasking and task-switching: a meta-analytic review and a neuro-cognitive processing model of human multitasking (S). : Brain Struct. Funct. 224 (5), 1845–1869. https://doi.org/10.1007/s00429-019-01870-4.

Wöstmann, Nicola M., Aichert, D.ésirée S., Costa, Anna, Rubia, Katya, Möller, Hans-J. ürgen, Ettinger, Ulrich, 2013. Reliability and plasticity of response inhibition and interference control (S). : Brain Cogn. 81 (1), 82–94. https://doi.org/10.1016/j.bandc.2012.09.010.

Xu, Kitty Z., Anderson, Brian A., Emeric, Erik E., Sali, Anthony W., Stuphorn, Veit, Yantis, Steven, Courtney, Susan M., 2017. Neural basis of cognitive control over movement inhibition: human fmri and primate electrophysiology evidence. : Neuron 96 (6), 1447–1458.e6. https://doi.org/10.1016/j.neuron.2017.11.010.

Zandbelt, Bram B., Vink, Matthijs, 2010. On the role of the striatum in response inhibition. : PLOS ONE 5 (11), e13848. https://doi.org/10.1371/journal.pone.0013848.

Zandbelt, Bram B., van Buuren, Mariët, Kahn, René S., Vink, Matthijs, 2011. Reduced proactive inhibition in schizophrenia is related to corticostriatal dysfunction and poor working memory (S). Biol. Psychiatry 70 (12), 1151–1158. https://doi.org/10.1016/j.biopsych.2011.07.028.

Zhang, Fan, Iwaki, Sunao, 2019. Common neural network for different functions: an investigation of proactive and reactive inhibition. : Front. Behav. Neurosci. 13 https://doi.org/10.3389/fnbeh.2019.00124 https://www.frontiersin.org/articles/10.3389/fnbeh.2019.00124.

Zhang, Ruibin, Geng, Xiujuan, Lee, Tatia M.C., 2017. Large-scale functional neural network correlates of response inhibition: an fMRI meta-analysis (S). : Brain Struct. Funct. 222 (9), 3973–3990. https://doi.org/10.1007/s00429-017-1443-x.

Zhang, Sheng, Li, Chiang-Shan R., 2017. Functional connectivity parcellation of the human thalamus by independent component analysis (S). : Brain Connect. 7 (9), 602–616. https://doi.org/10.1089/brain.2017.0500.

Supplementary Tables

Table S1: Checklist for Neuroimaging Meta-analyses by Müller et al., 2018	
The research question is specifically defined	YES, and it includes the following contrasts: 1) Standard no-go > go, event-related 2) Complex no-go > go, event-related 3) Standard stop > go, event-related 4) Complex stop > go, event-related
The literature search was systematic	YES, it included the following keywords in the following databases: 1) (title or abstract) "go/no-go task", "stop-signal task", "response inhibition"," action inhibition", "motor inhibition", "inhibition", "inhibitory control", "action cancellation" "action withholding", "fMRI" or "neuroimaging". 2) Databases: PubMed (https://www.ncbi.nlm.nih.gov/pubmed/) and google Scholar (http://scholar.google.de)
Detailed inclusion and exclusion criteria are included	YES, and reasons of non-standard criterion were: Inclusion of: - fMRI studies, which reported the coordinates in a standard reference space (Montreal Neurological Institute (MNI) or Talairach-Tournoux system (TAL)) - Healthy participants over the age of 18 and without any pharmacological manipulations - Activation data - Whole-brain data - Only event-related designs - No correlation or interaction with other variables (e.g., performance measures)
Sample overlap was taken into account	YES, using the following method: - If a study reported several experiments eligible for inclusion from the same subject group, the reported coordinates were pooled to constitute a single experiment - If a study separately reported two or more subject groups, e.g. young and old participants with separate results, the coordinates were not pooled
All experiments use the same search coverage (state how brain coverage is assessed and how small volume corrections and conjunctions are taken into account)	YES, the search coverage is the following: - Only whole-brain coverage - Exclusion of ROI studies - Exclusion of partial brain coverage
Studies are converted to a common reference space	YES, using the following conversion(s): - Coordinates reported in Talairach space were converted to MNI space (Lancaster et al., 2007).

Data extraction has been conducted by two investigators (ideal case) or double-checked by the same investigator (state how double-checking was performed)	YES, the following authors: - Taraneh Aziz-Safaie and Edna Cieslik, checked inclusion criteria - Taraneh Aziz-Safaie extracted coordinates - Taraneh Aziz-Safaie extracted other info: Number and age of subjects included, task, contrast, space, modality, task complexity, reason for task complexity, event-related or blocked design - Edna Cieslik double-checked the following data: Coordinates extracted, number and age of subjects included, task, contrast, space, modality, task complexity, reason for task complexity, event-related or blocked design
The paper includes a table with at least the references, basic study description (e.g. for fMRI tasks, stimuli), contrasts and basic sample descriptions (e.g. size, mean age and gender distribution, specific characteristics) of the included studies, source of information (e.g. contact with authors), reference space	YES, the table includes the following information: - Number and mean age of participants - Space used in original study and how coordinates were treated (MNI or Talairach) when space was not clearly specified in original study (these studies are labeled with a *) - Where information of coordinates was extracted from (table, main text or by correspondence with the authors) - Which task design, standard or complex, was used and the specific type of task complexity, i.e. stimulus complexity, task complexity or both - Specific contrast - Stimulus modality and stimulus type - Narrative description for each task - Stimulus probabilities and trial duration
The study protocol and all analyses were planned beforehand, including the methods and parameters used for inference, correction for multiple testing, etc.	YES: 1) No non-planned or post-hoc analyses 2) The meta-analysis used the default methods and parameters of our group as suggested in Eickhoff et al. (2016)
The meta-analysis includes diagnostics	Contributions are provided for each meta-analysis performed

Table S2: Experiments contributing to the individual clusters for the main analysis across go/no-go experiments independent of task complexity:

Cluster 1: 998 voxel - *Right inferior parietal lobe and interparietal sulcus* • Garavan et al., 1999 • Liddle et al., 2001 • Garavan et al., 2002 • Garavan et al., 2003 • Kelly et al., 2004 • Wager et al., 2005 • Chikazoe et al., 2009b • McNab et al., 2008 • Walther et al., 2010 • Rothmayr et al., 2011 • Fassbender et al., 2004 • Sebastian et al., 2012 • Hester et al., 2004a • Hester et al., 2004b • Kaladjian et al., 2007 • Kaladjian et al., 2009a • Mazzola-Pomietto et al., 2009 • Kaladjian et al., 2009b • Page et al., 2009 • Bunge et al., 2002 • Sebastian et al., 2013a • Sebastian et al., 2013b-2 • Falconer et al., 2008 • Fedota et al., 2015 • Fuentes-Claramonte et al., 2016 • Köhler et al., 2018 • Lawrence et al., 2009 • Mander et al., 2010 • Meffert et al., 2016 • Nakata et al., 2008 • O'Connor et al., 2012 • Czapla et al., 2017 • Baumeister et al. 2014 • Steele et al. 2013	**Cluster 7: 233 voxel -** *Right inferior frontal junction* • *Garavan et al., 1999* • *Liddle et al., 2001* • *Garavan et al., 2002* • *Chikazoe et al., 2009b* • *Geng et al., 2009* • *Walther et al., 2010* • *Sebastian et al., 2012* • *Hester et al., 2004b* • *Kaladjian et al., 2009b* • *Bunge et al., 2002* • *Sebastian et al., 2013b* • *Sebastian et al., 2013b-2* • *Chiu et al., 2015* • *Falconer et al., 2008* • *Fedota et al., 2015* • *Mander et al., 2010* • *Nakata et al., 2008* • *O'Connor et al., 2012*
Cluster 2: 683 voxel - *Right anterior insula and putamen* • Garavan et al., 1999 • Garavan et al., 2002 • Kelly et al., 2004 • Wager et al., 2005 • Chikazoe et al., 2009b • McNab et al., 2008 • Walther et al., 2010	**Cluster 8: 197 voxel -** *Left intraparietal sulcus* • Garavan et al., 1999 • Garavan et al., 2003 • Kelly et al., 2004 • Chikazoe et al., 2009b • McNab et al., 2008 • Walther et al., 2010 • Hester et al., 2004a

• Rothmayr et al., 2011 • Hester et al., 2004a • Hester et al., 2004b • Bunge et al., 2002 • Sebastian et al., 2013a • Sebastian et al., 2013b • Sebastian et al., 2013b-2 • Chen et al., 2015a • Chiu et al., 2015 • Dambacher et al., 2015 • Fedota et al., 2015 • Fuentes-Claramonte et al., 2016 • goghari et al., 2009 • Hsu et al., 2017 • Köhler et al., 2018 • Mander et al., 2010 • O'Connor et al., 2012 • Baumeister et al. 2014 • Steele et al. 2013	• Hester et al., 2004b Kaladjian et al., 2009a • Page et al., 2009 • Fuentes-Claramonte et al., 2016 • Köhler et al., 2018 • O'Connor et al., 2012 • Steele et al. 2013
Cluster 3: 567 voxel - *Right mid-dorsolateral prefrontal cortex* • Garavan et al., 1999 • Garavan et al., 2002 • Watanabe et al., 2002 • Garavan et al., 2003 • Kelly et al., 2004 • Wager et al., 2005 • Chikazoe et al., 2009b • McNab et al., 2008 • Zheng et al., 2008 • Walther et al., 2010 • Hester et al., 2004a • Hester et al., 2004b • Kaladjian et al., 2009b • Page et al., 2009 • Bunge et al., 2002 • Sebastian et al., 2013a • Sebastian et al., 2013b • Van Eijk et al., 2015-2 • Dambacher et al., 2015 • Fedota et al., 2015 • Fuentes-Claramonte et al., 2016 • goghari et al., 2009 • Kolodony et al., 2017 • Köhler et al., 2018 • Nakata et al., 2008 • Baumeister et al. 2014	**Cluster 9: 172 voxel** - *Right anterior midcingulate cortex* • Garavan et al., 1999 • Garavan et al., 2002 • Kelly et al., 2004 • Wager et al., 2005 • Chikazoe et al., 2009b • Hester et al., 2004b • Chen et al., 2015a • Falconer et al., 2008 • Fuentes-Claramonte et al., 2016 • Nakata et al., 2008 • O'Connor et al., 2012 • Steele et al. 2013

• Steele et al. 2013	
Cluster 4: 367 voxel - *Left anterior insula and putamen* • Garavan et al., 2002 • Kelly et al., 2004 • Chikazoe et al., 2009b • McNab et al., 2008 • Fassbender et al., 2004 • Hester et al., 2004a • Hester et al., 2004b • Rubia et al., 2006 • Hough et al., 2015 • Sebastian et al., 2013a • Sebastian et al., 2013b • Van Eijk et al., 2015-2 • Chen et al., 2015a • Fuentes-Claramonte et al., 2016 • Köhler et al., 2018 • O'Connor et al., 2012 • Baumeister et al. 2014 • Steele et al. 2013	**Cluster 10: 124 voxel -** *Left lateral occipital cortex* • Kiehl et al., 2000 • Sebastian et al., 2012 • Kaladjian et al., 2007 • Kaladjian et al., 2009a • Kaladjian et al., 2009b • Rubia et al., 2006 • Sebastian et al., 2013a • Sebastian et al., 2013b • Sebastian et al., 2013b-2 • Van Eijk et al., 2015 • Fedota et al., 2015 • Mander et al., 2010
Cluster 5: 246 voxel - *Right superior temporal sulcus* • Garavan et al., 2002 • Garavan et al., 2003 • Chikazoe et al., 2009b • Walther et al., 2010 • Sebastian et al., 2012 • Hester et al., 2004a • Hester et al., 2004b • Mazzola-Pomietto et al., 2009 • Roth et al., 2007 • Bunge et al., 2002 • Sebastian et al., 2013a Sebastian et al., 2013b • Sebastian et al., 2013b-2 • Chiu et al., 2015 • Fedota et al., 2015 • Köhler et al., 2018 • Lawrence et al., 2009 • Steele et al. 2013	**Cluster 11: 119 voxel -** *Left lateral occipital cortex* • Garavan et al., 1999 • Kelly et al., 2004 • Chikazoe et al., 2009b • Hester et al., 2004b • Kaladjian et al., 2007 • Page et al., 2009 • Rubia et al., 2006 • Hough et al., 2015 • Sebastian et al., 2013b-2 • Van Eijk et al., 2015-2 • Dambacher et al., 2015 • Fedota et al., 2015 • Kolodony et al., 2017 • Mander et al., 2010 • O'Connor et al., 2012 • Steele et al. 2013
Cluster 6: 238 voxel - *pre-/supplementary motor area* • Kiehl et al., 2000 • Garavan et al., 2002 • Chikazoe et al., 2009b • Walther et al., 2010 • Rothmayr et al., 2011 • Sebastian et al., 2012	**Cluster 12: 116 voxel -** *Left inferior parietal lobe* • Liddle et al., 2001 • Kelly et al., 2004 • Chikazoe et al., 2009b • Rothmayr et al., 2011 • Hester et al., 2004a • Hester et al., 2004b

• Hester et al., 2004a • Hester et al., 2004b • Sebastian et al., 2013a • Sebastian et al., 2013b • Van Eijk et al., 2015 • Chiu et al., 2015 • Fuentes-Claramonte et al., 2016 • O'Connor et al., 2012 • Baumeister et al. 2014 • Steele et al. 2013	• Hough et al., 2015 • Bunge et al., 2002 • Sebastian et al., 2013b-2 • Khler et al., 2018 • O'Connor et al., 2012 • Baumeister et al. 2014 • Steele et al. 2013

Table S3: Contributing experiments to the individual clusters for the standard go/no-go task meta-analysis:

Cluster 1: 169 voxel - *Right superior temporal sulcus* ● Walther et al., 2010 ● Sebastian et al., 2012 ● Mazzola-Pomietto et al., 2009 ● Roth et al., 2007 ● Sebastian et al., 2013a ● Sebastian et al., 2013b ● Fedota et al., 2015 ● Steele et al. 2013	**Cluster 5: 109 voxel -** *Right inferior parietal lobe* ● Liddle et al., 2001 ● Walther et al., 2010 ● Kaladjian et al., 2007 ● Kaladjian et al., 2009a ● Mazzola-Pomietto et al., 2009 ● Fedota et al., 2015 ● Steele et al. 2013
Cluster 2: 163 voxel - *Left lateral occipital cortex* ● Kiehl et al., 2000 ● Sebastian et al., 2012 ● Kaladjian et al., 2007 ● Kaladjian et al., 2009a ● Kaladjian et al., 2009b ● Sebastian et al., 2013a ● Sebastian et al., 2013b ● Van Eijk et al., 2015 ● Fedota et al., 2015	**Cluster 6: 85 voxel -** *Right anterior insula* ● Wager et al., 2005 ● Zheng et al., 2008 ● Chen et al., 2015a ● Dambacher et al., 2015 ● Fedota et al., 2015 ● Hsu et al., 2017 ● Steele et al. 2013
Cluster 3: 123 voxel - *Right lateral occipital cortex* ● Kiehl et al., 2000 ● Watanabe et al., 2002 ● Zheng et al., 2008 ● Sebastian et al., 2012 ● Page et al., 2009 ● Sebastian et al., 2013a ● Sebastian et al., 2013b ● Steele et al. 2013	
Cluster 4: 123 voxel - *pre-/ supplementary motor area* ● Kiehl et al., 2000 ● Walther et al., 2010 ● Sebastian et al., 2012 ● Sebastian et al., 2013a ● Sebastian et al., 2013b ● Van Eijk et al., 2015 ● Steele et al. 2013	

Table S4: Contributing experiments to the individual clusters for the complex go/no-go task meta-analysis:

Cluster 1: 559 voxel - *Right anterior insula and putamen* • Garavan et al., 1999 • Garavan et al., 2000 • Kelly et al., 2004 • Chikazoe et al., 2009b • McNab et al., 2008 • Rothmayr et al., 2011 • Hester et al., 2004a • Hester et al., 2004b • Bunge et al., 2002 • Sebastian et al., 2013b_2 • Fuentes-Claramonte et al., 2016 • goghari et al., 2009 • Köhler et al., 2018 • Mander et al., 2010 • O'Connor et al., 2012 • Baumeister et al. 2014	**Cluster 6: 199 voxel** - *Left intraparietal sulcus* • Garavan et al., 1999 • Garavan et al., 2003 • Kelly et al., 2004 • Chikazoe et al., 2009b • McNab et al., 2008 • Hester et al., 2004a • Hester et al., 2004b • Fuentes-Claramonte et al., 2016 • Köhler et al., 2018
Cluster 2: 510 voxel - *Right interparietal sulcus, superior and inferior parietal lobe* • Garavan et al., 1999 • Garavan et al., 2002 • Garavan et al., 2003 • Kelly et al., 2004 • Chikazoe et al., 2009b • McNab et al., 2008 • Fassbender et al., 2004 • Hester et al., 2004a • Hester et al., 2004b • Bunge et al., 2002 • Sebastian et al., 2013b_2 • Falconer et al., 2008 • Fuentes-Claramonte et al., 2016 • Köhler et al., 2018 • Mander et al., 2010 • Meffert et al., 2010 • Nakata et al., 2008 • Czapla et al., 2017 • Baumeister et al. 2014	**Cluster 7: 172 voxel** - *Right inferior frontal junction* • Garavan et al., 1999 • Garavan et al., 2002 • Chikazoe et al., 2009b • Geng et al., 2009 • Kelly et al., 2004 • Hester et al., 2004b • Bunge et al., 2002 • Sebastian et al., 2013b_2 • Chiu et al., 2015 • Falconer et al., 2008 • Mander et al., 2010 • Nakata et al., 2008 • O'Connor et al., 2012
Cluster 3: 357 voxel - *Left anterior insula and putamen* • Garavan et al., 2002 • Kelly et al., 2004 • Chikazoe et al., 2009b • McNab et al., 2008	**Cluster 8: 111 voxel** - *Right inferior frontal gyrus* • Garavan et al., 2002 • Kelly et al., 2004 • Chikazoe et al., 2009b • Bunge et al., 2002

• Fassbender et al., 2004 • Hester et al., 2004a • Hester et al., 2004b • Rubia et al., 2006 • Van Eijk et al., 2015_2 • Fuentes-Claramonte et al., 2016 • goghari et al., 2009 • Köhler et al., 2018 • O'Connor et al., 2012 • Baumeister et al., 2014	• Chiu et al., 2015 • Fuentes-Claramonte et al., 2016 • Köhler et al., 2018 • Nakata et al., 2008
<u>Cluster 4: 213 voxel</u> - *Right anterior midcingulate cortex* • Garavan et al., 1999 • Garavan et al., 2002 • Kelly et al., 2004 • Chikazoe et al., 2009b • Hester et al., 2004b • Bunge et al., 2002 • Fuentes-Claramonte et al., 2016 • Köhler et al., 2018 • Nakata et al., 2008 • O'Connor et al., 2012	**<u>Cluster 9: 105 voxel</u> -** *Right anterior-dorsolateral prefrontal cortex* • Kelly et al., 2004 • Chikazoe et al., 2009b • Fassbender et al., 2004 • Rubia et al., 2006 • Falconer et al., 2008 • Fuentes-Claramonte et al., 2016 • Köhler et al., 2018
<u>Cluster 5: 201 voxel</u> - *Right mid-dorsolateral prefrontal cortex* • Garavan et al., 1999 • Garavan et al., 2002 • Garavan et al., 2003 • Kelly et al., 2004 • Chikazoe et al., 2009b • McNab et al., 2008 • Hester et al., 2004a • Hester et al., 2004b • Van Eijk et al., 2015_2 • Fuentes-Claramonte et al., 2016 • Köhler et al., 2018 • Baumeister et al., 2014	

Table S5: Contributing experiments to the individual clusters for the general analysis across stop-signal experiments independent of task complexity:

Cluster 1: 1218 voxel - *Right anterior insula, inferior frontal gyrus, dorsal premotor cortex and middle frontal gyrus*

- Chevrier et al., 2007
- Marco-Pallares et al., 2008
- McNab et al., 2008
- Zheng et al., 2008
- Cai and Leung, 2009
- Boehler et al., 2010
- Hendrick et al., 2010
- Sharp et al., 2010
- Aron and Poldrack, 2006
- Cai and Leung, 2011
- Chikazoe et al., 2009a
- Hughes et al., 2012
- Jahfari et al., 2011
- Jahfari et al., 2012
- Kenner et al., 2010
- Leung and Cai, 2007
- Sebastian et al., 2012
- Tabu et al., 2012
- Xue et al., 2008
- Fauth-Bühler et al., 2012
- Tabu et al., 2011
- Sebastian et al., 2013a
- Sebastian et al., 2013b
- Sebastian et al., 2013b_2
- Van Eijk et al., 2015_2
- Berkmann et al., 2014
- Boecker et al., 2011
- Coxon et al., 2016
- Ganos et al., 2014
- Ghahremani et al., 2012
- Harle et al., 2016
- Hughes et al., 2013
- Leunissen et al., 2016
- Lorenz et al., 2015
- Mohammadi et al., 2015
- Rae et al., 2014
- Rodriguez-Pujadas et al., 2014
- Schel et al., 2014
- Van der Meer et al., 2013
- Wilbertz et al., 2014
- Xu et al., 2015

Cluster 5: 821 voxel - *Left anterior insula*

- McNab et al., 2008
- Cai and Leung, 2009
- Boehler et al., 2010
- Hendrick et al., 2010
- Aron and Poldrack, 2006
- Chikazoe et al., 2009a
- Hughes et al., 2012
- Jahfari et al., 2011
- Jahfari et al., 2012
- Kenner et al., 2010
- Leung and Cai, 2007
- Sebastian et al., 2012
- Tabu et al., 2012
- Fauth-Bhler et al., 2012
- Tabu et al., 2011
- Sebastian et al., 2013a
- Sebastian et al., 2013b
- Sebastian et al., 2013b_2
- Van Eijk et al., 2015_2
- Berkmann et al., 2014
- Congdon et al., 2014
- Coxon et al., 2016
- Ganos et al., 2014
- Ghahremani et al., 2012
- Lorenz et al., 2015
- Mohammadi et al., 2015
- Rae et al., 2014
- Van der Meer et al., 2013
- Wilbertz et al., 2014
- Xu et al., 2015
- Xu et al., 2017
- Ko et al., 2016
- Jahfari et al., 2015
- Cai et al. 2014
- Zandbelt et al. 2010
- Zandbelt et al. 2011
- Sebastian et al., 2017

• Xu et al., 2017 • Ko et al., 2016 • Lavallee et al., 2014 • Jahfari et al., 2015 • Cai et al. 2014 • Lenartowicz et al. 2010 • Swann et al. 2012 • Zandbelt et al. 2010 • Zandbelt et al. 2011 • Sebastian et al., 2017	
Cluster 2: 1364 voxel - *Right anterior midcingulate cortex, pre-supplementary motor area and right superior frontal gyrus* • Marco-Pallars et al., 2008 • McNab et al., 2008 • Cai and Leung, 2009 • Boehler et al., 2010 • Hendrick et al., 2010 • Sharp et al., 2010 • Aron and Poldrack, 2006 • Cai and Leung, 2011 • Chikazoe et al., 2009a • Jahfari et al., 2011 • Kenner et al., 2010 • Leung and Cai, 2007 • Sebastian et al., 2012 • Tabu et al., 2012 • Xue et al., 2008 • Tabu et al., 2011 • Sebastian et al., 2013b_2 • Van Eijk et al., 2015_2 • Berkmann et al., 2014 • Boecker et al., 2011 • Coxon et al., 2016 • Ganos et al., 2014 • Ghahremani et al., 2012 • Harle et al., 2016 • Leunissen et al., 2016 • Lorenz et al., 2015 • Mohammadi et al., 2015 • Rae et al., 2014 • Van der Meer et al., 2013 • Wilbertz et al., 2014 • Xu et al., 2015 • Xu et al., 2017 • Chikara et al., 2018 • Ko et al., 2016	**Cluster 6: 511 voxel** - *Right caudate and thalamus* • Chevrier et al., 2007 • McNab et al., 2008 • Boehler et al., 2010 • Hendrick et al., 2010 • Aron and Poldrack, 2006 • Cai and Leung, 2011 • Chikazoe et al., 2009a • Kenner et al., 2010 • Fauth-Bühler et al., 2012 • Berkmann et al., 2014 • Congdon et al., 2014 • Coxon et al., 2016 • Harle et al., 2016 • Leunissen et al., 2016 • Lorenz et al., 2015 • Montojo et al., 2013 • Schel et al., 2014 • Wilbertz et al., 2014 • Xu et al., 2015 • Xu et al., 2017 • Zandbelt et al. 2010 • Zandbelt et al. 2011

• Jahfari et al., 2015 • Cai et al. 2014 • Lenartowicz et al. 2010 • Zandbelt et al. 2010 • Zandbelt et al. 2011	
Cluster 3: 1323 voxel - *Right inferior parietal lobe, intraparietal sulcus, right middle temporal gyrus, right superior temporal sulcus* • Marco-Pallares et al., 2008 • McNab et al., 2008 • Zheng et al., 2008 • Cai and Leung, 2009 • Boehler et al., 2010 • Hendrick et al., 2010 • Sharp et al., 2010 • Aron and Poldrack, 2006 • Chikazoe et al., 2009a • Hughes et al., 2012 • Jahfari et al., 2011 • Jahfari et al., 2012 • Kenner et al., 2010 • Leung and Cai, 2007 • Sebastian et al., 2012 • Tabu et al., 2012 • Xue et al., 2008 • Fauth-Bühler et al., 2012 • Sebastian et al., 2013a • Sebastian et al., 2013b • Sebastian et al., 2013b_2 • Berkmann et al., 2014 • Boecker et al., 2011 • Coxon et al., 2016 • Coxon et al., 2016 • Ganos et al., 2014 • Ghahremani et al., 2012 • Hughes et al., 2013 • Leunissen et al., 2016 • Lorenz et al., 2015 • Montojo et al., 2013 • Rae et al., 2014 • Rodriguez-Pujadas et al., 2014 • Schel et al., 2014 • Van der Meer et al., 2013 • Wilbertz et al., 2014 • Xu et al., 2015 • Ko et al., 2016 • Jahfari et al., 2015	**Cluster 7: 365 voxel** - *Right anterior and mid-dorsolateral prefrontal cortex* • McNab et al., 2008 • Cai and Leung, 2009 • Boehler et al., 2010 • Aron and Poldrack, 2006 • Chikazoe et al., 2009a • Leung and Cai, 2007 • Sebastian et al., 2012 • Tabu et al., 2012 • Xue et al., 2008 • Sebastian et al., 2013a • Sebastian et al., 2013b • Van Eijk et al., 2015 • Berkmann et al., 2014 • Boecker et al., 2011 • Coxon et al., 2016 • Ghahremani et al., 2012 • Hughes et al., 2013 • Leunissen et al., 2016 • Lorenz et al., 2015 • Schel et al., 2014 • Van der Meer et al., 2013 • Wilbertz et al., 2014 • Xu et al., 2015 • Ko et al., 2016 • Lavallee et al., 2014 • Cai et al. 2014 • Zandbelt et al. 2010 • Zandbelt et al. 2011

• Cai et al. 2014 • Lenartowicz et al. 2010 • Swann et al. 2012 • Zandbelt et al. 2010 • Zandbelt et al. 2011 • Sebastian et al., 2017	
Cluster 4: 1067 voxel – *Left inferior parietal lobe, intraparietal sulcus and middle temporal gyrus* • McNab et al., 2008 • Cai and Leung, 2009 • Boehler et al., 2010 • Hendrick et al., 2010 • Chikazoe et al., 2009a • Hughes et al., 2012 • Jahfari et al., 2011 • Jahfari et al., 2012 • Kenner et al., 2010 • Sebastian et al., 2012 • Tabu et al., 2012 • Xue et al., 2008 • Sebastian et al., 2013a • Sebastian et al., 2013b • Sebastian et al., 2013b_2 • Berkmann et al., 2014 • Boecker et al., 2011 • Coxon et al., 2016 • Ganos et al., 2014 • Ghahremani et al., 2012 • Harle et al., 2016 • Leunissen et al., 2016 • Lorenz et al., 2015 • Rae et al., 2014 • Van der Meer et al., 2013 • Wilbertz et al., 2014 • Xu et al., 2015 • Ko et al., 2016 • Lavallee et al., 2014 • Cai et al. 2014 • Swann et al. 2012 • Zandbelt et al. 2010 • Zandbelt et al. 2011 • Sebastian et al., 2017	**Cluster 8: 137 voxel** – *Left inferior frontal junction* • Cai and Leung, 2009 • Boehler et al., 2010 • Chikazoe et al., 2009a • Kenner et al., 2010 • Tabu et al., 2012 • Fauth-Bühler et al., 2012 • Coxon et al., 2016 • Lorenz et al., 2015 • Wilbertz et al., 2014 • Xu et al., 2015 • Xu et al., 2017 • Ko et al., 2016 • Lavallee et al., 2014 • Zandbelt et al. 2010 • Zandbelt et al. 2011

Table S6: Contributing experiments to the individual clusters for the standard stop-signal task meta-analysis:

Cluster 1: 1218 voxel - *Right anterior insula and inferior frontal gyrus* • Chevrier et al., 2007 • Zheng et al., 2008 • Cai and Leung, 2009 • Hendrick et al., 2010 • Aron and Poldrack, 2006 • Chikazoe et al., 2009a • Hughes et al., 2012 • Leung and Cai, 2007 • Sebastian et al., 2012 • Tabu et al., 2012 • Xue et al., 2008 • Fauth-Bühler et al., 2012 • Tabu et al., 2011 • Sebastian et al., 2013a • Sebastian et al., 2013b • Berkmann et al., 2014 • Ganos et al., 2014 • Ghahremani et al., 2012 • Harle et al., 2016 • Lorenz et al., 2015 • Rodriguez-Pujadas et al., 2014 • Schel et al., 2014 • Van der Meer et al., 2013 • Xu et al., 2015 • Ko et al., 2016 • Cai et al. 2014 • Swann et al. 2012	**Cluster 6: 288 voxel** - *Left intraparietal sulcus* • Cai and Leung, 2009 • Chikazoe et al., 2009a • Hughes et al., 2012 • Sebastian et al., 2012 • Xue et al., 2008 • Sebastian et al., 2013a • Sebastian et al., 2013b • Berkmann et al., 2014 • Ganos et al., 2014 • Ghahremani et al., 2012 • Lorenz et al., 2015 • Van der Meer et al., 2013 • Cai et al. 2014 • Swann et al. 2012
Cluster 2: 594 voxel - *Left anterior insula* • Cai and Leung, 2009 • Hendrick et al., 2010 • Aron and Poldrack, 2006 • Chikazoe et al., 2009a • Hughes et al., 2012 • Leung and Cai, 2007 • Sebastian et al., 2012 • Tabu et al., 2012 • Fauth-Bühler et al., 2012 • Tabu et al., 2011 • Sebastian et al., 2013a • Sebastian et al., 2013b • Berkmann et al., 2014 • Congdon et al., 2014	**Cluster 7: 190 voxel** - *Right dorsal premotor cortex* • Cai and Leung, 2009 • Hendrick et al., 2010 • Aron and Poldrack, 2006 • Chikazoe et al., 2009a • Sebastian et al., 2012 • Tabu et al., 2012 • Fauth-Bühler et al., 2012 • Sebastian et al., 2013b • Berkmann et al., 2014 • Ganos et al., 2014 • Ghahremani et al., 2012 • Harle et al., 2016 • Lorenz et al., 2015

• Ganos et al., 2014 • Ghahremani et al., 2012 • Lorenz et al., 2015 • Mohammadi et al., 2015 • Van der Meer et al., 2013 • Xu et al., 2015 • Ko et al., 2016 • Cai et al. 2014	
<u>Cluster 3: 543 voxel</u> - *Right anterior midcingulate cortex, pre-supplementary motor area and right superior frontal gyrus* • Cai and Leung, 2009 • Hendrick et al., 2010 • Aron and Poldrack, 2006 • Chikazoe et al., 2009a • Leung and Cai, 2007 • Sebastian et al., 2012 • Tabu et al., 2012 • Xue et al., 2008 • Tabu et al., 2011 • Berkmann et al., 2014 • Ganos et al., 2014 • Ghahremani et al., 2012 • Harle et al., 2016 • Lorenz et al., 2015 • Mohammadi et al., 2015 • Van der Meer et al., 2013 • Xu et al., 2015 • Ko et al., 2016 • Cai et al. 2014	**<u>Cluster 8: 126 voxel</u>** - *Right dorsolateral prefrontal cortex* • Cai and Leung, 2009 • Aron and Poldrack, 2006 • Chikazoe et al., 2009a • Leung and Cai, 2007 • Tabu et al., 2012 • Xue et al., 2008 • Sebastian et al., 2013a • Berkmann et al., 2014 • Ghahremani et al., 2012 • Lorenz et al., 2015 • Schel et al., 2014 • Van der Meer et al., 2013 • Xu et al., 2015 • Ko et al., 2016 • Cai et al. 2014
<u>Cluster 4: 540 voxel</u> - *Right inferior parietal lobe, superior temporal sulcus and gyrus* • Zheng et al., 2008 • Hendrick et al., 2010 • Aron and Poldrack, 2006 • Chikazoe et al., 2009a • Hughes et al., 2012 • Sebastian et al., 2012 • Tabu et al., 2012 • Xue et al., 2008 • Fauth-Bühler et al., 2012 • Sebastian et al., 2013a • Sebastian et al., 2013b • Berkmann et al., 2014 • Ganos et al., 2014 • Ghahremani et al., 2012 • Hughes et al., 2013	**<u>Cluster 9: 106 voxel</u>** - *Right caudate* • Chevrier et al., 2007 • Hendrick et al., 2010 • Aron and Poldrack, 2006 • Chikazoe et al., 2009a • Berkmann et al., 2014 • Congdon et al., 2014 • Harle et al., 2016 • Lorenz et al., 2015 • Montojo et al., 2013 • Schel et al., 2014 • Xu et al., 2015

• Lorenz et al., 2015 • Montojo et al., 2013 • Rodriguez-Pujadas et al., 2014 • Schel et al., 2014 • Xu et al., 2015 • Ko et al., 2016 • Cai et al. 2014 • Swann et al. 2012	
<u>Cluster 5: 349 voxel</u> - *Left inferior parietal lobe and interparietal sulcus* • Hendrick et al., 2010 • Chikazoe et al., 2009a • Sebastian et al., 2012 • Tabu et al., 2012 • Sebastian et al., 2013a • Sebastian et al., 2013b • Berkmann et al., 2014 • Harle et al., 2016 • Lorenz et al., 2015 • Van der Meer et al., 2013 • Xu et al., 2015 • Ko et al., 2016 • Swann et al. 2012	**<u>Cluster 10: 105 voxel</u>** - *Right intraparietal sulcus* • Zheng et al., 2008 • Cai and Leung, 2009 • Aron and Poldrack, 2006 • Chikazoe et al., 2009a • Leung and Cai, 2007 • Tabu et al., 2012 • Fauth-Bühler et al., 2012 • Sebastian et al., 2013a • Sebastian et al., 2013b • Berkmann et al., 2014 • Schel et al., 2014 • Cai et al. 2014

Table S7: Contributing experiments to the individual clusters for the complex stop-signal task meta-analysis:

Cluster 1: 1015 voxel - *Right anterior midcingulate cortex, pre-supplementary motor area and right superior frontal gyrus* • Marco-Pallar s et al., 200 • McNab et al., 2008 • Boehler et al., 2010 • Sharp et al., 2010 • Cai and Leung, 2011 • Jahfari et al., 2011 • Jahfari et al., 2012 • Kenner et al., 2010 • Sebastian et al., 2013b_2 • Van Eijk et al., 2015_2 • Boecker et al., 2011 • Coxon et al., 2016 • Leunissen et al., 2016 • Rae et al., 2014 • Wilbertz et al., 2014 • Xu et al., 2017 • Ko et al., 2016 • Jahfari et al., 2015 • Lenartowicz et al. 2010 • Zandbelt et al. 2010 • Zandbelt et al. 2011	**Cluster 5: 430 voxel -** *Left anterior insula* • McNab et al., 2008 • Boehler et al., 2010 • Jahfari et al., 2011 • Jahfari et al., 2012 • Kenner et al., 2010 • Sebastian et al., 2013b_2 • Van Eijk et al., 2015_2 • Coxon et al., 2016 • Rae et al., 2014 • Wilbertz et al., 2014 • Xu et al., 2017 • Ko et al., 2016 • Jahfari et al., 2015 • Zandbelt et al. 2010 • Zandbelt et al. 2011 • Sebastian et al., 2017
Cluster 2: 670 voxel - *Right anterior insula and inferior frontal gyrus* • Marco-Pallar s et al., 2000 • McNab et al., 2008 • Boehler et al., 2010 • Sharp et al., 2010 • Cai and Leung, 2011 • Jahfari et al., 2011 • Jahfari et al., 2012 • Kenner et al., 2010 • Sebastian et al., 2013b_2 • Van Eijk et al., 2015_2 • Boecker et al., 2011 • Coxon et al., 2016 • Leunissen et al., 2016 • Rae et al., 2014 • Wilbertz et al., 2014 • Xu et al., 2017 • Jahfari et al., 2015 • Lenartowicz et al. 2010	**Cluster 6: 259 voxel -** *Right thalamus* • McNab et al., 2008 • Boehler et al., 2010 • Cai and Leung, 2011 • Coxon et al., 2016 • Leunissen et al., 2016 • Wilbertz et al., 2014 • Xu et al., 2017 • Zandbelt et al. 2010 • Zandbelt et al. 2011

• Zandbelt et al. 2010 • Zandbelt et al. 2011 • Sebastian et al., 2017	
Cluster 3: 670 voxel - *Right inferior parietal lobe* • Marco-Pallar s et al., 200 • McNab et al., 2008 • Boehler et al., 2010 • Sharp et al., 2010 • Jahfari et al., 2011 • Jahfari et al., 2012 • Kenner et al., 2010 • Sebastian et al., 2013b_2 • Boecker et al., 2011 • Coxon et al., 2016 • Leunissen et al., 2016 • Rae et al., 2014 • Wilbertz et al., 2014 • Jahfari et al., 2015 • Lenartowicz et al. 2010 • Zandbelt et al. 2010 • Zandbelt et al. 2011 • Sebastian et al., 2017	**Cluster 7: 146 voxel -** *Left precentral gyrus and inferior frontal junction* • Boehler et al., 2010 • Kenner et al., 2010 • Coxon et al., 2016 • Wilbertz et al., 2014 • Xu et al., 2017 • Ko et al., 2016 • Lavallee et al., 2014 • Zandbelt et al. 2010 • Zandbelt et al. 2011
Cluster 4: 479 voxel - *Left inferior parietal lobe* • McNab et al., 2008 • Boehler et al., 2010 • Jahfari et al., 2011 • Jahfari et al., 2012 • Kenner et al., 2010 • Sebastian et al., 2013b_2 • Coxon et al., 2016 • Leunissen et al., 2016 • Rae et al., 2014 • Wilbertz et al., 2014 • Lavallee et al., 2014 • Zandbelt et al. 2010 • Zandbelt et al. 2011 • Sebastian et al., 2017	**Cluster 8: 118 voxel -** *Right inferior frontal junction* • Boehler et al., 2010 • Cai and Leung, 2011 • Jahfari et al., 2012 • Sebastian et al., 2013b_2 • Boecker et al., 2011 • Coxon et al., 2016 • Lavallee et al., 2014 • Zandbelt et al. 2010 • Zandbelt et al. 2011

Table S8a: Description of all experiments included in the meta-analyses of the go/no-go task, with information on which task design was used, i.e. standard (S) or complex (C), the specific type of task complexity (stimulus, task complexity or both), the specific contrast included and stimulus modality. Active baseline refers to cases where only no-go stimuli were modeled, while go stimuli were not modeled explicitly but included in the active baseline. Furthermore, the table provides information from which source, i.e. table, main text, or correspondence with the authors, the coordinates were extracted. * Studies using FSL or SPM and reporting TAL coordinates without stating that a transformation into TAL space was performed and hence treated as MNI space in the present analysis

Author	Year	n	Mean Age	TAL /MNI	Source	Standard or Complex	Specific Contrast	Stimulus modality	Stimulus type
Baumeister et al.	2014	23	24,7	MNI	Tab.1	C - Task	No-go > neutral	visual	Arrow, Symbol
Bunge et al.	2002	16	24	MNI	Tab.2	C -Task	No-go > neutral	visual	Arrow, Symbol
Chen et al.	2015	25	25,6	MNI	p.183, Tab.2	S	Correct no-go > correct go	visual	Numerical
Chikazoe et al.	2009	25	20-27	MNI	Tab.1	C - Task	Correct no-go > correct frequent-go (Correct frequent go modeled as baseline not as events)	visual	Color
	2009	25	20-27	MNI	Tab. 2	C- Task	Correct no-go > correct infrequent-go	visual	Color
Chiu et al.	2015	21		MNI	p.11941, Tab.3	C - Stimulus	No-go > go	visual	Gender
Czapla et al.	2017	21	41,9	MNI	SM Tab 5	S	Correct geometric_no-go > correct geometric_go	visual	Shape
	2017	21	41,9	MNI	SM Tab 4	C - Stimulus	Correct alcohol_no-go > correct non-alcohol_go	visual	Object
Dambacher et al.	2015	15	22,3	TAL	p.512, Tab.1	S	No-go > go	visual	Shape
Falconer et al.	2008	23	39,3	MNI	p.132, Tab.1	C - Task	No-go > go	visual	Colour
Fassbender et al.	2004	18	26,5	TAL	Tab.2	C - Task	Correct no-go > go	visual	Numerical
Fedota et al.	2014	16	19-37	MNI	p.114, Tab.1	S	No-go > go	visual	Letter
Fuentes-Claramonte et al.	2016	57	21,5	MNI	Tab.2	C - Task	Correct no-go > correct frequent-go (Correct frequent go not explicitely modeled as events but implicit baseline)	visual	Colour
	2016	57	21,5	MNI	Tab.2	C - Task	Correct no-go > infrequent-go	visual	Colour

Garavan et al.	1999	14	31	TAL	Tab.1	C - Task	Correct no-go > active baseline	visual	Letter
Garavan et al.	2002	14	30	TAL	Tab.1	C - Task	Correct no-go > active baseline	visual	Letter
Garavan et al.	2003	16	31	TAL	Tab.1	C - Task	Correct no-go > active baseline	visual	Letter
Geng et al.	2008	16	18-32	MNI	Tab.3	C – Both	Correct no-go > correct go	visual cue, acoustic go and no-go signal	Tone
Goghari et al.	2009	12	26,2	MNI	p.77, Tab.3	C - Task	No-go > go	visual	Colour
Goya- Maldonado et al.	2010	21	27,4	TAL	Text p.90	S	Rare-no-go > rare-go	visual	Shape
Hester et al.	2004a	15	30	TAL	Tab.1	C- Task	Correct cued and uncued no-go > active baseline	visual	Letter
Hester et al.	2004b	15	31	TAL	Tab.3	C - Task	Correct no-go > ongoing go trial activity	visual	Letter
Hough et al.	2016	19	44,8	MNI	SM Tab.5	S	No-go > go	visual	Letter
Hsu et al.	2017	20	23,7	MNI	p.5, Tab.2	S	Correct no-go > go	visual	Numerical
Kaladjian et al.	2007	21	35,7	TAL	Tab.3	S	Correct no-go > correct go	visual	Letter
Kaladjian et al.	2009a	20	34,6	TAL	Tab.3	S	Correct no-go > correct go	visual	Letter
Kaladjian et al.	2009b	10	41,5	TAL	Tab.3	S	Correct no-go > correct go (t1)	visual	Letter
	2009b	10	41,5	TAL	Tab.3	S	Correct no-go > correct go (t2)	visual	Letter
Kelly et al.	2004	15	30	TAL	Tab.1	C - Task	Fast and slow correct no-go > active baseline	visual	Letter
Kiehl et al.	2000	14	28,4	MNI	Tab.1	S	Correct no-go > active baseline	visual	Letter
Ko	2014	23	24,4	MNI	Tab. 2	S	Correct no-go > go	visual	Numerical
Kolodony et al.	2017	20	19-37	MNI	Tab.1	S	No-go > go (in the rare-no-go condition)	visual	Colour, Symbole
Köhler et al.	2018	33	26,8	MNI	SM Tab.1	C - Stimulus	Correct no-go > correct go	visual	Object
Lawrence et al.	2009	21		TAL	Tab.2	C - Task	No-go > go	visual	Arrow
	2009	21		TAL	Tab.2	C - Task	No-go > oddball	visual	Arrow
Liddle et al.	2001	16	30,2	TAL	Tab.3	S	Correct no-go > correct go	visual	Letter
Mander et al.	2010	9	26	MNI	SM Tab.1	C - Task	No-go > go	visual	Symbol
Mazzola-Pomietto et al.	2009	16	34,6	TAL	Tab. 3	S	Correct no-go > correct go	visual	Letter
McNab et al.	2008	11	24	MNI	Tab.2	C - Task	No-go > go	visual	Colour

	2008	11	24	MNI	Tab.2	C - Task	No-go > oddball	visual	Colour
Meffert et al.	2016	22	25,95	TAL	Tab.1	C - Stimulus	Correct low frequency no-go > correct high frequency go	visual	Symbol
Nakata et al.	2008	15	23,6	TAL	p.201, Tab.5	C - Stimulus	Correct no-go > correct go	somatosensory	electrical stimuli
O'Connor et al.	2012	18	23	MNI	p.1844, Tab. 1	C - Task	Correct no-go > active baseline	visual	Numerical
Page et al.	2009	11	34,1	TAL	Appendix A	S	No-go > active baseline	visual	Arrow
Roth et al.	2007	14	34,9	TAL	Tab.2	S	No-go > go	visual	Shape
Rothmayr et al.	2011	12	23,7	MNI	p.5, Tab.2	C - Both	Correct no-go > correct go	visual	Number of Person in picture
Rubia et al.	2006	23	20-43	TAL	p.8, Tab.2	C - Task	Correct no-go > correct go	visual	Arrow
Sebastian et al.	2012	24	30,3	MNI	p.6, Tab.5	S	Correct no-go > correct go (active baseline)	visual	Letter
Sebastian et al.	2013a	48	39,9	MNI	SM Tab.1	S	Correct no-go > go	visual	Letter
Sebastian et al.	2013b_1	24	27,4	MNI	Tab.3	S	Correct no-go > go	visual	Letter
	2013b_2	21	24,7	MNI	Tab.3	C - Task	Correct no-go > correct congruent go	visual	Letter
Steele et al.	2013	102	33,9	MNI	p.532, Tab.2	S	Correct no-go > correct go	visual	Letter
Van Eijk et al.	2015_1	18	25,3	MNI	p.384, Tab.4	S	Correct no-go > correct go	visual	Letter
	2015_2	25	26,9	MNI	p.385, Tab.5	C - Task	Correct no-go > correct congruent go	visual	Letter
Wager et al.	2005	14	18-25	TAL	Tab.1	S	No-go > go	visual	Letter
Walther et al.	2010	17	27,5	MNI	Tab.1	S	Conjunction (Correct no-go_aud > correct go_aud; AND Correct no-go_vis > correct go_vis)	visual blocks and acoustic blocks	Shape for visual blocks,Tone for acoustic blocks
Watanabe et al.	2002	11	19-40	MNI*	Tab.5	S	No-go > go, masked by no-go	visual	Color
Zheng et al.	2008	18		TAL	Tab.1	S	Correct no-go > go	visual	Shape

Table S8b: This table includes additional information of all experiments included in the meta-analyses of the go/no-go task, including a short description for each task, standard (S) or complex (C) categorization, stimulus probabilities and trial duration. The column "Task Design" includes a more detailed task description for the complex, non-standard task versions, so that the reader can more easily understand which specific task modification led to the label "complex". Abbreviations: ISI – interstimulus interval

Author	Year	Task Design	Standard or Complex	Stimuli Probabilities	Trial Duration
Baumeister et al.	2014	Combined Flanker-go/no-go task: a central arrow was flanked by either (i) go-stimuli: arrows (congruent and incongruent conditions, central arrow indicates if right or left response button should be pressed, irrespective of flanking stimuli) or (ii) neutral stimuli: boxes, or (iii) no-go stimuli: Xs.	C - Task	23 % no-go trials, 21 % neutral trials, 28 % incongruent trials, 28 % congruent trials	Stimulus was presented for 800ms, followed by an inter-stimulus interval varied between 3 and 12 s.
Bunge et al.	2002	Combined Flanker-go/no-go task: central arrow flanked by either go-stimuli (arrows (congruent and incongruent conditions, central arrow indicates if right or left button should be pressed)) or boxes (neutral condition) or no-go stimuli (letter X).	C -Task	Information not available.	Stimulus was presented for 800 ms + blank screen (300 ms) + a crosshair (1600 ms) + the next trial began 300 ms later.
Chen et al.	2015	Go stimuli: numbers 1, 3 - 9; no-go stimulus: number 2	S	frequent go (83% go, 27% no-go trials)	Stimulus was presented for 200 ms, followed by 1425-ms inter-stimulus intervals.
Chikazoe et al.	2009	Go/no-go task with three different trial types. Frequent go stimulus: gray circle. Infrequent go stimulus: blue circle. No-go stimulus = yellow circle. The infrequent go stimulus introduces an additional oddball-component.	C - Task	frequent go Contrast: no-go vs. frequent go (75,4% go, 12,3 % infrequent go, 12,3% no-go)	Stimulus was presented for 400 ms, which was followed by a 400-ms intertrial interval.
	2009	Go/no-go task with three different trial types. Frequent-go stimulus: gray circle. Infrequent go stimulus: blue circle. No-go stimulus = yellow circle. The implemented infrequent go-trial introduces an additional oddball-component.	C- Task	Contrast: no-go vs. infrequent go (75,4% go, 12,3 % infrequent go, 12,3% no-go)	Stimulus was presented for 400 ms, which was followed by a 400-ms intertrial interval.

Chiu et al.	2015	Go stimuli: male faces; No-go stimuli: female faces. One half of the participants used the opposite mapping (i.e. go stimuli: female faces, no-go stimuli: male faces). 240 different faces with a neutral expression were used as stimuli.	C - Stimulus	equiprobable design (50%go / 50% no-go)	Stimulus was presented for 800 ms, which was followed by an intertrial interval between 2.5– 4.5 s.
Czapla et al.	2017	Go stimulus: rectangle. No-go stimulus: circle	S	frequent go (80% go, 20% no-go trials)	Stimulus was presented for 490 ms + fixation cross for 1000ms
	2017	Go stimulus: image of non-alcoholic beverages. No-go stimuli: image of alcoholic beverages.	C - Stimulus	frequent go (80% go, 20% no-go trials)	Stimulus was presented for 490 ms + fixation cross for 1000ms
Dambacher et al.	2015	Go and no-go stimuli: A square or a circle. The associations were randomized between participants.	S	frequent go (75% go, 25% no-go trials)	Stimulus was presented for 200ms + fixation cross for a randomized interval of 1300, 2800 or 4300ms.
Falconer et al.	2008	Go stimulus: The word “PRESS” in green color . No-go stimulus: The word “PRESS” in red color.	C - Task	frequent go (75% go, 25% no-go trials)	Stimulus was presented for 500 milliseconds, which was followed by an 1143 ms inter-stimulus interval.
Fassbender et al.	2004	Go stimulus: Numbers 1,2, 4 - 9 presented either in a random/ unpredictable sequence (random condition) or sequential and predictable (fixed condition) order. No-go stimulus: Number 3.	C - Task	frequent go (Fixed condition: 89% go trials and 11% no-go trials; Random condition: 90% go trials and 10% no-go trials)	Stimulus was presented for 250 ms + a visual response cue of 50-ms duration + poststimulus onset time of 100 ms. Duration of the entire poststimulus mask varied (461, 572, 683, 794, 906 or 1017 ms).
Fedota et al.	2014	Go stimulus: letter X. No-go stimulus: letter A.	S	frequent go (83% go, 17% no-go trials)	Stimulus was presented for 200ms, which was followed by a black screen for 2500ms.
Fuentes-Claramonte et al.	2016	Go/no-go task with three different trial types: Frequent go stimulus: gray circle. Infrequent go stimulus: blue circle. No-go stimulus: yellow circle. The infrequent go stimulus introduces an additional oddball-component.	C - Task	frequent go Contrast: no-go vs. frequent go (77,5% go, 11,25 % infrequent go trials, no-go trials 11,25%)	Each colored circle was presented for 400ms, followed by a 400ms intertrial-interval. The task consisted in eight runs of identical duration (2min

					and 24 s each) with a total of 1290 trials.
	2016	Go/no-go task with three different trial types: Frequent go stimulus: gray circle, Infrequent go stimulus: blue circle, No-go stimulus: yellow circle. The infrequent go stimulus introduces an additional oddball-component.	C - Task	Contrast: no-go vs. infrequent go (77,5% go, 11,25 % infrequent go trials no-go trials 11,25%)	Stimulus was presented for 400ms, which was followed by a 400ms intertrial-interval.
Garavan et al.	1999	Go stimuli: Presentation of the target letters X and Y in an alternating order (i.e., X-Y-X-Y). Subjects had to respond to each target stimulus with a button press. No-go stimuli: when the alternating order was broken, e.g. X-Y-Y, the second Y was a no-go trial.	C - Task	frequent go (86% go, 14% no-go trials)	Stimulus was presented every 500 msec with 0-msec interstimulus interval.
Garavan et al.	2002	Go stimuli: Presentation of the target letters X and Y in an alternating order (i.e., X-Y-X-Y). Subjects had to respond to each target stimulus with a button press. No-go stimuli: when the alternating order was broken, e.g. X-Y-Y, the second Y was a no-go trial.	C - Task	frequent go (94% go, 6% no-go trials)	Stimulus was presented for 600, 700, 800, or 900 ms followed by a 400-, 300-, 200-, or 100-ms fixation point.
Garavan et al.	2003	Go stimuli: Presentation of the target letters X and Y in an alternating order (i.e., X-Y-X-Y). Subjects had to respond to each target stimulus with a button press. No-go stimuli: when the alternating order was broken, e.g. X-Y-Y, the second Y was a no-go trial. There were high conflict (stimulus presentation: 600 ms) and low conflict (stimulus presentation: 900 ms) conditions.	C - Task	frequent go (90% go, 10% no-go trials)	HIGH CONFLICT: Stimuli was presented for 600-ms durations, which was followed by a 400-ms blank screen ISI. LOW CONFLICT: Stimuli was presented stimuli for 900-ms durations, which was followed by a 100-ms blank ISI.
Geng et al.	2008	Go and no-go stimuli: A low (300 Hz) or high (600 Hz) auditory tone indicating if the participants should make a saccade to a target location or to maintain central fixation. The tone pitch - response associations were randomized between participants.	C – Both	Information not available.	Direction cue for 1200 msec + 1200-msec interval fixation dot + auditory stimulus for 300 ms + 2000–6000 msec blank interval
Goghari et al.	2009	First a central cue (Left' or 'Right') was shown which indicated if participants had to respond with a left or right button press. The cue was then followed by a go or no-go stimulus. Go stimulus: Green circle. No-go stimulus: Red circle.	C - Task	frequent go (80% go, 20% no-go trials)	Cue was presented for 500 ms + variable delay + Stimulus was presented for 500 ms. Interstimulus and intertrial intervals

					varied (2000, 2250, 2750, 3250, 3750, and 4000 ms).
Goya-Maldonado et al.	2010	Participants were asked to respond to a target (go stimulus) and withhold responses to a non-target (no-go stimulus). Stimuli were circles and squares.	S	varying no-go probabilities (20 % and 80% no-go probabilities, resulting in an overall equal distribution of go and no-go stimuli)	Stimulus was presented for 120 ms, followed by a fixation cross for 1340 ms.
Hester et al.	2004a	First a list of 1, 3, or 5 letters was shown to the participants, which they should memorize. Then the go/no-go task followed. Go-stimuli: Presented letter had not been part of the memory list. No-go stimuli: Presented letters had been part of the memory list.	C- Task	frequent go (78% go), 12% no-go trials)	Stimulus was presented for 1000 ms, which was followed by a blank screen for the concluding 500 ms.
Hester et al.	2004b	Go stimuli: Presentation of the target letters X and Y in an alternating order (i.e., X-Y-X-Y). Subjects had to respond to each target stimulus with a button press. No-go stimuli: when the alternating order was broken, e.g. X-Y-Y, the second Y was a no-go trial. In 50% of the no-go trials a visual cue (letter X or Y with a strikethrough) was presented two to seven trials prior to the presentation of the respective no-go stimulus	C - Task	frequent go (94% go, 6% no-go trials)	Stimulus was presented for 900-msec, which was followed by a 100 msec blank screen.
Hough et al.	2016	Go stimulus: letter X. No-go stimulus: letter K.	S	frequent go (80% go, 20% no-go trials)	Stimulus was presented for 100ms, which was followed by random interstimulus intervals of 1000, 1500 and 2000ms.
Hsu et al.	2017	Go stimuli: numbers 1, 3 - 9; no-go stimulus: number 2	S	frequent go (83% go, 17% no-go trials)	Stimulus was presented for 200-ms, which was followed by 1426-ms inter-stimulus intervals.
Kaladjian et al.	2007	Go stimulus: letter X. No-go stimulus: letter A.	S	equiprobable design (50% go / 50 % no-go trials)	5-s preparation phase. Stimulus was presented for 250 ms, which was followed by a rest period demarcated from 3083 to 29,000 ms.
Kaladjian et al.	2009a	Go stimulus: letter X. No-go stimulus: letter A.	S	equiprobable design (50% go / 50 % no-go trials)	5-s preparation phase. Stimulus was presented for 250 ms, which was followed by a rest period

					demarcated from 3083 to 29,000 ms.
Kaladjian et al.	2009b	Go stimulus: letter X. No-go stimulus: letter A.	S	equiprobable design (50% go / 50 % no-go trials)	5-s preparation phase. Stimulus was presented for 250 ms, which was followed by a rest period demarcated from 3083 to 29,000 ms.
	2009b	Go stimulus: letter X. No-go stimulus: letter A.	S	equiprobable design (50% go / 50 % no-go trials)	5-s preparation phase. Stimulus was presented for 250 ms, which was followed by a rest period demarcated from 3083 to 29,000 ms.
Kelly et al.	2004	Go stimuli: Presentation of the target letters X and Y in an alternating order (i.e., X-Y-X-Y). Subjects had to respond to each target stimulus with a button press. No-go stimuli: when the alternating order was broken, e.g. X-Y-Y, the second Y was a no-go trial. Equal use of fast and slow stimulus durations.	C - Task	frequent go (92% go, 8% no-go trials)	Stimulus durations were 700ms and 1100ms, followed by 100 ms ISI. These durations alternated every 7-11 trials, in blocks of 313 trials, resulting in a repeating oscillation between Fast stimulus presentations and slow stimulus presentations throughout the block.
Kiehl et al.	2000	Go stimulus: letter X. No-go stimulus: letter K.	S	frequent go (80% go, 20% no-go trials)	Stimulus were presented for 50 ms, which was followed by a varying the interstimulus interval between 1,000, 2,000, and 3,000 ms.
Ko	2014	Go stimuli: numbers 1, 3 - 9; no-go stimulus: number 2.	S	frequent go (83% go, 17% no-go trials)	Stimulus was presented for 200-ms durations, which was followed by a1426-ms inter-stimulus intervals.

Kolodony et al.	2017	Go stimulus: red square. No-go stimuli: all color and shape combinations except the red square.	S	frequent go (75% go, 25% no-go trials)	Stimuli were presented for 100ms, which was followed by a varying inter-stimulus-interval from 1.8sec to 12sec.
Köhler et al.	2018	Go stimuli: A jug with transverse cracks either starting from the left side or from the right side of the jug. No-go stimuli: A jug with vertical cracks either starting from the upper end or from the bottom end of the jug.	C - Stimulus	frequent go (74% go, 26% no-go trials)	Stimulus was presented for 600ms, which was followed by varying inter-stimulus-intervals of 3800ms, 6000ms and 8200ms.
Lawrence et al.	2009	Go stimuli: Arrows showing to the left or to the right side. Subjects had to respond with a left or right button press.Oddball stimuli: Slightly slanted arrows pointing to left or right. Subjects had to respond with a left or right button press respectively. No-go signal: Arrows pointing to the top.	C - Task	frequent go Contrast: no-go > frequent go (76% go trials, 12% no-go trials, 12% oddball go trials)	Stimulus was presented for 500ms, which was followed by a blank screen of 1.1–1.5 s.
	2009	Go stimuli: Arrows showing to the left or to the right side. Subjects had to respond with a left or right button press.Oddball stimuli: Slightly slanted arrows pointing to left or right. Subjects had to respond with a left or right button press respectively. No-go signal: Arrows pointing to the top	C - Task	Contrast: no-go > oddball go (76% go trials, 12% no-go trials, 12% oddball go trials)	Stimulus was presented for 500ms, which was followed by a blank screen of 1.1–1.5 s.
Liddle et al.	2001	Go stimulus: letter X. No-go stimulus: letter A.	S	equiprobable design (50% go / 50% no-go trials)	5s preparation phase. Stimulus was presented for 250 ms, followed by a blank screen for 750 ms. Between trials, a blank screen was presented for 3, 4, or 5 sec.
Mander et al.	2010	Go stimuli: Presentation of the target symbols x and + in an alternating order (i.e., X-+-X-+-X). Subjects had to respond to each target stimulus with a button press. No-go stimuli: when the alternating order was broken, e.g. X-+-+, the second + was a no-go trial or if any other non-target symbol appeared.	C - Task	equiprobable design (53% go, 47% no-go (29% non-targets and 18% lures) trials)	Fixation display for 200, 400, or 800 ms. Stimulus was presented for 100 ms followed by varying intertrial intervals (1200, 1600 or 1800 ms).

Mazzola-Pomietto et al.	2009	Go stimulus: letter X. No-go stimulus: letter A.	S	equiprobable design (50% go / 50% no-go trials)	5-s preparation phase. Stimulus was presented for 250 ms, which was followed by a rest period demarcated from 3083 to 29,000 ms.
McNab et al.	2008	Go/no-go task with three different trial types: Go stimulus: Yellows square. No-go Stimulus: Yellow triangle. Oddball stimulus: Blue square The infrequent oddball stimulus introduces an additional oddball component.	C - Task	Contrast: no-go > frequent go (50% go trials, 25% no-go trials, 25% oddball go trials)	Stimulus was presented for 1300 ms, which was followed by a blank screen for 400 ms, and a fixation cross for 300ms.
	2008	Go/no-go task with three different trial types: Go stimulus: Yellows square. No-go Stimulus: Yellow triangle. Oddball stimulus: Blue square The infrequent oddball stimulus introduces an additional oddball component.	C - Task	Contrast: no-go vs. oddball go (50% go trials, 25% no-go trials, 25% oddball go trials)	Stimulus was presented for 1300 ms, which was followed by a blank screen for 400 ms, and a fixation cross for 300ms.
Meffert et al.	2016	Go stimulus: Spiderman. No-go stimulus: Green Goblin	C - Stimulus	frequent go (75% go, 25% no-go trials)	Stimulus was presented for 500 ms, which was followed by a jittered interval (1000–1500 ms).
Nakata et al.	2008	Somatosensory go/no-go tasks in which an electrical stimuli was used to induce a clear twitch of the fingers. Go stimulus: Stimulation of the left median nerve, participants had to respond by a button press with their right index finger contralateral to the stimulated side, No-go Stimulus: Stimulation of left ulnar nerve.	C - Stimulus	equiprobable design (50% go / 50% no-go trials)	Stimulus was presented for 0.3 ms in, which was followed by an interstimulus interval of 14 s.
O'Connor et al.	2012	Reward/No-RewardGo/no-go task. Go stimuli: different-digit double-digit numbers (e.g. 45, 67, but not 55). Reward stimuli: same-digit double-digit numbers (e.g. 44, 66). Money trials paid monetary rewards in proportion to how quickly participants responded to presentation of the reward stimuli. No-go stimulus: A designated double-digit number which was chosen for each block (e.g., 22).	C - Task	frequent go (75% go + 12,5% money trials, 12,5% no-go trials)	Stimulus was presented for 750 ms, followed by a 1250 ms ISI, a 1000 ms feedback screen and 1000 ms ISI.

Page et al.	2009	Go stimuli: Arrows pointing to the left or to the right. Subjects had to respond by pressing the left or right response button. No-go Signal: Arrows pointing to the top.	S	frequent go (88% go, 12% no-go trials)	Stimuli was presented for 300 ms, followed by 1.5 s of blank screen.
Roth et al.	2007	Go stimulus: A circle with a vertical cross inside, No-go stimulus: A circle with an X inside.	S	varying no-go probability (25%, 50%, and 75%), resulting in an overall equal distribution of go and no-go stimuli	Stimuli were presented for 200 msec, which was followed by a randomized 2- to 4-sec inter-stimulus interval.
Rothmayr et al.	2011	Go stimulus: Number of children in the currently presented picture differed from the number of children in the previous picture. No-go stimulus: Number of children in the currently presented picture was the same as in the previous picture.	C - Both	frequent go (80% go, 20% no-go trials)	Stimulus were presented for 1000 ms followed by fixation periods varying between 3000 and 4000 ms.
Rubia et al.	2006	Go stimuli: Arrows pointing to the left or to the right. Subjects have to respond by a button press with the left or right response button. Oddball stimuli: Slightly slanted arrows pointing left or right. Subjects then have to press the left or the right response button. No-go stimulus: Arrows pointing to the top.	C - Task	frequent go (76% go, 12% no-go, 12% oddball go trials)	Stimulus was presented for 500 ms, followed by a blank screen of 1300 ms.
Sebastian et al.	2012	Go stimuli: All consonants of the alphabet except X, No-go stimulus: X	S	frequent go (71% go, 29% no-go trials)	Stimulus was presented for 500 ms, which was followed by a blank screen for 500 ms.
Sebastian et al.	2013a	Go stimuli: All consonants of the alphabet except X, No-go stimulus: X	S	frequent go (71% go, 29% no-go trials)	Stimulus was presented for 500 ms, which was followed by a blank screen for 500 ms.
Sebastian et al.	2013b_1	Go stimuli: All consonants of the alphabet except X, No-go stimulus: X	S	frequent go (71% go, 29% no-go trials)	Stimulus was presented for 500 ms, which was followed by a blank screen for 500 ms.

	2013b_2	HRI task which included features of Simon, the go/no-go, and the stop-signal tasks. Congruent go stimulus: e.g. a right pointing arrow was shown in the right half of an ellipse. Incongruent go stimulus: e.g. a right pointing arrow was shown in the left half of an ellipse. In go trials participants had to respond according to the direction of the arrow. No-go stimulus: The color of the ellipse changed from white to blue at the onset of the arrow. Stop stimulus: The color of the ellipse changed from white to blue with a variable stop-signal delay after the onset of the arrow.	C - Task	62,5% congruent go, 12,5% incongruent go, 12,5 % stop trials, 12,5% no-go trials	Preparation 500 ms. Stimulus was presented for 1000 ms or until a button press was performed. Varying interstimulus intervals with a mean duration of 1500 ms and a standard deviation of 372 ms.
Steele et al.	2013	Go stimulus: letter X, No-go stimulus: letter K.	S	frequent go (84% go, 16% no-go trials)	Stimulus was presented for 250 ms, which was followed by an varying inter-stimulus interval of 750, 1750 and 2750 ms
Van Eijk et al.	2015_1	Go stimuli: All consonants of the alphabet except X, No-go stimulus: X	S	frequent go (71% go, 29% no-go trials)	Stimulus was presented for 500 ms, followed by a blank screen for 500 ms.
	2015_2	HRI task which includes features of Simon, the go/no-go, and the stop-signal tasks. Congruent go stimulus: e.g. a right pointing arrow was shown in the right half of an ellipse. Incongruent go stimulus: e.g. a right pointing arrow was shown in the left half of an ellipse. In go trials participants had to respond according to the direction of the arrow. No-go stimulus: The color of the ellipse changed from white to blue at the onset of the arrow. Stop stimulus: The color of the ellipse changed from white to blue with a variable stop-signal delay after the onset of the arrow.	C - Task	62,5% congruent go, 12,5% incongruent go, 12,5 % stop trials, 12,5% no-go trials	Preparation 500 ms. Stimulus was presented for 1000 ms or until a button press was performed. Varying interstimulus intervals with a mean duration of 1500 ms and a standard deviation of 372 ms.
Wager et al.	2005	Go stimuli: All letters except X, No-go stimulus: X	S	varying no-go probabilities (50% or 20% no-go trials)	Stimulus was presented 440 ms, which was followed by a 1000-ms central fixation cross.
Walther et al.	2010	Go and no-go stimuli in visual trials: square or circle. Go and no-go stimuli in auditory trials: low (400 Hz) and high (800Hz) single tones.	S	frequent go (80% go, 20% no-go trials)	Stimulus was presented for 120 ms, followed by an

		Before each block participants were instructed which stimulus was the go and which stimulus the no-go stimulus.			intertrial interval of 1340ms.
Watanabe et al.	2002	Go: red square, no-go stimulus:blue square. In a second session the colors of the go and no-go stimulus were reversed to cancel out the color factor.	S	Information not available.	Fixation cross 9s; Preparation Cue 1s. Stimulus was presented for 1 s.
Zheng et al.	2008	Go stimulus: circle, No-go stimulus: cross.	S	frequent go (75% go, 25% no-go trials)	Stimulus was presented for 1000 ms, followed by a randomized time interval (1500 - 2500 msec).

Table S8c: Description of the minimal, maximal, and mean trial duration of all experiments included in the meta-analyses of the go/no-go task, including standard (S) or complex (C) categorization. Abbreviations: ISI – interstimulus interval, ITI – intertrial interval

Author	Year	Standard or Complex	Duration of Each Trial (stimulus-stimulus interval)	MIN (ms)	MAX (ms)	Mean
Baumeister et al.	2014	C - Task	Stimulus was presented for 800ms, followed by an inter-stimulus interval varied between 3 and 12 s.	3800	12800	8300
Bunge et al.	2002	C -Task	Stimulus was presented for 800 ms + blank screen (300 ms) + a crosshair (1600 ms) + the next trial began 300 ms later.	2950	3050	3000
Chen et al.	2015a	S	Stimulus was presented for 200 ms, followed by 1425-ms inter-stimulus intervals.	1575	1675	1625
Chikazoe et al.	2009b	C - Task	Stimulus was presented for 400 ms, which was followed by a 400-ms intertrial interval.	750	850	800
	2009b	C- Task	Stimulus was presented for 400 ms, which was followed by a 400-ms intertrial interval.	750	850	800
Chiu et al.	2015	C - Stimulus	Stimulus was presented for 800 ms, which was followed by an intertrial interval between 2.5– 4.5 s.	3300	5300	4300
Czapla et al.	2017	S	Stimulus was presented for 490 ms + fixation cross for 1000ms	1440	1540	1490
	2017	C - Stimulus	Stimulus was presented for 490 ms + fixation cross for 1000ms	1440	1540	1490
Dambacher et al.	2015	S	Stimulus was presented for 200ms + fixation cross for a randomized interval of 1300, 2800 or 4300ms.	1500	4500	3000
Falconer et al.	2008	C - Task	Stimulus was presented for 500 milliseconds, which was followed by an 1143 ms inter-stimulus interval.	1593	1693	1643
Fassbender et al.	2004	C - Task	Stimulus was presented for 250 ms + a visual response cue of 50-ms duration + poststimulus onset time of 100 ms. Duration of the entire poststimulus mask varied (461, 572, 683, 794, 906 or 1017 ms).	1111	1667	1389
Fedota et al.	2015	S	Stimulus was presented for 200ms, which was followed by a black screen for 2500ms.	2650	2750	2700

Fuentes-Claramonte et al.	2016	C - Task	Stimulus was presented for 400ms, which was followed by a 400ms intertrial interval.	750	850	800
	2016	C - Task	Stimulus was presented for 400ms, which was followed by a 400ms intertrial interval.	750	850	800
Garavan et al.	1999	C - Task	Stimulus was presented every 500 msec with 0-msec interstimulus interval.	450	550	500
Garavan et al.	2002	C - Task	Stimulus was presented for 600, 700, 800, or 900 ms followed by a 400-, 300-, 200-, or 100-ms fixation point.	700	1300	1000
Garavan et al.	2003	C - Task	HIGH CONFLICT: Stimuli was presented stimuli for 600-ms durations, followed by a 400-ms blank screen ISI. LOW CONFLICT: Stimuli was presented for 900-ms durations, which was followed by a 100-ms blank ISI.	950	1050	1000
Geng et al.	2009	C – Both	Direction cue for 1200 ms + 1200-ms interval fixation dot + auditory stimulus for 300 ms + 2000–6000 ms blank interval	4700	8700	6700
Goghari et al.	2009	C - Task	Cue was presented for 500 ms + Varying ISI-Delay + Stimulus was presented for 500 ms + Varying ITI-Delay. Interstimulus and intertrial intervals varied (2000, 2250, 2750, 3250, 3750, and 4000 ms).	5000	9000	7000
Gayo et al.	2010	S	Stimulus was presented for 120 ms, which was followed by a fixation cross for 1340 ms.	1410	1510	1460
Hester et al.	2004a	C- Task	Stimulus was presented for 1000 ms, which was followed by a blank screen for the concluding 500 ms.	1450	1550	1500
Hester et al.	2004b	C - Task	Stimulus was presented for 900-msec, which was followed by a 100 msec blank screen.	950	1050	1000
Hough et al.	2016	S	Stimulus was presented for 100ms, which was followed by random interstimulus intervals of 1000, 1500 and 2000ms.	1100	2100	1600
Hsu et al.	2017	S	Stimulus was presented for 200-ms, which was followed by 1426-ms inter-stimulus intervals.	1576	1676	1626

Kaladjian et al.	2007	S	5-s preparation phase. Stimulus was presented for 250 ms, which was followed by a rest period demarcated from 3083 to 29,000 ms.	8333	34250	21291,5
Kaladjian et al.	2009a	S	5-s preparation phase. Stimulus was presented for 250 ms, which was followed by a rest period demarcated from 3083 to 29,000 ms.	8333	34250	21291,5
Kaladjian et al.	2009b	S	5-s preparation phase. Stimulus was presented for 250 ms, which was followed by a rest period demarcated from 3083 to 29,000 ms.	8333	34250	21291,5
	2009b	S	5-s preparation phase. Stimulus was presented for 250 ms, which was followed by a rest period demarcated from 3083 to 29,000 ms.	8333	34250	21291,5
Kelly et al.	2004	C - Task	Stimulus was presented for 700ms or 1100ms, which was followed by 100 ms ISI.	800	1200	1000
Kiehl et al.	2000	S	Stimulus were presented for 50 ms, which was followed by a varying the interstimulus interval between 1,000, 2,000, and 3,000 ms.	1050	3050	2050
Ko	2013	S	Stimulus was presented for 200-ms duration, which was followed by a1426-ms inter-stimulus intervals.	1576	1676	1626
Kolodony et al.	2017	S	Stimuli were presented for 100ms, which was followed by a varying inter-stimulus-interval from 1.8sec to 12sec.	1900	12100	7000
Köhler et al.	2018	C - Stimulus	Stimulus was presented for 600ms, which was followed by varying inter-stimulus-intervals of 3800 ms, 6000ms and 8200ms.	4400	8800	6600
Lawrence et al.	2009	C - Task	Stimulus was presented for 500- ms, which was followed by a blank screen of 1.1–1.5 s.	1600	2000	1800
	2009	C - Task	Stimulus was presented for 500- ms, which was followed by a blank screen of 1.1–1.5 s.	1600	2000	1800
Liddle et al.	2001	S	5s preparation phase. Stimulus was presented for 250 ms, followed by a blank screen for 750 ms. Between trials, a blank screen was presented for 3, 4, or 5 sec.	9000	11000	10000

Mander et al.	2010	C - Task	Fixation display for 200, 400, or 800 ms. Stimulus was presented for 100 ms followed by varying intertrial intervals (1200, 1600 or 1800 ms).	1500	2700	2100
Mazzola-Pomietto et al.	2009	S	5-s preparation phase. Stimulus was presented for 250 ms, which was followed by a rest period demarcated from 3083 to 29,000 ms.	8333	34250	21291,5
McNab et al.	2008	C - Task	Stimulus was presented for 1300 ms, which was followed by a blank screen for 400 ms, and a fixation cross for 300ms.	1950	2050	2000
	2008	C - Task	Stimulus was presented for 1300 ms, which was followed by a blank screen for 400 ms, and a fixation cross for 300ms.	1950	2050	2000
Meffert et al.	2016	C - Stimulus	Stimulus was presented for 500 ms, which was followed by a jittered interval (1000–1500 ms).	1500	2000	1750
Nakata et al.	2008	C - Stimulus	Stimulus was presented for 0.3 ms in, which was followed by an interstimulus interval of 14 s.	13950,3	14050,3	14000,3
O'Connor et al.	2012	C - Task	Stimulus was presented for 750 ms, followed by a 1250 ms ISI, a 1000 ms feedback screen and 1000 ms ISI.	3950	4050	4000
Page et al.	2009	S	Stimuli was presented for 300 ms, followed by 1.5 s of blank screen.	1750	1850	1800
Roth et al.	2007	S	Stimuli were presented for 200 msec, which was followed by a randomized 2- to 4-sec inter-stimulus interval.	2200	4200	3200
Rothmayr et al.	2011	C - Both	Stimulus were presented for 1000 ms followed by fixation periods varying between 3000 and 4000 ms.	4000	5000	4500
Rubia et al.	2006	C - Task	Stimulus was presented for 500 ms, followed by a blank screen of 1300 ms.	1750	1850	1800
Sebastian et al.	2012	S	Stimulus was presented for 500 ms, which was followed by a blank screen for 500 ms.	950	1050	1000
Sebastian et al.	2013a	S	Stimulus was presented for 500 ms, which was followed by a blank screen for 500 ms.	950	1050	1000

Sebastian et al.	2013b_1	S	Stimulus was presented for 500 ms, which was followed by a blank screen for 500 ms.	950	1050	1000
	2013b_2	C - Task	Preparation 500 ms. Stimulus was presented for 1000 ms or until a button press was performed. Varying interstimulus interval with a mean duration of 1500 ms and a standard deviation of 372 ms.	2628	3372	3000
Steele et al.	2013	S	Stimulus was presented for 250 ms, which was followed by a varying inter-stimulus interval of 750, 1750 and 2750 ms	1000	3000	2000
Van Eijk et al.	2015_1	S	Stimulus was presented for 500 ms, which was followed by a blank screen for 500 ms.	950	1050	1000
	2015_2	C - Task	Preparation 500 ms. Stimulus was presented for 1000 ms or until a button press was performed. Varying interstimulus intervals with a mean duration of 1500 ms and a standard deviation of 372 ms.	2628	3372	3000
Wager et al.	2005	S	Stimulus was presented 440 ms, which was followed by a 1000-ms central fixation cross.	1390	1490	1440
Walther et al.	2010	S	Stimulus was presented for 120 ms, followed by an intertrial interval of 1340ms.	1410	1510	1460
Watanabe et al.	2002	S	Fixation cross 9s; Preparation Cue 2s. Stimulus was presented for 1 s.	11950	12050	12000
Zheng et al.	2008	S	Stimulus was presented for 1000 ms, followed by a randomized time interval (between 1500 and 2500 msec).	2500	3500	3000

References of all experiments included in the main meta-analyses of the go/no-go task

Baumeister, Sarah; Hohmann, Sarah; Wolf, Isabella; Plichta, Michael M.; Rechtsteiner, Stefanie; Zangl, Maria et al. (2014): Sequential inhibitory control processes assessed through simultaneous EEG–fMRI. In: NeuroImage 94, S. 349–359. DOI: 10.1016/j.neuroimage.2014.01.023.

Bunge, Silvia A.; Dudukovic, Nicole M.; Thomason, Moriah E.; Vaidya, Chandan J.; Gabrieli, John D. E. (2002): Immature Frontal Lobe Contributions to Cognitive Control in Children: Evidence from fMRI. In: Neuron 33 (2), S. 301–311.

Chen, Chiao-Yun; Yen, Ju-Yu; Yen, Cheng-Fang; Chen, Cheng-Sheng; Liu, Gin-Chung; Liang, Chih-Yuan; Ko, Chih-Hung (2015): Aberrant brain activation of error processing among adults with attention deficit and hyperactivity disorder. In: The Kaohsiung Journal of Medical Sciences 31 (4), S. 179–187. DOI: 10.1016/j.kjms.2015.01.001.

Chikazoe, Junichi; Jimura, Koji; Asari, Tomoki; Yamashita, Ken-ichiro; Morimoto, Hiroki; Hirose, Satoshi et al. (2009): Functional Dissociation in Right Inferior Frontal Cortex during Performance of Go/No-Go Task. In: Cerebral Cortex 19 (1), S. 146–152. DOI: 10.1093/cercor/bhn065.

Chiu, Y.-C.; Egner, T. (2015): Inhibition-Induced Forgetting Results from Resource Competition between Response Inhibition and Memory Encoding Processes. In: The Journal of Neuroscience 35 (34), S. 11936. DOI: 10.1523/JNEUROSCI.0519-15.2015.

Czapla, Marta; Baeuchl, Christian; Simon, Joe J.; Richter, Barbara; Kluge, Matthias; Friederich, Hans-Christoph et al. (2017): Do alcohol-dependent patients show different neural activation during response inhibition than healthy controls in an alcohol-related fMRI go/no-go-task? In: Psychopharmacology 234 (6), S. 1001–1015. DOI: 10.1007/s00213-017-4541-9.

Dambacher, Franziska; Sack, Alexander T.; Lobbestael, Jill; Arntz, Arnoud; Brugman, Suzanne; Schuhmann, Teresa (2015): Out of control: Evidence for anterior insula involvement in motor impulsivity and reactive aggression. In: Social Cognitive and Affective Neuroscience 10 (4), S. 508–516. DOI: 10.1093/scan/nsu077.

Falconer, E.; Bryant, R.; Felmingham, K. L.; Kemp, A. H.; Gordon, E.; Peduto, A. et al. (2008): The neural networks of inhibitory control in posttraumatic stress disorder. In: J Psychiatry Neurosci.

Fassbender, C.; Murphy, K.; Foxe, J. J.; Wylie, G. R.; Javitt, D. C.; Robertson, I. H.; Garavan, H. (2004): A topography of executive functions and their interactions revealed by functional magnetic resonance imaging. In: Cognitive Brain Research 20 (2), S. 132–143. DOI: 10.1016/j.cogbrainres.2004.02.007.

Fedota, John R.; Hardee, Jillian E.; Pérez-Edgar, Koraly; Thompson, James C. (2014): Representation of response alternatives in human presupplementary motor area: Multi-voxel pattern analysis in a go/no-go task. In: Neuropsychologia 56, S. 110–118. DOI: 10.1016/j.neuropsychologia.2013.12.022.

Fuentes-Claramonte, Paola; Ávila, César; Rodríguez-Pujadas, Aina; Costumero, Víctor; Ventura-Campos, Noelia; Bustamante, Juan Carlos et al. (2016): Inferior frontal cortex activity is modulated by reward sensitivity and performance variability. In: Biological Psychology 114, S. 127–137. DOI: 10.1016/j.biopsycho.2016.01.001.

Garavan, H.; Ross, T. J.; Murphy, K.; Roche, R.A.P.; Stein, E. A. (2002): Dissociable Executive Functions in the Dynamic Control of Behavior: Inhibition, Error Detection, and Correction. In: NeuroImage 17 (4), S. 1820–1829. DOI: 10.1006/nimg.2002.1326.

Garavan, H.; Ross, T. J.; Stein, E. A. (1999): Right hemispheric dominance of inhibitory control: An event-related functional MRI study. In: Proceedings of the National Academy of Sciences of the United States of America 96 (14), S. 8301–8306. Online verfügbar unter http://www.ncbi.nlm.nih.gov/pmc/articles/PMC22229/.

Garavan, H.; Ross, T.J; Kaufman, J.; Stein, E.A (2003): A midline dissociation between error-processing and response-conflict monitoring. In: NeuroImage 20 (2), S. 1132–1139. DOI: 10.1016/S1053-8119(03)00334-3.

Geng, Joy J.; Ruff, Christian C.; Driver, Jon (2008): Saccades to a Remembered Location Elicit Spatially Specific Activation in Human Retinotopic Visual Cortex. In: Journal of Cognitive Neuroscience 21 (2), S. 230–245. DOI: 10.1162/jocn.2008.21025.

Goghari, Vina M.; MacDonald, Angus W. (2009): The neural basis of cognitive control: Response selection and inhibition. In: Brain and Cognition 71 (2), S. 72–83. DOI: 10.1016/j.bandc.2009.04.004.

Goya-Maldonado, Roberto; Walther, Stephan; Simon, Joe; Stippich, Christoph; Weisbrod, Matthias; Kaiser, Stefan (2010): Motor impulsivity and the ventrolateral prefrontal cortex. In: Psychiatry Research: Neuroimaging 183 (1), S. 89–91. DOI: 10.1016/j.pscychresns.2010.04.006.

Hester, Robert; Murphy, Kevin; Garavan, Hugh (2004b): Beyond common resources: the cortical basis for resolving task interference. In: NeuroImage 23 (1), S. 202–212. DOI: 10.1016/j.neuroimage.2004.05.024.

Hester, Robert L.; Murphy, Kevin; Foxe, John J.; Foxe, Deirdre M.; Javitt, Daniel C.; Garavan, Hugh (2004a): Predicting Success: Patterns of Cortical Activation and Deactivation Prior to Response Inhibition. In: Journal of Cognitive Neuroscience 16 (5), S. 776–785. DOI: 10.1162/089892904970726.

Hough, Christina M.; Luks, Tracy L.; Lai, Karen; Vigil, Ofilio; Guillory, Sylvia; Nongpiur, Arvind et al. (2016): Comparison of brain activation patterns during executive function tasks in hoarding disorder and non-hoarding OCD. In: Psychiatry Research: Neuroimaging 255, S. 50–59. DOI: 10.1016/j.pscychresns.2016.07.007.

Hsu, Jui-Sheng; Wang, Peng-Wei; Ko, Chih-Hung; Hsieh, Tsyh-Jyi; Chen, Chiao-Yun; Yen, Ju-Yu (2017): Altered brain correlates of response inhibition and error processing in females with obesity and sweet food addiction: A functional magnetic imaging study. In: Obesity Research & Clinical Practice 11 (6), S. 677–686. DOI: 10.1016/j.orcp.2017.04.011.

Kaladjian, Arthur; Jeanningros, Régine; Azorin, Jean-Michel; Grimault, Stephan; Anton, Jean-Luc; Mazzola-Pomietto, Pascale (2007): Blunted activation in right ventrolateral prefrontal cortex during motor response inhibition in schizophrenia. In: Schizophrenia Research 97 (1), S. 184–193. DOI: 10.1016/j.schres.2007.07.033.

Kaladjian, Arthur; Jeanningros, Régine; Azorin, Jean-Michel; Nazarian, Bruno; Roth, Muriel; Anton, Jean-Luc; Mazzola-Pomietto, Pascale (2009b): Remission from mania is associated with a decrease in amygdala activation during motor response inhibition. In: Bipolar Disorders 11 (5), S. 530–538. DOI: 10.1111/j.1399-5618.2009.00722.x.

Kaladjian, Arthur; Jeanningros, Régine; Azorin, Jean-Michel; Nazarian, Bruno; Roth, Muriel; Mazzola-Pomietto, Pascale (2009a): Reduced brain activation in euthymic bipolar patients during response inhibition: An event-related fMRI study. In: Psychiatry Research: Neuroimaging 173 (1), S. 45–51. DOI: 10.1016/j.pscychresns.2008.08.003.

Kelly, A. M. Clare; Hester, Robert; Murphy, Kevin; Javitt, Daniel C.; Foxe, John J.; Garavan, Hugh (2004): Prefrontal-subcortical dissociations underlying inhibitory control revealed by event-related fMRI. In: European Journal of Neuroscience 19 (11), S. 3105–3112. DOI: 10.1111/j.0953-816X.2004.03429.x.

Kiehl, Kent A.; Liddle, Peter F.; Hopfinger, Joseph B. (2000): Error processing and the rostral anterior cingulate: An event-related fMRI study. In: Psychophysiology 37 (2), S. 216–223. DOI: 10.1111/1469-8986.3720216.

Ko, Chih-Hung; Hsieh, Tsyh-Jyi; Chen, Chiao-Yun; Yen, Cheng-Fang; Chen, Cheng-Sheng; Yen, Ju-Yu et al. (2014): Altered brain activation during response inhibition and error processing in subjects with Internet gaming disorder: a functional magnetic imaging study. In: European Archives of Psychiatry and Clinical Neuroscience 264 (8), S. 661–672. DOI: 10.1007/s00406-013-0483-3.

Köhler, Stefanie; Schumann, Andy; La Cruz, Feliberto de; Wagner, Gerd; Bär, Karl-Jürgen (2018): Towards response success prediction: An integrative approach using high-resolution fMRI and autonomic indices. In: Neuropsychologia 119, S. 182–190. DOI: 10.1016/j.neuropsychologia.2018.08.003.

Kolodny, Tamar; Mevorach, Carmel; Shalev, Lilach (2017): Isolating response inhibition in the brain: Parietal versus frontal contribution. In: Cortex 88, S. 173–185. DOI: 10.1016/j.cortex.2016.12.012.

Lawrence, E. J.; Rubia, K.; Murray, R. M.; McGuire, P. K.; Walshe, M.; Allin, M. et al. (2009): The neural basis of response inhibition and attention allocation as mediated by gestational age. In: Hum. Brain Mapp. 30 (3), S. 1038–1050.

Liddle Peter F.; Kiehl Kent A.; Smith Andra M. (2000): Event-related fMRI study of response inhibition. In: Hum. Brain Mapp. 12 (2), S. 100–109. DOI: 10.1002/1097-0193(200102)12:2<100::AID-HBM1007>3.0.CO;2-6.

Mander, Bryce A.; Reid, Kathryn J.; Baron, Kelly G.; Tjoa, Tjoson; Parrish, Todd B.; Paller, Ken A. et al. (2010): EEG Measures Index Neural and Cognitive Recovery from Sleep Deprivation. In: The Journal of Neuroscience 30 (7), S. 2686. DOI: 10.1523/JNEUROSCI.4010-09.2010.

Mazzola-Pomietto, Pascale; Kaladjian, Arthur; Azorin, Jean-Michel; Anton, Jean-Luc; Jeanningros, Régine (2009): Bilateral decrease in ventrolateral prefrontal cortex activation during motor response inhibition in mania. In: Journal of Psychiatric Research 43 (4), S. 432–441. DOI: 10.1016/j.jpsychires.2008.05.004.

McNab, Fiona; Leroux, Gaëlle; Strand, Fredrik; Thorell, Lisa; Bergman, Sissela; Klingberg, Torkel (2008): Common and unique components of inhibition and working memory: An fMRI, within-subjects investigation. In: Neuropsychologia 46 (11), S. 2668–2682. DOI: 10.1016/j.neuropsychologia.2008.04.023.

Meffert, Harma; Hwang, Soonjo; Nolan, Zachary T.; Chen, Gang; Blair, James R. (2016): BOLD data representing activation and connectivity for rare no-go versus frequent go cues. In: Data in Brief 7, S. 66–70. DOI: 10.1016/j.dib.2016.02.011.

Nakata, Hiroki; Sakamoto, Kiwako; Ferretti, Antonio; Gianni Perrucci, Mauro; Del Gratta, Cosimo; Kakigi, Ryusuke; Luca Romani, Gian (2008): Executive functions with different motor outputs in somatosensory Go/Nogo tasks: An event-related functional MRI study. In: Brain Research Bulletin 77 (4), S. 197–205. DOI: 10.1016/j.brainresbull.2008.07.008.

O'Connor, David A.; Rossiter, Sarah; Yücel, Murat; Lubman, Dan I.; Hester, Robert (2012): Successful inhibitory control over an immediate reward is associated with attentional disengagement in visual processing areas. In: NeuroImage 62 (3), S. 1841–1847. DOI: 10.1016/j.neuroimage.2012.05.040.

Page, Lisa A.; Rubia, Katya; Deeley, Quinton; Daly, Eileen; Toal, Fiona; Mataix-Cols, David et al. (2009): A functional magnetic resonance imaging study of inhibitory control in obsessive-compulsive disorder. In: Psychiatry Research: Neuroimaging 174 (3), S. 202–209. DOI: 10.1016/j.pscychresns.2009.05.002.

Roth, Robert M.; Saykin, Andrew J.; Flashman, Laura A.; Pixley, Heather S.; West, John D.; Mamourian, Alexander C. (2007): Event-Related Functional Magnetic Resonance Imaging of Response Inhibition in Obsessive-Compulsive Disorder. In: Biological Psychiatry 62 (8), S. 901–909. DOI: 10.1016/j.biopsych.2006.12.007.

Rothmayr, Christoph; Sodian, Beate; Hajak, Göran; Döhnel, Katrin; Meinhardt, Jörg; Sommer, Monika (2011): Common and distinct neural networks for false-belief reasoning and inhibitory control. In: NeuroImage 56 (3), S. 1705–1713. DOI: 10.1016/j.neuroimage.2010.12.052.

Rubia Katya; Smith Anna B.; Woolley James; Nosarti Chiara; Heyman Isobel; Taylor Eric; Brammer Mick (2006): Progressive increase of frontostriatal brain activation from childhood to adulthood during event-related tasks of cognitive control. In: Hum. Brain Mapp. 27 (12), S. 973–993. DOI: 10.1002/hbm.20237.

Sebastian, A.; Baldermann, C.; Feige, B.; Katzev, M.; Scheller, E.; Hellwig, B. et al. (2013a): Differential effects of age on subcomponents of response inhibition. In: Neurobiology of Aging 34 (9), S. 2183–2193. DOI: 10.1016/j.neurobiolaging.2013.03.013.

Sebastian, A.; Pohl, M. F.; Klöppel, S.; Feige, B.; Lange, T.; Stahl, C. et al. (2013b): Disentangling common and specific neural subprocesses of response inhibition. In: NeuroImage 64, S. 601–615. DOI: 10.1016/j.neuroimage.2012.09.020.

Sebastian, Alexandra; Gerdes, Birthe; Feige, Bernd; Klöppel, Stefan; Lange, Thomas; Philipsen, Alexandra et al. (2012): Neural correlates of interference inhibition, action withholding and action cancelation in adult ADHD. In: Psychiatry Research: Neuroimaging 202 (2), S. 132–141. DOI: 10.1016/j.pscychresns.2012.02.010.

Steele, Vaughn; Aharoni, Eyal; E Munro, Gillian; Calhoun, Vince; Nyalakanti, Prashanth; Stevens, Michael et al. (2013): A large scale (N = 102) functional neuroimaging study of response inhibition in a Go/NoGo task. In: Behavioural Brain Research. DOI: 10.1016/j.bbr.2013.06.001.

van Eijk, Julia; Sebastian, Alexandra; Krause-Utz, Annegret; Cackowski, Sylvia; Demirakca, Traute; Biedermann, Sarah V. et al. (2015): Women with borderline personality disorder do not show altered BOLD responses during response inhibition. In: Psychiatry Research: Neuroimaging 234 (3), S. 378–389. DOI: 10.1016/j.pscychresns.2015.09.017.

Wager, Tor D.; Sylvester, Ching-Yune C.; Lacey, Steven C.; Nee, Derek Evan; Franklin, Michael; Jonides, John (2005): Common and unique components of response inhibition revealed by fMRI. In: NeuroImage 27 (2), S. 323–340. DOI: 10.1016/j.neuroimage.2005.01.054.

Walther, Stephan; Goya-Maldonado, Roberto; Stippich, Christoph; Weisbrod, Matthias; Kaiser, Stefan (2010): A supramodal network for response inhibition. In: NeuroReport 21 (3). Online verfügbar unter https://journals.lww.com/neuroreport/Fulltext/2010/02170/A_supramodal_network_for_response_inhibition.7.aspx.

Watanabe, Jobu; Sugiura, Motoaki; Sato, Kazunori; Sato, Yuko; Maeda, Yasuhiro; Matsue, Yoshihiko et al. (2002): The Human Prefrontal and Parietal Association Cortices Are Involved in NO-GO Performances: An Event-Related fMRI Study. In: NeuroImage 17 (3), S. 1207–1216. DOI: 10.1006/nimg.2002.1198.

Zheng, Dongming; Oka, Tatsuro; Bokura, Hirokazu; Yamaguchi, Shuhei (2008): The Key Locus of Common Response Inhibition Network for No-go and Stop Signals. In: Journal of Cognitive Neuroscience 20 (8), S. 1434–1442. DOI: 10.1162/jocn.2008.20100.

Table S9a: Description of all experiments included in the meta-analyses of the stop-signal task, with information on which task design was used, i.e. standard (S) or complex (C), the specific type of task complexity (stimulus, task complexity or both), the specific contrast included and stimulus modality. Furthermore, the table provides information from which source, i.e. table, main text, or correspondence with the authors, the coordinates were extracted. * Studies using FSL or SPM and reporting TAL coordinates without stating that a transformation into TAL space was performed and hence treated as MNI space in the present analysis

Author	Year	n	Age	TAL /MNI	Source	Standard or Complex	Specific Contrast	Stimulus modality	Stimulus type
Aron and Poldrack et al.	2006	13	29,2	MNI	SM Tab. 2	S	Stop > go	auditory stop / visual go	Arrow, Tone
Berkmann et al.	2014	60	21,6	MNI	p.152, Tab. 2	S	Correct stop > correct go	auditory stop / visual go	Arrow, Tone
Bobb et al.	2011	13	62	MNI	p.1066, Tab. 2	S	Correct stop > correct go	visual	Arrow
Boecker et al.	2011	15	24,8	MNI	SM Tab. 1	C - Task	Correct stop > correct go	auditory stop / visual go	Shape, Tone
Boehler et al.	2010	15	22,9	MNI	p. 27, Tab. 3	C - Task	Correct stop > go	visual	Shape, Color
Cai and Leung et al.	2009	12	18-36	MNI	p. 3, Tab. 1	S	Correct stop > correct go	visual	Color
	2009	12	18-36	MNI	p. 3, Tab. 1	S	Correct stop > correct go	visual	Shape
Cai and Leung et al.	2011	23	18-39	MNI	SM Tab.1	C - Task	Correct stop > go	visual	Color
Cai et al.	2014	19		MNI	Tab.2	S	Correct stop > correct go	visual go, visual or auditory stop	Shape, Tone
Chevrier et al.	2007	14	29,4	TAL	Tab. 1	S	Correct stop > go	visual	Color
Chikara et al.	2018	18	23,3	MNI	Tab. 3A	C - Both	Correct stop > correct go	visual	BFS
Chikazoe et al.	2009	22	22,3	MNI	Tab. 2	S	Correct stop > correct uncertain go	visual	Color
Congdon et al.	2014	62	30,8	MNI	Tab. 2	S	Correct stop > correct go	auditory stop / visual go	arrow, tone
Coxon et al.	2016_1	20	25	MNI	Tab.2	C - Both	Correct stop > go	visual	moving bar
	2016_2	20	68,7	MNI	Tab.2	C - Both	Correct stop > go	visual	moving bar
Fauth-Bühler et al.	2012	18	21,2	MNI	correspondence	S	Correct stop > active go baseline	visual	arrow
Ganos et al.	2014	15		MNI	SM Tab. 2	S	Correct stop > go	visual	color

Ghahremani et al.	2012	18	32,5	MNI	Tab.3	S	Correct stop > correct go	auditory stop / visual go	Arrow, Tone
Harle et al.	2016	34	36,1	TAL	SM Tab. 2	S	Correct stop > correct go	auditory stop / visual go	Letter, Tone
Hendrick et al.	2010	60		MNI	Tab. 1	S	Stop > go	visual	Letter
Hughes et al.	2012	10	35,1	MNI	Tab. 4	S	Correct stop > active baseline	auditory stop / visual go	Letter, Tone
Hughes et al.	2013	15	27,5	MNI	Tab.3	S -	Correct stop > active baseline	Auditory stop / visual go	Letter, Tone
Jahfari et al.	2011	20	23,5	MNI	Tab.4	C - Task	Correct stop > go	auditory stop / visual go	Color,Tone
Jahfari et al.	2012	16	24,1	MNI	Tab. 5	C - Both	Correct stop (high, low) > go (none)	auditory stop / visual go	Face/House, Tone
Jahfari et al.	2015	23	21,6	MNI	Tab.3	C- Stimulus	Correct stop > go	auditory stop / visual go	Face, Tone
Kenner et al.	2010	24	29,8	MNI	SM Tab.3	C - Task	Correct stop > correct go	visual	Color, Letter
Ko et al.	2016	32		MNI	Tab. 1A	S	Correct stop > correct go	visual	Letter
	2016	32		MNI	Tab. 1B	C- Stimulus	Correct stop > correct go	visual	Battle Field Scenario
Lavallee et al.	2014	21	24,5	MNI	Tab. 2	C - Task	Correct stop > go (i.e.Stim-1-Context-1 > go-Context-1)	visual	Shape, Color
Lenartowicz et al.	2010	23		MNI	Tab. 2	C - Both	Go/stop-stop > go/stop-go	auditory stop / visual go	Gender, Auditory
	2010	23		MNI	Tab. 2	C - Both	Go-stop>go/stop-go	auditory stop / visual go	Gender, Auditory
Leung and Cai	2007	12	19-28	MNI	Tab.1	S	Conjunction across manual stop > go AND saccadic stop > go	visual	Location
Leunissen et al.	2016	22	23,5	MNI	SM Tab. 1	C - Both	Stop > go	visual	moving bar
Lorenz et al.	2015	38	47,3	MNI	SM Tab. 1	S	Correct stop > go	visual	Arrow, Color
Marco-Pallarés et al.	2008	10	23	MNI	Tab. 1	C - Task	Correct stop > correct go	visual	Color, Shape
McNab et al.	2008	11	24	MNI	p.5, Tab.2	C - Task	Stop > go	visual	Arrow, color change
	2008	11	24	MNI	p.5, Tab.2	C - Task	Stop > oddball	visual	Arrow, color change
Mohammadi et al.	2015	17	53	MNI	SM Tab.2	S	Correct stop > go	visual	Arrow, second colored arrow as stop signal

Montojo et al.	2013	30	23	MNI	Tab.3	S	Correct stop > correct go	auditory stop / visual go	Arrow, Tone
Rae et al.	2014	17	28	MNI	SM Tab. 2	C - Task	Correct stop_specified > correct go_specified	auditory and visual stop / visual go	Color, Tone
	2014	17	28	MNI	SM Tab. 2	C - Task	Correct stop_select > correct go_select	auditory and visual stop / visual go	Color, Tone
Rodriguez-Pujadas et al.	2014	33	21,2	MNI*	Tab.2	S	Correct stop > correct go	auditory stop / visual go	Letter, Tone
Schel et al.	2014	24	21,5	MNI	p.8, Tab. 4	S	Correct stop > correct go	visual	Arrow, Color change stop signal
Sebastian et al.	2012	24	30,3	MNI	Tab.5	S	Correct stop > correct go	visual	Arrow, Color change stop signal
Sebastian et al.	2013a	48	39,9	MNI	SM Tab.1	S	Correct stop > correct go	visual	Arrow, Color Change stop signal
Sebastian et al.	2013b_1	24	27,4	MNI	Tab.3	S	Correct stop > correct go	visual	Arrow, Color change of surrounding circle is stop signal
	2013b_2	21	24,7	MNI	Tab.3	C - Task	Correct stop > correct congruent go	visual	Arrow, Color change of surrounding circle is stop signal
Sebastian et al.	2017	80	24,8	MNI	correspondence	C - Task	Correct stop > correct go	visual	Arrow, Color change of arrow to blue as stop signal and to green as attentional capture signal
	2017	80	24,8	MNI	correspondence	C - Task	Correct stop > correct attentional capture	visual	Arrow, Color change of arrow to blue as stop signal and to green as

									attentional capture signal
Sharp et al.	2010	26	34	MNI	SM Tab.1	C - Task	Correct stop > correct go	visual	Arrow, Colored dot as stop signal
	2010	26	34	MNI	SM Tab.3	C - Task	Correct stop > correct continue	visual	Arrow, Colored dot as stop signal
Swann et al.	2012	16	18-28	MNI	SM Tab. 2	S	Maybe stop_correct stop > maybe stop_correct go	auditory stop / visual go	Arrow, Tone
Tabu et al.	2011	13	27,5	MNI	Text p.280	S	Correct stop > correct go	visual	Arrow, Colored rectangle as stop signal
Tabu et al.	2012	13	37	MNI	SM Tab.1	S	Correct stop > correct go	visual	Shape, Color
	2012	13	37	MNI	SM Tab.1	S	Correct stop > correct go	visual	Shape, Color
van der Meer et al.	2013	19	21,6	MNI	SM Tab.3A	S	Correct stop > correct go	visual	Arrow
van Eijk	2015_1	18	25,3	MNI	Tab.4	S	Correct stop > correct go	visual	Arrow, Color
	2015_2	25	26,96	MNI	Tab.5	C - Task	Correct stop > correct congruent go	visual	Arrow, Color
Wilbertz et al.	2014	49	20-33	MNI	SM Tab.2	C - Task	Correct stop > go	visual	Color and Shape as stop signal
Xu et al.	2015	18	26,4	MNI	Tab.2	S	Correct stop > go	visual	Color
Xu et al.	2017	21	22	MNI	SM Tab.1	C - Task	Correct stop > correct go	visual	Shape, Color
Xue et al.	2008	15	23,6	MNI	SM Tab.1	S	Correct stop > correct go	auditory stop / visual go	Letter, Tone
	2008	15	23,6	MNI	SM Tab.1	S	Correct stop > correct go	auditory stop / visual go	Letter, Tone
Zandbelt et al.	2010	24	22,2	MNI	SM Tab.1	C - Both	Correct stop > go	visual	Moving Bar
Zandbelt et al.	2011	22		MNI	SM Tab. 11	C - Both	Correct stop > go (stop signal probability > 0%)	visual	Moving Bar
Zheng et al.	2008	18		TAL	p.6, Tab.1	S	Correct stop > go	visual	Shape

Table S9b: This table includes additional information of all experiments included in the meta-analyses of the stop-signal task, including a short description for each task, standard (S) or complex (C) categorization, stimulus probabilities and trial duration. The column "Task Design" includes a more detailed task description for the complex, non-standard task versions, so that the reader can more easily understand which specific task modification led to the label "complex". Abbreviations: ITI – intertrial interval, SSD – stop signal delay

Author	Year	Task Description	Standard or Complex	Stimulus Probabilities	Go Trial Duration	Stop Signal Delay
Aron and Poldrack et al.	2006	Go stimulus: Left- or right-pointing arrow. Stop stimulus: Auditory stop signal was presented following the arrow	S	frequent go (75% go, 25% stop trials)	500 ms fixation + 1000ms stimulus + 500 - 4000 ms ITI	Four SSD-staircases (100, 150, 200, and 250 ms) +/- 50 ms.
Berkmann et al.	2014	Go stimulus: Left- or right-pointing arrow. Stop stimulus: Auditory stop signal was presented following the arrow	S	frequent go (75% go, 25% stop trials)	500 ms fixation + 1000 ms stimulus + 1400 ms ITI	SSD +/- 50 ms
Bobb et al.	2011	Go stimulus: Left- or right-pointing horizontal arrow. Stop stimulus: a vertical arrow was presented following the horizontal arrow	S	frequent go (80% go, 20% stop trials)	500 ms Stimulus + 1600 - 2000ms ITI	SSD 250 +/- 50 ms staircase
Boecker et al.	2011	SST with three different trial types: Go stimulus: Black circle and black triangle associated with either right or left button press. Stop stimulus: the go stimulus was followed by an auditory stop signal signaling to cancel the response. Change stimulus: An auditory change signal was presented following the go stimulus signaling participants to press the middle response button instead.	C - Task	frequent go (70% go, 15% stop trials, 15% change trials)	Duration of Trials: 3,350 ms	SSD 250 +/- 50 ms staircase
Boehler et al.	2010	Go stimulus: Green walking figure, which was oriented either to the left or right side. Stop stimulus: Red Figure was presented following the green figure. Additionally, stop-irrelevant blocks were included where participants were instructed	C - Task	frequent go (80% go, 20% stop trials)	800 ms stimulus + 2000 - 8000ms ITI	SSD 200 +/- 17 ms staircase

		to ignore the stop signal and to respond to all go stimuli, irrespective if they were followed by a stop stimulus or not.				
Cai and Leung et al.	2009	The subjects focused on a central fixation bar. Go stimulus: An additional bar war shown on the left or right side of the fixation bar. Stop stimulus: indicated by a color change of the fixation bar in the color task.	S	frequent go (85% go, 15% stop trials)	300ms fixation + (500 ms Go stimulus presentation) 700ms go response time + not defined ITI. 300ms stop stimulus presentation and 1000ms stop response time.	Four fixed SSD for each subject based on performance.
	2009	The subjects focused on a central fixation bar. Go stimulus: An additional bar war shown on the left or right side of the fixation bar. Stop stimulus: indicated by an orientation change in the orientation task.	S	frequent go (85% go, 15% stop trials)	300ms fixation + (500 ms Go stimulus presentation) 700ms go response time + not defined ITI. 300ms stop stimulus presentation and 1000ms stop response time.	Four fixed SSD for each subject based on performance.
Cai and Leung et al.	2011	Combined stop signal and not-stop task. In not-stop trials participants were instructed to ignore the stop signal. Color (matrices of black and color squares) and motion cues (matrices of upward or downward moving squares) were used to indicate a stop or a not-stop trial. Go stimulus: Black triangle, Stop stimulus: Black triangle encircled in a black circle.	C - Task	frequent go (70% go, 30% stop trials)	Trial duration: 1000 - 2000 ms (500 ms Go stimulus presentation and 700ms go response time or 300ms stop stimulus presentation	SSD 150 +/- 50 ms staircase

					and 1000ms stop response time.)	
Cai et al.	2014	Go stimulus: Left or right part of the central diamond turned black indicating either a left or a right button press in the hand conditions or a saccadic eye movement to the left or right side in the eye conditions. Stop stimulus: Either a circle in the center of the screen or a beep signaled participants to cancel their response.	S	frequent go (70% go, 30% stop trials)	200 ms Fixation stimulus + 1700 - 4300 ms ITI	SSDs hand condition: 10, 110, 210, and 310 ms. SSDs eye condition: 10, 90, 180, and 270 ms.
Chevrier et al.	2007	Go stimuli: ‘‘X’’ indicating a left-hand or ‘‘O’’ indicating a right-hand response, Stop stimulus: Change of background color to red.	S	frequent go (67% go, 33% stop trials)	500 ms black screen + 1000 ms stimulus + 2500 - 3500 ms ITI,	SSD 250 +/- 50 ms staircase
Chikara et al.	2018	Battlefield Scenario stop signal task. Only the no-feedback was included in this meta-analysis. Go stimulus: Image of a terrorist holding a weapon, Stop stimulus: Image of a hostage image presented after the Go stimulus.	C - Both	frequent go (75% go, 25% stop trials)	500 - 6500 ms fixation cross 1000 ms stimulus	SSD 150 +/- 50 ms staircase
Chikazoe et al.	2009	SST with (i) certain go trials (blue circle), i.e. the go stimulus was never followed by a stop stimulus, and (ii) uncertain go trials (yellow circle). In uncertain go trials the color of the circle could change to magenta indicating a stop trial.	S	frequent go (44,4% uncertain go trials, 44,4% certain go trials,11,1% stop trials)	800 ms stimulus + 1700 ms intertrial interval.	SSD 200 +/- 30 ms staircase
Congdon et al.	2014	Go stimuli: Left- and right pointing arrows. Stop stimulus: an auditory stop signal was presented following the arrow.	S	frequent go (75% go, 25% stop trials)	500ms fixation cross + 1000 ms trial + 500 - 4000ms ITI	SSD 250 or 350 +/- 50 ms staircase
Coxon et al.	2016_1	Participants watched two vertical bars continuously moving from the bottom to the top until reaching a target line. Participants were instructed to simultaneously press mouse buttons with the two index fingers. When the target line was reached,	C - Both	frequent go (70% go, 10% stop all, 10% stopleft/ goright, 10% stopright/ goleft trials)	500 ms warning rectangle + 800 ms stimulus + 200 ms (1000ms after trial onset, the	Individual SSD based on prescan performance.

		participants were instructed to release both button presses. Stop trials were divided in (i) all or (ii) right/left stop trials. In "all stop trials' ' the two moving bars stopped suddenly before reaching the target line and participants should keep pressing the buttons rather than to release them. On "right/left stop trials' ' one of the bars stopped while the other one kept moving to the target line, requiring participants to prevent movement of the corresponding hand, while still responding with the other at the target.			indicators were reset to empty)	
	2016_2	See above.	C - Both	frequent go (70% go, 10% stop all, 10% stopleft/ goright, 10% stopright/ goleft)	500 ms warning rectangle + 800 ms stimulus + 200 ms (1000ms after trial onset, the indicators were reset to empty)	Individual SSD based on prescan performance.
Fauth-Bühler et al.	2012	Go stimuli: Left and right pointing arrows, Stop stimulus: An upward pointing arrow was presented following the right or left pointing arrow.	S	frequent go (83% go, 17% stop trials)	100 ms hold period + 700 - 1100 ms fixation cross	SSD 250 +/- 50 ms staircase
Ganos et al.	2014	Go stimulus: White circle, Stop stimulus: Color of the circle suddenly changed to red	S	frequent go (67% go, 33% stop trials)		SSD 200 +/- 10 ms staircase
Ghahremani et al.	2012	Go stimuli: Left- and right pointing arrows. Stop stimulus: An auditory stop signal was presented following the arrow.	S	frequent go (75% go, 25% stop trials)	500 ms fixation + 1000ms stimulus	Starting SSD based on prescan performance +/- 50 ms staircase
Harle et al.	2016	Go stimuli: X = left button press; O = right button press. Stop stimulus: Auditory stop signal was presented following the go signal.	S	frequent go (75% go, 25% stop trials)	1300 ms trial duration + 200 ms ITI	SSD: 0, 100, 200, 300, 400, or 500 ms less than the mean reaction time
Hendrick et al.	2010	Go stimulus: Circle. Stop stimulus: X.	S	frequent go (75% go, 25% stop trials)	1000 - 5000 ms fore-period 1000	SSD 200 +/-67 ms staircase

					ms trial duration + 2000ms ITI	
Hughes et al.	2012	Go stimuli: X or O = left or right button press. Stop stimulus: Auditory stop signal was presented following the go signal.	S	frequent go (75% go, 25% stop trials)	2000 ms trial duration	SSD 200 +/- 50 ms staircase
Hughes et al.	2013	Go stimuli: X or O = left or right button press. Stop stimulus: Auditory stop signal was presented following the go signal.	S -	frequent go (70% go, 30% stop trials)	Go stimulus onset asynchrony: 1200 - 3000ms	Variable SSD range linked to median go response time.
Jahfari et al.	2011	Go stimulus: Squares with four different colors on the left or right side of the screen (two colors respectively associated with right or left-hand finger press). In congruent trials the position of the square and color-finger press association were compatible while this was not the case in incongruent trials. Stop stimulus: Auditory stop signal was presented following the go signal.	C - Task	frequent go (66% go, 33% stop trials) (50%/50% incongruent and congruent trials)	4000 -5500 ms null trial+ 4000 ms trial length.	SSD 250 +/- 50 ms staircase
Jahfari et al.	2012	Trials started with a cue indicating the probability of a stop signal trial. Go stimulus: House or face stimulus indicating a left or right finger press, Stop stimulus: Auditory stop signal was presented following the go signal.	C - Both	Varying stimulus probabilities (25% stop trials in low probability, 50% stop trials in high probability condition)	4000 ms trial duration = 500 - 2000 ms fixation cross + 500 ms cue, 300ms stimulus + ITI. Each trial was followed by a 2000ms null period.	SSD 250 +/- 50 ms staircase
Jahfari et al.	2015	Go stimulus: Male or female face: Left or right response. Stop stimulus: Auditory stop signal was presented following the go signal.	C- Stimulus	frequent go (70% go, 30% stop trials)	2000 ms trial duration = 500 - 700 ms fixation cross + 500 ms stimulus + 1000ms Response window + ITI. Each trial was followed by a	SSD 250 +/- 50 ms staircase

					2000ms null period.	
Kenner et al.	2010	Stop signal task with a switch component. Go stimulus: O = press button 1; X = press button 2. Switch stimulus: Change of the background color to blue indicated a switch between the letter-button association. Stop stimulus: Change of the background color to red.	C - Task	frequent go (66% go trials, 33% stop signal trials (33 % stop trials in stop runs))	750ms ITI + 500 ms fixation cross + 1000 ms stimulus	SSD +/- 50 ms staircase
Ko et al.	2016	Go stimulus: Circle. Stop stimulus: Cross.	S	frequent go (75% go, 25% stop trials)	500 - 6500 ms fixation cross + 1000 ms stimulus	SSD 150 +/- 50 ms staircase
	2016	Go stimulus: Image of a ruffian holding a weapon, Stop stimulus: Image of a hostage image presented after the Go stimulus.	C-Stimulus	frequent go (75% go, 25% stop trials)	500 - 6500 ms fixation cross + 1000 ms stimulus	SSD 150 +/- 50 ms staircase
Lavallee et al.	2014	Stop signal task which used different task rules dependent on three different task contexts. As stimuli, different combinations of geometrical figures and colors were used. Each participant was assigned a go signal (e.g. green triangle) and two infrequently presented stimuli (Stim1: e.g. blue square, Stim2: e.g. violet circle). In context 1 subjects should react to the Go stimulus and cancel their response if Stim1 or Stim2 was shown. In context 2 subjects were instructed to cancel the go response after presentation of Stim1 but to continue the response when Stim2 was presented. In context 3 subjects were asked to continue their response when Stim1 was shown and to cancel their go response if Stim2 was presented.	C - Task	Total of 1152 trials 61% of all trials were pure go trials, 13% of trials consisted of Stimulus1 being presented after a go signal and 26% of trials consisted of stimulus 2 being presented after a go signal, resulting in 61 % go, 26 % stop and 13 % continue trials	0 - 2000 ms trial onset + 350 ms response active window	SSD 128 ms + 16 ms/ - 64 ms
Lenartowicz et al.	2010	Go stimuli: Faces. Subjects had to assign a gender to the shown face, Stop stimulus: Auditory stop signal was presented following the go signal.	C - Both	frequent go (76% go with 52% go-go, 12% stop-go, 12% go/stop-go; 24% stop trials	500ms fixation cross + 1000 ms stimulus + 500 - 4000 ms ITI	SSDs of 250 or 50 msec +/- 50 ms staircase

		A training and a test phase was conducted. In the training phase the different faces were systematically mapped with either a go or a stop trial, however, this mapping could be reversed in the test phase, e.g. some faces were mapped with a go response in the training phase and with a stop trial in the test phase, which was called a go-stop trial. Faces that were mapped with either a go or a stop trial in the training phase and with a stop trial in the test phase, were called go/stop-stop trials.		with 12% go-stop, 12% go/stop-stop)		
	2010	see above	C - Both	frequent go (76% go with 52% go-go, 12% stop-go, 12% go/stop-go; 24% stop trials with 12% go-stop, 12% go/stop-stop)	500ms fixation cross + 1000 ms Go stimulus + 500 - 4000 ms ITI	SSDs of 250 or 50 msec +/- 50 ms staircase
Leung and Cai	2007	Go stimulus: Plus sign on the left or the right side of the screen, Stop stimulus: A circle presented after the Go stimulus.	S	frequent go (70% go, 30% stop trials)	Each trial was 3000 ms long + ITI	Prescan training with four different SSDs.A short and a long SSD were chosen.
Leunissen et al.	2016	First a cue was shown which indicated the probability of a stop signal trial. Participants watched a vertical bar moving from the bottom upwards on each trial. Participants were instructed to stop the moving bar as close as possible to a target line by releasing a mouse key. At the end of a go trial, the target line changed its color to green, yellow, orange or red in order to indicate how far the distance between the bar and target line actually was. In stop trials the vertical bar stopped before reaching the target line and subjects were instructed to hold the button press and thus prevent the button release.	C - Both	20% stop in low, 40% stop in high stop signal probability condition	1000ms cue + response time/ indicator was reset to empty after 1000ms + 3250 ITI	SSD was determined in a prescan run + /- 10 ms staircase
Lorenz et al.	2015	Go stimuli: white arrows pointing either to the right or left,	S	frequent go (75% go, 25% stop trials)	500 ms cue + 1,000 ms	SSD 150 or 200 ms +/- 50 ms staircase

		Stop stimulus: the white arrow changed its color to red.			stimulus + ITI 500 - 4000 ms	
Marco-Pallarés et al.	2008	Flanker-SST variant. Go stimuli: target letter flanked by four letters (target H = right hand press, target S = left hand press). In the congruent condition the target and the flanker letters were the same (e.g., HHHHH). In the incongruent condition target and flanker letters didn't match (e.g., SSHSS). In half of the trials the target letters were degraded by removal of 70% of the pixels. Stop stimulus: Red square surrounding the target letter.	C -Task	frequent go (75% go, 25% stop trials)	Stimulus onset asynchrony: 1750 - 2250 msec	SSD was determined in a prescan run. An easy and a hard to inhibit delay was used.
McNab et al.	2008	Go stimulus: horizontal yellow arrow, Stop stimulus: vertical yellow arrow was presented after the go stimulus, Oddball stimulus: blue horizontal arrow which was presented after the go stimulus and signaled participants to still execute the go response. The oddball stimulus introduces an additional oddball-component.	C - Task	Contrast: stop > go 50% go, 25% stop, 25% oddball trials	1500 ms stimulus + 400 ms blank screen + 300 ms fixation cross.	First trial: 250 ms switch and 12500 ms stop trial SSD -> Staircase +/- 50 ms
	2008	Go stimulus: horizontal yellow arrow, Stop stimulus: vertical yellow arrow was presented after the go stimulus, Oddball stimulus: blue horizontal arrow which was presented after the go stimulus and signaled participants to still execute the go response. The oddball stimulus introduces an additional oddball-component.	C - Task	Contrast: stop > oddball 50% go, 25% stop, 25% oddball trials	1500 ms stimulus + 400 ms blank screen + 300 ms fixation cross.	First trial: 250 ms switch and 12500 ms stop trial SSD -> Staircase +/- 50 ms
Mohammadi et al.	2015	Go stimuli: Arrows pointing to the right or left, Stop stimulus: The first arrow was followed by a second arrow.	S	frequent go (75% go, 25% stop trials)	Trial duration: 1000 - 4000 ms.	SSDs of 200 +/- 50 ms staircase

Montojo et al.	2013	Go stimuli: Left- and right pointing arrows, Stop stimulus: An auditory stop signal was presented following the arrow	S	frequent go (75% go, 25% stop trials)	500 ms fixation cross + 1000 ms stimulus + 500 - 4000ms null period.	SSDs of 250 or 350 msec +/- 50 ms staircase
Rae et al.	2014	Combined selection-stopping task. Subjects were presented with a picture of a right hand with four circles, one above each finger. There were two trial types: “specified” and “select”: Specified go trial: One of the circles changed its color to green, indicating the finger which should be used for a button press. Select go trial: All four circles changed to green indicating subjects could choose themselves which finger they wanted to use for the button press. Stop stimulus: Auditory signal in conjunction with a change of the color of the circles to red.	C - Task	frequent go (75% go, 25% stop trials)	1000 ms stimulus + 2000 - 8000 ms ITI	SSD was determined in a prescan run based on response time + staircase.
	2014	See above.	C - Task	frequent go (75% go, 25% stop trials)	1000 ms stimulus + 2000 - 8000 ms ITI	SSD was determined in a prescan run based on response time + staircase.
Rodriguez-Pujadas et al.	2014	Go stimulus: White letter (T or D), Stop stimulus: Auditory stop signal was presented following the go signal.	S	frequent go (75% go, 25% stop trials)	500 ms fixation cross + 1000 ms stimulus + 1000 ms ITI	Started with different SSD values (100, 150, 200, and 250 ms) +/- 50ms staircase
Schel et al.	2014	Go stimuli: Left or right pointing arrows, Stop stimulus: Color of arrow changed to red.	S	frequent go (75% go, 25% stop trials)	1500 ms stimulus + 2000 - 4000 ms fixation cross	SSDs of 250 +/- 50 ms staircase
Sebastian et al.	2012	Go stimuli: Left or right pointing arrows in a white fixation ring, Stop stimulus: Change of the color of the fixation ring from white to blue.	S	frequent go (75% go, 25% stop trials)	500ms fixation circle + 1000ms Go stimulus + 208 - 792ms	SSDs of 220 +/- 50 ms staircase

					variable ITI (ISI: 708 - 1292 ms).	
Sebastian et al.	2013a	Go stimuli: Left or right pointing arrows in a white fixation ring, Stop stimulus: Change of the color of the fixation ring from white to blue.	S	frequent go (75% go, 25% stop trials)	500ms fixation circle + 1000ms Go stimulus + 208 - 792ms variable ITI (ISI: 708 - 1292 ms).	SSDs of 220 +/- 50 ms staircase
Sebastian et al.	2013b_1	Go stimuli: Left or right pointing arrows in a white fixation ring, Stop stimulus: Change of the color of the fixation ring from white to blue.	S	frequent go (75% go, 25% stop trials)	500ms fixation circle + 1000ms Go stimulus + 208 - 792ms variable ITI (ISI: 708 - 1292 ms).	SSDs of 220 +/- 50 ms staircase
	2013b_2	HRI task which included features of Simon, the go/no-go, and the stop-signal tasks. Congruent go stimulus: e.g., a right pointing arrow was shown in the right half of an ellipse. Incongruent go stimulus: e.g. a right pointing arrow was shown in the left half of an ellipse. No-Go stimulus: The color of the ellipse changed from white to blue at the onset of the arrow. Stop stimulus: The color of the ellipse changed from white to blue with a variable stop-signal delay (SSD) after the onset of the arrow.	C - Task	62,5% congruent go, 12,5% incongruent go, 12,5 % stop trials, 12,5% no-go trials	Preparation 500 ms + 1000 ms stimulus + 1500ms (+/- 372 ms) ITI.	SSDs of 220 +/- 50 ms staircase
Sebastian et al.	2017	Go stimuli: Left or right pointing arrows in a white fixation ring, Stop stimulus: Change of the color of the fixation ring from white to blue, Attentional capture stimuli: Color change of the arrow from white to green, indicating subjects to continue their response.	C - Task	50% go, 25% stop, 25% attentional capture	500 ms fixation cross + 1000ms stimulus + 2500 - 3500 ms ITI	SSDs of 210 +/- 30 ms staircase
	2017	See above.	C - Task	50% go, 25% stop, 25% attentional capture	500 ms fixation cross + 1000ms stimulus + 2500 - 3500 ms ITI	SSDs of 210 +/- 30 ms staircase

Sharp et al.	2010	Go stimulus: Left or right pointing arrows. Stop stimulus: Red circle was presented above the go stimulus, Continue stimulus: Green circle was presented below the go signal, indicating participants to continue their response	C - Task	Contrast: Correct stop > Correct go 50% go trials, 20% stop trials, 20% continue trials, 10% rest	350ms stimulus + 1400 ms stimulus	SSD started with a mean go RT of the choice reaction task minus 200 ms +/- 50ms staircase.
	2010	See above.	C - Task	Contrast: Correct stop > Correct continue 50% go trials, 20% stop trials, 20% continue trials, 10% rest	350ms stimulus + 1400 ms stimulus	SSD started with a mean go RT of the choice reaction task minus 200 ms +/- 50ms staircase.
Swann et al.	2012	Cued stop signal task: Each trial began with a cue, which could either be the words "Maybe Stop" written in red letters on a black background or "No Stop" written in green letters on a black background. In the “maybe stop” condition the go stimulus was followed by a stop stimulus in 50% of the trials. Go stimulus: Left or right pointing arrow. Stop stimulus: Auditory stop signal was presented following the go signal.	S	frequent go (25% maybe go, 50% no-stop-go trials, 25% maybe stop trials)	1000ms Cue + response time 1000ms + 1500 - 5000ms ITI	SSDs of 150 +/- 50 ms staircase
Tabu et al.	2011	Go stimulus: Green left or right pointing arrows. Stop stimulus: A red rectangle replaced the go stimulus.	S	frequent go (75% go, 25% stop trials)	900 ms stimulus + 3000 - 5000 ms fixation cross	SSDs of 150 +/- 50 ms staircase
Tabu et al.	2012	Go stimulus: Green left or right pointing arrows. Response with hand. Stop stimulus: Red rectangle replaced the go stimulus.	S	frequent go (75% go, 25% stop trials)	900 ms stimulus + 3000 - 5000 ms fixation cross	SSDs of 150 +/- 50 ms staircase
		Go stimulus: Green left or right pointing arrows. Response with foot. Stop stimulus: Red rectangle replaced the go stimulus.	S	frequent go (75% go, 25% stop trials)	900 ms stimulus + 3000 - 5000 ms fixation cross	SSDs of 150 +/- 50 ms staircase
van der Meer et al.	2013	Go stimuli: Left or right pointing arrows, Stop stimulus: Arrow pointing upwards was presented after or simultaneously with Go stimulus.	S	frequent go (80% go, 20% stop trials)	500ms stimulus + 1400–2200 ms ITI	SSDs of 250 +/- 50 ms staircase
van Eijk	2015_1	Go stimuli: Left or right pointing arrows in a white fixation ring,	S	frequent go (75% go, 25% stop trials)	500ms fixation circle + 1000ms	SSDs of 220 +/- 50 ms staircase

		Stop stimulus: Change of the color of the fixation ring from white to blue.			Go stimulus + 208 - 792ms variable ITI (ISI: 708 - 1292 ms).	
	2015_2	HRI task which included features of Simon, the go/no-go, and the stop-signal tasks. Congruent Go stimulus: e.g. a right pointing arrow was shown in the right half of an ellipse. Incongruent Go stimulus: e.g. a right pointing arrow was shown in the left half of an ellipse. In go trials participants were required to respond according to the direction of the arrow. No-Go stimulus: The color of the ellipse changed from white to blue at the onset of the arrow. Stop stimulus: The color of the ellipse changed from white to blue with a variable stop-signal delay (SSD) after the onset of the arrow.	C - Task	62,5% congruent go, 12,5% incongruent go, 12,5 % stop trials, 12,5% no-go trials	Preparation 500 ms + 1000 ms stimulus + 1500ms (+/- 372 ms) ITI.	SSDs of 220 +/- 50 ms staircase
Wilbertz et al.	2014	Reward-stop signal task: Go stimulus: Symbol of a green walking figure pointing to the right or to the left side. Stop stimulus: Color change of the symbol to pink (monetary rewarded stop trials) or to blue (non rewarded stop trials).	C - Task	frequent go (67% go, 33% stop trials)	600 ms stimulus + 1500 s to 9000 ms ITI	Start SSD from training session + /- 34ms staircase
Xu et al.	2015	SST with three task conditions: Condition 1 only included go trials, Condition 2 included 75% go and 25% stop trials, Condition 3 included 75% go and 25% switch trials. Go stimuli: Black arrow with a “+” in the middle pointing to left, right, up or down. Participants were required to respond with a corresponding button press on a four-response button device. Stop stimulus: "+" in the middle of the arrow turns red, signaling participants to cancel their go response.	S	frequent go (75% go, 25% stop trials)	1500 ms stimulus + 2000 - 6000 ms ITI	SSDs of 150 +/- 50 ms staircase

		Switch stimulus: Arrow turns red, indicating to press the opposite response button (e.g. left button press when the arrow is pointing to the right) Conditions were performed separately and only the results of the stop condition were included.				
Xu et al.	2017	All trials started with a central cue (triangle or square) indicating rule mapping. Go stimulus: A black circle was presented left or right of a white fixation circle. Depending on the position of the stimulus the subjects were instructed to make a saccade to the left or to the right. In some trials the go stimulus was followed by a stop (blue circle) or continue (yellow circle) stimulus shown in the white fixation circle. The color-mapping was dependent on the cue shown at the start of each trial. In stop trials, participants should cancel their response, in continue trial participants should continue the saccadic movement regardless of the presented colored stimulus.	C - Task	56% go trials, 22% stop trials, 22% continue trials	500 ms cue + 2000 - 3500 ms fixation period ms + 500ms stimulus + 200ms saccade maintaining 2000 - 6000 ms ITI	Four fixed SSDs based on task performance (50 - 250 ms).
Xue et al.	2008	Manual task version: Go stimulus: Letters T or D indicated a response with the right index or middle finger. Stop stimulus: Auditory stop signal was presented following the go signal.	S	frequent go (75% go, 25% stop trials)	500ms fixation cross + 1000ms stimulus + 1000ms ITI	Four SSD-staircases (100, 150, 200, and 250 ms) +/- 50 ms.
	2008	Letter naming task version: Go stimulus: Subjects named the letter T or D. Stop stimulus: Auditory stop signal was presented following the go signal.	S	frequent go (75% go, 25% stop trials)	500ms fixation cross + 1000ms stimulus + 1000ms ITI	Four SSD-staircases (100, 150, 200, and 250 ms) +/- 50 ms.
Zandbelt et al.	2010	Each trial started with a colored cue indicating the probability of a stop signal trial. Participants watched a vertical bar moving upwards. When the target line was reached, the participants were instructed to press a response button. In stop trials the vertical bar suddenly stopped before reaching the target	C - Both	0%, 17%, 20% 25% and 33% stop signal probability	1000ms trial + 1000ms ITI	SSDs of 550 +/- 25 ms staircase

		line and participants were instructed not to respond.				
Zandbelt et al.	2011	Each trial started with a colored cue indicating the probability of a stop signal trial. Participants watch a vertical bar moving upwards. When the target line was reached, participants were instructed to press a response button. In stop trials the vertical bar suddenly stopped before reaching the target line and participants were instructed not to respond.	C - Both	frequent go (83% go, 13% stop trials with 17%, 20%, 25% and 33% probabilities)	1000ms trial + 1000ms ITI	SSDs of 550 +/- 25 ms staircase
Zheng et al.	2008	Go stimulus: Circle, Stop stimulus: ‘‘X,’’ was presented following the circle.	S	frequent go (75% go, 25% stop trials)	1500 - 2500 ms fixation + 1000ms stimulus	SSDs of 200 +/- 50 ms staircase

Table S9c: Description of the minimal, maximal and mean trial duration of all experiments included in the meta-analyses of the stop-signal task, including standard (S) or complex (C) categorization. Abbreviations: ITI – intertrial interval

Author	Year	Standard or Complex	Go Trial Duration	MIN (ms)	MAX (ms)	Mean
Aron and Poldrack et al.	2006	S	500 ms fixation + 1000 ms stimulus + 500 - 4000 ms ITI	2000	5500	3750
Berkmann et al.	2014	S	500 ms fixation + 1000 ms stimulus + 1400 ms ITI	2850	2950	2900
Bobb et al.	2011	S	500 ms stimulus + 1600 - 2000 ms ITI	2100	2500	2300
Boecker et al.	2011	C - Task	Duration of trials: 3350 ms	3300	3400	3350
Boehler et al.	2010	C - Task	800 ms stimulus + 2000 - 8000 ms ITI	2800	8800	5800
Cai and Leung et al.	2011	C - Task	Trial duration: 1000 - 2000 ms (500 ms Go stimulus presentation and 700ms go response time or 300ms stop stimulus presentation and 1000ms stop response time.)	1000	2000	1500
Chevrier et al.	2007	S	500 ms black screen + 1000 ms stimulus + 2500 - 3500 ms ITI,	4000	5000	4500
Chikara et al.	2018	C - Both	500 - 6500 ms fixation cross + 1000 ms stimulus	1500	7500	4500
Chikazoe et al.	2009a	S	800 ms stimulus + 1700 ms intertrial interval.	1450	1500	1475
Congdon et al.	2014	S	500ms fixation cross + 1000 ms trial + 500 - 4000ms ITI	2000	5500	3750
Coxon et al.	2016_1	C - Both	500 ms warning rectangle + 800 ms stimulus + 200 ms (1000ms after trial onset, the indicators were reset to empty)	1450	1550	1500
	2016_2	C - Both	500 ms warning rectangle + 800 ms stimulus + 200 ms (1000ms after trial onset, the indicators were reset to empty)	1450	1550	1500
Ghahremani et al.	2012	S	500 ms fixation + 1000ms stimulus	1450	1550	1500
Harle et al.	2016	S	1300 ms trial duration + 200 ms ITI	1450	1550	1500
Hendrick et al.	2010	S	1000 - 5000 ms fore-period + 1000ms trial duration + 2000ms ITI	4000	8000	6000
Hughes et al.	2012	S	2000 ms trial duration	1950	2050	2000
Hughes et al.	2013	S	Go stimulus onset asynchrony: 1200 - 3000ms	1200	3000	2100
Jahfari et al.	2011	C - Task	4000 -5500 ms null trial+ 4000 ms trial length.	8000	9500	8750
Jahfari et al.	2012	C - Both	4000 ms trial duration = 500 - 2000 ms fixation cross + 500 ms cue, 300ms stimulus + ITI. Each trial was followed by a 2000ms null period.	5950	6050	6000

Jahfari et al.	2015	C- Stimulus	2000 ms trial duration = 500 - 700 ms fixation cross + 500 ms stimulus + 1000ms Response window + ITI. Each trial was followed by a 2000ms null period.	3950	4050	4000
Kenner et al.	2010	C - Task	750ms ITI + 500 ms fixation cross + 1000 ms stimulus	2200	2300	2250
Ko et al.	2016	S	500 - 6500 ms fixation cross + 1000 ms stimulus	1500	7500	4500
	2016	C- Stimulus	500 - 6500 ms fixation cross + 1000 ms stimulus	1500	7500	4500
Lavallee et al.	2014	C - Task	0 - 2000 ms trial onset + 350 ms response active window	350	2350	1350
Lenartowicz et al.	2010	C - Both	500ms fixation cross + 1000 ms stimulus + 500 - 4000 ms ITI	2000	4500	3250
	2010	C - Both	500ms fixation cross + 1000 ms stimulus + 500 - 4000 ms ITI	2000	4500	3250
Leunissen et al.	2016	C - Both	1000ms cue + response time/ indicator was reset to empty after 1000ms + 3250 ITI	5200	5300	5250
Lorenz et al.	2015	S	500 ms cue + 1,000 ms stimulus + ITI 500 - 4000 ms	2000	5500	3750
Marco-Pallarés et al.	2008	C - Task	Stimulus onset asynchrony: 1750 - 2250 msec	1750	2250	2000
McNab et al.	2008	C - Task	1500 ms stimulus + 400 ms blank screen + 300 ms fixation cross.	2150	2250	2200
	2008	C - Task	1500 ms stimulus + 400 ms blank screen + 300 ms fixation cross.	2150	2250	2200
Mohammadi et al.	2015	S	Trial duration: 1000 - 4000 ms.	1000	4000	2500
Montojo et al.	2015	S	500 ms fixation cross + 1000 ms stimulus + 500 - 4000ms null period.	2000	5500	3750
Rae et al.	2014	C - Task	1000 ms stimulus + 2000 - 8000 ms ITI	3000	9000	6000
	2014	C - Task	1000 ms stimulus + 2000 - 8000 ms ITI	3000	9000	6000
Rodriguez-Pujadas et al.	2014	S	500 ms fixation cross + 1000 ms stimulus + 1000 ms ITI	2450	2550	2500
Schel et al.	2014	S	1500 ms stimulus + 2000 - 4000 ms fixation cross	3500	5500	4500
Sebastian et al.	2012	S	500ms fixation circle + 1000ms Go stimulus + 208 - 792ms variable ITI (ISI: 708 - 1292 ms).	1792	2292	2042
Sebastian et al.	2013a	S	500ms fixation circle + 1000ms Go stimulus + 208 - 792ms variable ITI (ISI: 708 - 1292 ms).	1792	2292	2042
Sebastian et al.	2013b_1	S	500ms fixation circle + 1000ms Go stimulus + 208 - 792ms variable ITI (ISI: 708 - 1292 ms).	1792	2292	2042
	2013b_2	C - Task	Preparation 500 ms + 1000 ms stimulus + 1500ms (+/- 372 ms) ITI.	1628	2372	2000
Sebastian et al.	2017	C - Task	500 ms fixation cross + 1000ms stimulus + 2500 - 3500 ms ITI	4000	5000	4500
	2017	C - Task	500 ms fixation cross + 1000ms stimulus + 2500 - 3500 ms ITI	4000	5000	4500
Sharp et al.	2010	C - Task	350ms stimulus + 1400 ms stimulus	1700	1800	1750
	2010	C - Task	350ms stimulus + 1400 ms stimulus	1700	1800	1750
Tabu et al.	2011	S	900 ms stimulus + 3000 - 5000 ms fixation cross	3900	5900	4900

Tabu et al.	2012	S	900 ms stimulus + 3000 - 5000 ms fixation cross	3900	5900	4900
	2012	S	900 ms stimulus + 3000 - 5000 ms fixation cross	3900	5900	4900
Swann et al.	2012	S	1000ms Cue + response time 1000ms + 1500 - 5000ms ITI	2500	7000	4750
van der Meer et al.	2013	S	500ms stimulus + 1400–2200 ms ITI	1900	2700	2300
van Eijk	2015_1	S	500ms fixation circle + 1000ms Go stimulus + 208 - 792ms variable ITI (ISI: 708 - 1292 ms).	1792	2292	2042
	2015_2	C - Task	Preparation 500 ms + 1000 ms stimulus + 1500ms (+/- 372 ms) ITI.	1628	2372	2000
Wilbertz et al.	2014	C - Task	600 ms stimulus + 1500 s to 9000 ms ITI	2100	9600	5850
Xu et al.	2015	S	1500 ms stimulus + 2000 - 6000 ms ITI	3500	7500	5500
Xu et al.	2017	C - Task	500 ms cue + 2000 - 3500 ms fixation period ms + 500ms stimulus + 200ms saccade + 2000 - 6000 ms ITI	5200	10700	7950
Xue et al.	2008	S	500ms fixation cross + 1000ms stimulus + 1000ms ITI	2450	2550	2500
	2008	S	500ms fixation cross + 1000ms stimulus + 1000ms ITI	2450	2550	2500
Zandbelt et al.	2010	C - Both	1000ms trial + 1000ms ITI	1950	2050	2000
Zandbelt et al.	2011	C - Both	1000ms trial + 1000ms ITI	1950	2050	2000
Zheng et al.	2008	S	1500 - 2500 ms fixation + 1000ms stimulus	2500	3500	3000

References of all experiments included in the main meta-analyses of the stop-signal task

Aron, Adam R.; Poldrack, Russell A. (2006): Cortical and Subcortical Contributions to Stop Signal Response Inhibition: Role of the Subthalamic Nucleus. In: The Journal of Neuroscience 26 (9), S. 2424. DOI: 10.1523/JNEUROSCI.4682-05.2006.

Berkman, Elliot T.; Kahn, Lauren E.; Merchant, Junaid S. (2014): Training-Induced Changes in Inhibitory Control Network Activity. In: The Journal of Neuroscience 34 (1), S. 149. DOI: 10.1523/JNEUROSCI.3564-13.2014.

Bobb, David; Adinoff, Bryon; Laken, Steven; Mcclintock, Shawn; Rubia, Katya; Huang, Hung-Wei et al. (2011): Neural Correlates of Successful Response Inhibition in Unmedicated Patients With Late-Life Depression. In: The American journal of geriatric psychiatry : official journal of the American Association for Geriatric Psychiatry 20. DOI: 10.1097/JGP.0b013e318235b728.

Boecker, Maren; Drueke, Barbara; Vorhold, Verena; Knops, Andre; Philippen, Bernd; Gauggel, Siegfried (2011): When response inhibition is followed by response reengagement: An event-related fMRI study. In: Hum. Brain Mapp. 32 (1), S. 94–106. DOI: 10.1002/hbm.21001.

Boehler, C. N.; Appelbaum, L. G.; Krebs, R. M.; Hopf, J. M.; Woldorff, M. G. (2010): Pinning down response inhibition in the brain — Conjunction analyses of the Stop-signal task. In: NeuroImage 52 (4), S. 1621–1632. DOI: 10.1016/j.neuroimage.2010.04.276.

Cai, Weidong; Cannistraci, Christopher J.; Gore, John C.; Leung, Hoi-Chung (2014): Sensorimotor-independent prefrontal activity during response inhibition. In: Hum. Brain Mapp. 35 (5), S. 2119–2136. DOI: 10.1002/hbm.22315.

Cai, Weidong; Leung, Hoi-Chung (2009): Cortical activity during manual response inhibition guided by color and orientation cues. In: Brain Research 1261, S. 20–28. DOI: 10.1016/j.brainres.2008.12.073.

Cai, Weidong; Leung, Hoi-Chung (2011): Rule-Guided Executive Control of Response Inhibition: Functional Topography of the Inferior Frontal Cortex. In: PLOS ONE 6 (6), e20840. DOI: 10.1371/journal.pone.0020840.

Chevrier, Andre D.; Noseworthy, Michael D.; Schachar, Russell (2007): Dissociation of response inhibition and performance monitoring in the stop signal task using event-related fMRI. In: Hum. Brain Mapp. 28 (12), S. 1347–1358. DOI: 10.1002/hbm.20355.

Chikara, Rupesh K.; Chang, Erik C.; Lu, Yi-Chen; Lin, Dar-Shong; Lin, Chin-Teng; Ko, Li-Wei (2018): Monetary Reward and Punishment to Response Inhibition Modulate Activation and Synchronization Within the Inhibitory Brain Network. In: Frontiers in Human Neuroscience 12, S. 27. DOI: 10.3389/fnhum.2018.00027.

Chikazoe, Junichi; Jimura, Koji; Hirose, Satoshi; Yamashita, Ken-ichiro; Miyashita, Yasushi; Konishi, Seiki (2009): Preparation to Inhibit a Response Complements Response Inhibition during Performance of a Stop-Signal Task. In: The Journal of Neuroscience 29 (50), S. 15870. DOI: 10.1523/JNEUROSCI.3645-09.2009.

Congdon, Eliza; Altshuler, Lori L.; Mumford, Jeanette A.; Karlsgodt, Katherine H.; Sabb, Fred W.; Ventura, Joseph et al. (2014): Neural activation during response inhibition in adult attention-deficit/hyperactivity disorder: Preliminary findings on the effects of medication and symptom severity. In: Psychiatry Research: Neuroimaging 222 (1), S. 17–28. DOI: 10.1016/j.pscychresns.2014.02.002.

Coxon, James P.; Goble, Daniel J.; Leunissen, Inge; van Impe, Annouchka; Wenderoth, Nicole; Swinnen, Stephan P. (2016): Functional Brain Activation Associated with Inhibitory Control Deficits in Older Adults. In: Cerebral Cortex 26 (1), S. 12–22. DOI: 10.1093/cercor/bhu165.

Fauth-Bühler, Mira; Rover, Mischa de; Rubia, Katya; Garavan, Hugh; Abbott, Sanja; Clark, Luke et al. (2012): Brain networks subserving fixed versus performance-adjusted delay stop trials in a stop signal task. In: Behavioural Brain Research 235 (1), S. 89–97. DOI: 10.1016/j.bbr.2012.07.023.

Ganos, Christos; Kühn, Simone; Kahl, Ursula; Schunke, Odette; Feldheim, Jan; Gerloff, Christian et al. (2014): Action inhibition in Tourette syndrome. In: Mov Disord. 29 (12), S. 1532–1538. DOI: 10.1002/mds.25944.

Ghahremani, Dara G.; Lee, Buyean; Robertson, Chelsea L.; Tabibnia, Golnaz; Morgan, Andrew T.; Shetler, Natalie de et al. (2012): Striatal Dopamine D2/D3 Receptors Mediate Response Inhibition and Related Activity in Frontostriatal Neural Circuitry in Humans. In: The Journal of Neuroscience 32 (21), S. 7316. DOI: 10.1523/JNEUROSCI.4284-11.2012.

Harlé, Katia M.; Zhang, Shunan; Ma, Ning; Yu, Angela J.; Paulus, Martin P. (2016): Reduced Neural Recruitment for Bayesian Adjustment of Inhibitory Control in Methamphetamine Dependence. In: Biological Psychiatry: Cognitive Neuroscience and Neuroimaging 1 (5), S. 448–459. DOI: 10.1016/j.bpsc.2016.06.008.

Hendrick, Olivia M.; Ide, Jaime S.; Luo, Xi; Li, Chiang-Shan R. (2010): Dissociable Processes of Cognitive Control during Error and Non-Error Conflicts: A Study of the Stop Signal Task. In: PLOS ONE 5 (10), e13155. DOI: 10.1371/journal.pone.0013155.

Hughes, Matthew Edward; Fulham, William Ross; Johnston, Patrick James; Michie, Patricia Therese (2012): Stop-signal response inhibition in schizophrenia: Behavioural, event-related potential and functional neuroimaging data. In: Biological Psychology 89 (1), S. 220–231. DOI: 10.1016/j.biopsycho.2011.10.013.

Hughes, Matthew Edward; Johnston, Patrick James; Fulham, William Ross; Budd, Timothy William; Michie, Patricia Therese (2013): Stop-signal task difficulty and the right inferior frontal gyrus. In: Behavioural Brain Research 256, S. 205–213. DOI: 10.1016/j.bbr.2013.08.026.

Jahfari, Sara; Verbruggen, Frederick; Frank, Michael J.; Waldorp, Lourens J.; Colzato, Lorenza; Ridderinkhof, K. Richard; Forstmann, Birte U. (2012): How Preparation Changes the Need for Top–Down Control of the Basal Ganglia When Inhibiting Premature Actions. In: The Journal of Neuroscience 32 (32), S. 10870. DOI: 10.1523/JNEUROSCI.0902-12.2012.

Jahfari, Sara; Waldorp, Lourens; Ridderinkhof, K. Richard; Scholte, H. Steven (2015): Visual Information Shapes the Dynamics of Corticobasal Ganglia Pathways during Response Selection and Inhibition. In: Journal of Cognitive Neuroscience 27 (7), S. 1344–1359. DOI: 10.1162/jocn_a_00792.

Jahfari, Sara; Waldorp, Lourens; van den Wildenberg, Wery P. M.; Scholte, H. Steven; Ridderinkhof, K. Richard; Forstmann, Birte U. (2011): Effective Connectivity Reveals Important Roles for Both the Hyperdirect (Fronto-Subthalamic) and the Indirect (Fronto-Striatal-Pallidal) Fronto-Basal Ganglia Pathways during Response Inhibition. In: The Journal of Neuroscience 31 (18), S. 6891. DOI: 10.1523/JNEUROSCI.5253-10.2011.

Kenner, Naomi M.; Mumford, Jeanette A.; Hommer, Rebecca E.; Skup, Martha; Leibenluft, Ellen; Poldrack, Russell A. (2010): Inhibitory Motor Control in Response Stopping and Response Switching. In: The Journal of Neuroscience 30 (25), S. 8512. DOI: 10.1523/JNEUROSCI.1096-10.2010.

Ko, Li-Wei; Shih, Yi-Cheng; Chikara, Rupesh Kumar; Chuang, Ya-Ting; Chang, Erik C. (2016): Neural Mechanisms of Inhibitory Response in a Battlefield Scenario: A Simultaneous fMRI-EEG Study. In: Frontiers in Human Neuroscience 10, S. 185. DOI: 10.3389/fnhum.2016.00185.

Lavallee, Christina F.; Herrmann, Christoph S.; Weerda, Riklef; Huster, René J. (2014): Stimulus-Response Mappings Shape Inhibition Processes: A Combined EEG-fMRI Study of Contextual Stopping. In: PLOS ONE 9 (4), e96159. DOI: 10.1371/journal.pone.0096159.

Lenartowicz, Agatha; Verbruggen, Frederick; Logan, Gordon D.; Poldrack, Russell A. (2011): Inhibition-related Activation in the Right Inferior Frontal Gyrus in the Absence of Inhibitory Cues. In: Journal of Cognitive Neuroscience 23 (11), S. 3388–3399. DOI: 10.1162/jocn_a_00031.

Leung, Hoi-Chung; Cai, Weidong (2007): Common and Differential Ventrolateral Prefrontal Activity during Inhibition of Hand and Eye Movements. In: The Journal of Neuroscience 27 (37), S. 9893. DOI: 10.1523/JNEUROSCI.2837-07.2007.

Leunissen, Inge; Coxon, James P.; Swinnen, Stephan P. (2016): A proactive task set influences how response inhibition is implemented in the basal ganglia. In: Hum. Brain Mapp. 37 (12), S. 4706–4717. DOI: 10.1002/hbm.23338.

Lorenz, Robert C.; Gleich, Tobias; Buchert, Ralph; Schlagenhauf, Florian; Kühn, Simone; Gallinat, Jürgen (2015): Interactions between glutamate, dopamine, and the neuronal signature of response inhibition in the human striatum. In: Hum. Brain Mapp. 36 (10), S. 4031–4040. DOI: 10.1002/hbm.22895.

Marco-Pallarés, Josep; Camara, Estela; Münte, Thomas F.; Rodríguez-Fornells, Antoni (2008): Neural Mechanisms Underlying Adaptive Actions after Slips. In: Journal of Cognitive Neuroscience 20 (9), S. 1595–1610. DOI: 10.1162/jocn.2008.20117.

McNab, Fiona; Leroux, Gaëlle; Strand, Fredrik; Thorell, Lisa; Bergman, Sissela; Klingberg, Torkel (2008): Common and unique components of inhibition and working memory: An fMRI, within-subjects investigation. In: Neuropsychologia 46 (11), S. 2668–2682. DOI: 10.1016/j.neuropsychologia.2008.04.023.

Mohammadi, Bahram; Kollewe, Katja; Cole, David M.; Fellbrich, Anja; Heldmann, Marcus; Samii, Amir et al. (2015): Amyotrophic lateral sclerosis affects cortical and subcortical activity underlying motor inhibition and action monitoring. In: Hum. Brain Mapp. 36 (8), S. 2878–2889. DOI: 10.1002/hbm.22814.

Montojo, C. A.; Jalbrzikowski, M.; Congdon, E.; Domicoli, S.; Chow, C.; Dawson, C. et al. (2013): Neural Substrates of Inhibitory Control Deficits in 22q11.2 Deletion Syndrome†. In: Cerebral Cortex 25 (4), S. 1069–1079. DOI: 10.1093/cercor/bht304.

Rae, Charlotte L.; Hughes, Laura E.; Weaver, Chelan; Anderson, Michael C.; Rowe, James B. (2014): Selection and stopping in voluntary action: A meta-analysis and combined fMRI study. In: NeuroImage 86, S. 381–391. DOI: 10.1016/j.neuroimage.2013.10.012.

Rodríguez-Pujadas, Aina; Sanjuán, Ana; Fuentes, Paola; Ventura-Campos, Noelia; Barrós-Loscertales, Alfonso; Ávila, César (2014): Differential neural control in early bilinguals and monolinguals during response inhibition. In: Brain and Language 132, S. 43–51. DOI: 10.1016/j.bandl.2014.03.003.

Schel, Margot; Kühn, Simone; Brass, Marcel; Haggard, Patrick; Ridderinkhof, K. Richard; Crone, Eveline (2014): Neural correlates of intentional and stimulus-driven inhibition: a comparison. In: Frontiers in Human Neuroscience 8, S. 27. DOI: 10.3389/fnhum.2014.00027.

Sebastian, A.; Baldermann, C.; Feige, B.; Katzev, M.; Scheller, E.; Hellwig, B. et al. (2013a): Differential effects of age on subcomponents of response inhibition. In: Neurobiology of Aging 34 (9), S. 2183–2193. DOI: 10.1016/j.neurobiolaging.2013.03.013.

Sebastian, A.; Pohl, M. F.; Klöppel, S.; Feige, B.; Lange, T.; Stahl, C. et al. (2013b): Disentangling common and specific neural subprocesses of response inhibition. In: NeuroImage 64, S. 601–615. DOI: 10.1016/j.neuroimage.2012.09.020.

Sebastian, Alexandra; Gerdes, Birthe; Feige, Bernd; Klöppel, Stefan; Lange, Thomas; Philipsen, Alexandra et al. (2012): Neural correlates of interference inhibition, action withholding and action cancelation in adult ADHD. In: Psychiatry Research: Neuroimaging 202 (2), S. 132–141. DOI: 10.1016/j.pscychresns.2012.02.010.

Sebastian, Alexandra; Rössler, Kora; Wibral, Michael; Mobascher, Arian; Lieb, Klaus; Jung, Patrick; Tüscher, Oliver (2017): Neural Architecture of Selective Stopping Strategies: Distinct Brain Activity Patterns Are Associated with Attentional Capture But Not with Outright Stopping. In: The Journal of Neuroscience 37 (40), S. 9785. DOI: 10.1523/JNEUROSCI.1476-17.2017.

Sharp, D. J.; Bonnelle, V.; Boissezon, X. de; Beckmann, C. F.; James, S. G.; Patel, M. C.; Mehta, M. A. (2010): Distinct frontal systems for response inhibition, attentional capture, and error processing. In: Proceedings of the National Academy of Sciences 107 (13), S. 6106. DOI: 10.1073/pnas.1000175107.

Swann, Nicole C.; Cai, Weidong; Conner, Christopher R.; Pieters, Thomas A.; Claffey, Michael P.; George, Jobi S. et al. (2012): Roles for the pre-supplementary motor area and the right inferior frontal gyrus in stopping action: Electrophysiological responses and functional and structural connectivity. In: NeuroImage 59 (3), S. 2860–2870. DOI: 10.1016/j.neuroimage.2011.09.049.

Tabu, Hayato; Mima, Tatsuya; Aso, Toshihiko; Takahashi, Ryosuke; Fukuyama, Hidenao (2011): Functional relevance of pre-supplementary motor areas for the choice to stop during Stop signal task. In: Neuroscience Research 70 (3), S. 277–284. DOI: 10.1016/j.neures.2011.03.007.

Tabu, Hayato; Mima, Tatsuya; Aso, Toshihiko; Takahashi, Ryosuke; Fukuyama, Hidenao (2012): Common inhibitory prefrontal activation during inhibition of hand and foot responses. In: NeuroImage 59 (4), S. 3373–3378. DOI: 10.1016/j.neuroimage.2011.10.092.

van der Meer, Lisette; Groenewold, Nynke A.; Pijnenborg, Marieke; Aleman, André (2013): Psychosis-Proneness and Neural Correlates of Self-Inhibition in Theory of Mind. In: PLOS ONE 8 (7), e67774. DOI: 10.1371/journal.pone.0067774.

van Eijk, Julia; Sebastian, Alexandra; Krause-Utz, Annegret; Cackowski, Sylvia; Demirakca, Traute; Biedermann, Sarah V. et al. (2015): Women with borderline personality disorder do not show altered BOLD responses during response inhibition. In: Psychiatry Research: Neuroimaging 234 (3), S. 378–389. DOI: 10.1016/j.pscychresns.2015.09.017.

Wilbertz, Tilmann; Deserno, Lorenz; Horstmann, Annette; Neumann, Jane; Villringer, Arno; Heinze, Hans-Jochen et al. (2014): Response inhibition and its relation to multidimensional impulsivity. In: NeuroImage 103, S. 241–248. DOI: 10.1016/j.neuroimage.2014.09.021.

Xu, Benjamin; Levy, Sarah; Butman, John; Pham, Dzung; Cohen, Leonardo G.; Sandrini, Marco (2015): Effect of foreknowledge on neural activity of primary “go” responses relates to response stopping and switching. In: Frontiers in Human Neuroscience 9, S. 34. DOI: 10.3389/fnhum.2015.00034.

Xu, Kitty Z.; Anderson, Brian A.; Emeric, Erik E.; Sali, Anthony W.; Stuphorn, Veit; Yantis, Steven; Courtney, Susan M. (2017): Neural Basis of Cognitive Control over Movement Inhibition: Human fMRI and Primate Electrophysiology Evidence. In: Neuron 96 (6), 1447-1458.e6. DOI: 10.1016/j.neuron.2017.11.010.

Xue, Gui; Aron, Adam R.; Poldrack, Russell A. (2008): Common Neural Substrates for Inhibition of Spoken and Manual Responses. In: Cerebral Cortex 18 (8), S. 1923–1932. DOI: 10.1093/cercor/bhm220.

Zandbelt, Bram B.; van Buuren, Mariët; Kahn, René S.; Vink, Matthijs (2011): Reduced Proactive Inhibition in Schizophrenia Is Related to Corticostriatal Dysfunction and Poor Working Memory. In: Biological Psychiatry 70 (12), S. 1151–1158. DOI: 10.1016/j.biopsych.2011.07.028.

Zandbelt, Bram B.; Vink, Matthijs (2010): On the Role of the Striatum in Response Inhibition. In: PLOS ONE 5 (11), e13848. DOI: 10.1371/journal.pone.0013848.

Zheng, Dongming; Oka, Tatsuro; Bokura, Hirokazu; Yamaguchi, Shuhei (2008): The Key Locus of Common Response Inhibition Network for No-go and Stop Signals. In: Journal of Cognitive Neuroscience 20 (8), S. 1434–1442. DOI: 10.1162/jocn.2008.20100.

Table S10: Brain regions showing significant convergence of activity for the go/no-go task independent of task complexity

Cluster/Macroanatomical Structure	x	y	z	Cytoarchitectonic location	z-score
Cluster 1 (998 voxels)					
Right inferior parietal lobe	52	-52	30	Area PGa	5.54
Right intraparietal sulcus	30	-62	52	Area hIP3	5.42
Right intraparietal sulcus	42	-44	48	Area hIP2	5.32
Right intraparietal sulcus	48	-34	42		4.8
Right intraparietal sulcus	36	-56	46	Area hIP1	4.61
Right inferior parietal lobe	62	-44	34	Area PFm	4.11
Right inferior parietal lobe	54	-48	16	Area PGa	4.04
Right inferior parietal lobe	56	-44	24	Area PFm	3.46
Cluster 2 (683 voxels)					
Right anterior insula	34	22	-6		6.12
Right anterior insula	30	16	-12		5.19
Right inferior frontal gyrus	46	20	-2	Area 45	4.74
Right putamen	24	6	4		4.1
Right putamen	26	8	2		4.04
Right frontal operculum	36	20	8	Area OP8	3.42
Right frontal operculum	40	22	10	Area OP9	3.24
Cluster 3 (567 voxels)					
Right mid-dorsolateral prefrontal cortex	42	42	18		5.99
Right mid-dorsolateral prefrontal cortex	36	40	28		4.82
Right mid-dorsolateral prefrontal cortex	44	32	30		4.72
Right mid-dorsolateral prefrontal cortex	50	28	26		4.54
Right frontal pole	32	46	16		3.93
Cluster 4 (367 voxels)					
Left putamen	-24	12	2		5.61
Left anterior insula	-32	16	-6		4.79
Cluster 5 (246 voxels)					
Right superior temporal sulcus	60	-30	0		4.68
Right superior temporal sulcus	52	-24	-2		4.44
Right middle temporal gyrus	58	-48	-2		3.48
Right middle temporal gyrus	56	-40	0		3.17
Cluster 6 (238 voxels)					
Right pre-supplementary motor area	4	0	64	Area 6mr / preSMA	5.19
Right pre-supplementary motor area	6	12	58	Area 6mr / preSMA	5.1
Right supplementary motor area	-6	-6	64	Area 6mc / SMA	4.73

Cluster 7 (233 voxels)					
Right inferior frontal junction	42	4	42		4.33
Right inferior frontal junction	42	8	38		4.1
Right inferior frontal junction	48	10	30		3.93
Right inferior frontal junction	54	4	42		3.66
Cluster 8 (197 voxels)					
Left intraparietal sulcus	-46	-38	44		5.4
Left intraparietal sulcus	-40	-48	48	Area hIP3	4.43
Cluster 9 (172 voxels)					
Right anterior midcingulate cortex	2	28	36		5.02
Right anterior midcingulate cortex	6	32	28		4.8
Cluster 10 (124 voxels)					
Left lateral occipital cortex	-48	-74	4	Area hOc4la	5.12
Cluster 11 (119 voxels)					
Left lateral occipital Cortex	-44	-64	-12	Area FG2	4.62
Left lateral occipital Cortex	-46	-54	-14	Area FG4	3.48
Left lateral occipital Cortex	-48	-54	-14	Area FG4	3.48
Left lateral occipital Cortex	-46	-54	-12	Area FG4	3.48
Cluster 12 (116 voxels)					
Left inferior parietal lobe	-58	-46	28		4.59
Left inferior parietal lobe	-64	-44	34		3.49

Table S11: Brain regions showing significant convergence of activity for the standard go/no-go task

Cluster/Macroanatomical Structure	x	y	z	Cytoarchitectonic location	z-score
Cluster 1 (169 voxels)					
Right superior temporal sulcus	54	-26	-4		4.46
Right superior temporal sulcus	60	-30	0		4.43
Cluster 2 (163 voxels)					
Left lateral occipital Cortex	-50	-74	4	Area hOc4la	5.33
Cluster 3 (123 voxels)					
Right lateral occipital Cortex	48	-72	-2	Area hOc4la	5.71
Right lateral occipital Cortex	44	-74	-12	Area hOc4la	3.68
Cluster 4 (123 voxels)					
pre-supplementary motor area	4	0	64	Area 6mr/ preSMA	5.06
supplementary motor area	-6	-6	64	Area 6mc/ SMA	4.5
Cluster 5 (109 voxels)					
Right inferior parietal lobe	52	-52	30	Area PGa	5.1
Cluster 6 (85 voxels)					
Right anterior insula	32	18	-14		4.53
Right anterior insula	22	14	-14		3.16
Right anterior insula	20	16	-12		3.11

Table S12: Brain regions showing significant convergence of activity for the complex go/no-go task

Cluster/Macroanatomical Structure	x	y	z	Cytoarchitectonic location	z-score
Cluster 1 (559 voxels)					
Right anterior insula	32	24	-6		6.04
Right putamen	26	10	0		4.07
Right putamen	28	12	-2		4.05
Right anterior insula	34	18	8	Area OP8	3.8
Cluster 2 (510 voxels)					
Right intraparietal sulcus	42	-44	48	Area hIP2	5.19
Right superior parietal lobe	28	-64	50		5.03
Right intraparietal sulcus	36	-56	46	Area hIP1	4.29
Right inferior parietal lobe	54	-38	44	Area PFm	4.26
Cluster 3 (357 voxels)					
Left anterior insula	-32	16	-4		5.13
Left putamen	-24	12	0		4.63
Cluster 4 (213 voxels)					
Right anterior midcingulate cortex	8	32	28		5.33
Right anterior midcingulate cortex	2	28	36		5.09
Cluster 5 (201 voxels)					
Right mid-dorsolateral prefrontal cortex	42	40	18		6.42
Right mid-dorsolateral prefrontal cortex	32	46	16		3.48
Cluster 6 (199 voxels)					
Left intraparietal sulcus	-46	-40	44		5.28
Left intraparietal sulcus	-42	-48	48	Area hIP3	4.62
Cluster 7 (172 voxels)					
Right inferior frontal junction	44	6	38		4.08
Right inferior frontal junction	42	2	42		4.08
Right inferior frontal junction	46	10	32		3.8
Cluster 8 (111 voxels)					
Right inferior frontal gyrus (pars opercularis)	54	14	14	Area 44	4.85
Cluster 9 (105 voxels)					
Right anterior dorsolateral prefrontal cortex/ frontal pole	36	56	-2		4.68

Table S13: Brain regions showing significant convergence of activity for the stop-signal task independent of task complexity

Cluster/Macroanatomical Structure	x	y	z	Cytoarchitectonic location	z-score
Cluster 1 (2331 voxels)					
Right anterior insula	34	20	-2		8.34
Right inferior frontal gyrus (pars opercularis)	52	18	6	Area 44	6.22
Right inferior frontal gyrus (pars opercularis)	52	16	18	Area 44	6.05
Right inferior frontal junction	42	8	32		5.4
Right dorsal premotor cortex	48	6	48		4.88
Right dorsal premotor cortex	40	2	54		4.8
Right dorsal premotor cortex	38	2	54		4.8
Right inferior frontal gyrus (pars triangularis)	48	36	-2		4.31
Right middle frontal gyrus	46	26	30		4.19
Right inferior frontal gyrus (pars triangularis)	50	28	4	Area 45	4.09
Cluster 2 (1364 voxels)					
Right anterior midcingulate cortex	6	26	34		8.27
pre-supplementary motor area	4	14	48		7.44
Right superior frontal gyrus	12	14	60	Area 6d2	6.66
pre-supplementary motor area	-4	8	50		4.28
Cluster 3 (1323 voxels)					
Right inferior parietal lobe	64	-44	16	Area PGa	7.29
Right inferior parietal lobe	62	-42	8		7.23
Right inferior parietal lobe	58	-44	28	Area PFm	6.11
Right intraparietal sulcus	48	-42	40	Area hIP1	5.63
Right inferior parietal lobe	48	-42	42	Area hIP2	5.63
Right superior temporal sulcus	50	-24	-8		4.61
Right superior temporal sulcus	48	-26	-6		4.57
Cluster 4 (1067 voxels)					
Left inferior parietal lobe	-60	-46	34	Area PF	7.45
Left inferior parietal lobe	-54	-50	12		5.58
Left middle temporal gyrus	-58	-58	10		5.36
Left inferior parietal lobe	-52	-54	48	Area PFm	4.18
Left middle temporal gyrus	-60	-58	0		3.71
Left intraparietal sulcus	-42	-52	50	Area hIP2	3.37
Cluster 5 (821 voxels)					
Left anterior insula	-32	20	2	Area Id7	8.31
Cluster 6 (511 voxels)					
Right caudate	12	8	6		7.4
Right thalamus	10	-8	4		5.95
Right thalamus	8	-12	-2		5.88

Right thalamus	4	-24	-4		5.04
Right thalamus	8	-18	8		3.52
Cluster 7 (365 voxels)					
Right mid-dorsolateral prefrontal cortex	38	42	26		4.79
Right anterior-dorsolateral prefrontal cortex/ frontal pole	26	52	26		4.4
Right anterior-dorsolateral prefrontal cortex/ frontal pole	18	60	20		4.11
Cluster 8 (137 voxels)					
Left inferior frontal junction	-40	2	34		4.48
Left inferior frontal junction	-44	6	30		4.37

Table S14: Brain regions showing significant convergence of activity for the standard stop-signal task

Cluster/Macroanatomical Structure	x	y	z	Cytoarchitectonic location	z-score
Cluster 1 (1218 voxels)					
Right anterior insula	36	20	-2	Area Id7	7.78
Right inferior frontal gyrus (pars opercularis)	50	16	18	Area 44	6.05
Right inferior frontal gyrus (pars opercularis)	52	16	2	Area 44	4.03
Cluster 2 (594 voxels)					
Left anterior insula	-38	16	-4		8.25
Left anterior insula	-32	18	2		7.99
Cluster 3 (543 voxels)					
Right anterior midcingulate cortex	6	24	36		5.65
pre-supplementary motor area	4	16	48		5.34
Right superior frontal gyrus	12	14	62	Area 6d2	4.58
Cluster 4 (540 voxels)					
Right inferior parietal lobe	64	-42	16	Area PF	5.8
Right inferior parietal lobe	62	-44	6		4.48
Right superior temporal gyrus	62	-32	6		4.38
Right superior temporal sulcus	52	-28	0		4.05
Right superior temporal sulcus	52	-22	-6		3.83
Right superior temporal sulcus	52	-22	-4		3.83
Right inferior parietal lobe	64	-40	28	Area PF	3.43
Cluster 5 (349 voxels)					
Left inferior parietal lobe	-60	-46	32	Area PFcm	5.6
Left inferior parietal lobe	-52	-54	48	Area PFm	4.81
Left intraparietal sulcus	-52	-44	46	Area hIP2	3.54
Left intraparietal sulcus	-52	-44	48	Area hIP2	3.54
Cluster 6 (288 voxels)					
Left middle temporal gyrus	-58	-60	10		5.05
Left middle temporal gyrus	-60	-58	0		4.35
Left inferior parietal lobe	-62	-48	10		3.85
Cluster 7 (190 voxels)					
Right dorsal premotor cortex	38	2	54		4.45
Right dorsal premotor cortex	48	6	46		4.28
Right dorsal premotor cortex	48	12	50		3.83
Cluster 8 (126 voxels)					
Right dorsolateral prefrontal cortex	34	48	22		4.47

Cluster 9 (106 voxels)					
Right caudate	12	8	6		6.32
Cluster 10 (105 voxels)					
Right intraparietal sulcus	48	-42	42	Area hIP2	5.75

Table S15: Brain regions showing significant convergence of activity for the complex stop-signal task

Cluster/Macroanatomical Structure	x	y	z	Cytoarchitectonic location	z-score
Cluster 1 (1015 voxels)					
Right anterior midcingulate cortex	6	26	34		6.5
Right anterior midcingulate cortex	6	16	44		5.75
Right superior frontal gyrus	12	14	60	Area 6d2	4.96
Right superior frontal gyrus	16	8	68	Area 6d2	4.67
pre-supplementary motor area	-6	8	48	Area 6mr/ preSMA	4.46
Right superior frontal gyrus	22	-4	62	Area 6d3	3.93
Cluster 2 (670 voxels)					
Right anterior insula	34	20	-2		8.04
Right inferior frontal gyrus (pars opercularis)	54	20	6	Area 44	5.35
Cluster 3 (670 voxels)					
Right inferior parietal lobe	58	-44	28	Area PFm	6.39
Right inferior parietal lobe	62	-40	8		6.25
Right inferior parietal lobe	62	-44	16	Area PGa	4.9
Cluster 4 (479 voxels)					
Left inferior parietal lobe	-60	-50	30		5.6
Left inferior parietal lobe	-58	-46	38	Area PF	5.25
Left inferior parietal lobe	-56	-46	42	Area PFm	5.24
Left inferior parietal lobe	-60	-54	18		4.58
Left inferior parietal lobe	-54	-48	10		4.21
Left inferior parietal lobe	-64	-40	28	Area PF	3.3
Cluster 5 (430 voxels)					
Left anterior insula	-32	20	0	Area Id7	6.07
Left anterior insula	-34	18	-8		5.29
Left anterior insula	-34	20	-8		5.29
Left frontal operculum	-44	20	2	Area OP8	3.93
Cluster 6 (259 voxels)					
Right thalamus	6	-14	-4		5.55
Right thalamus	10	-8	6		5.09
Right thalamus	4	-24	-6		4.05
Cluster 7 (146 voxels)					
Left precentral gyrus	-42	0	34		4.71
Left inferior frontal junction	-44	4	30		4.63
Cluster 8 (118 voxels)					
Right inferior frontal junction	48	10	30		4.08
Right inferior frontal junction	48	26	32		3.33

Supplementary Methods

Meta-analytic contrast analysis: Differences between tasks (e.g., standard go/no-go task vs. standard stop-signal task) were tested by first performing separate ALE analyses for either task and then computing the voxel-wise difference between the ensuing ALE maps. All experiments that contributed to either analysis were then combined and randomly divided into two groups of the same size as the two original sets of experiments (Eickhoff et al., 2011). Then, the ALE scores for these two randomly assembled groups were calculated and the difference between these ALE scores was recorded for each voxel in the brain. Repeating this process 25,000 times yielded a null-distribution of differences in ALE scores between the two conditions. The "true" difference in ALE scores was then tested against this voxel-wise null-distribution of label exchangeability and thresholded at $P > 95\%$ for true differences. Surviving voxels were inclusively masked by the respective main effect, i.e. the significant effect of the ALE analysis for the minuend (Langner and Eickhoff, 2013; Rottschy et al., 2012).

Supplementary Figures

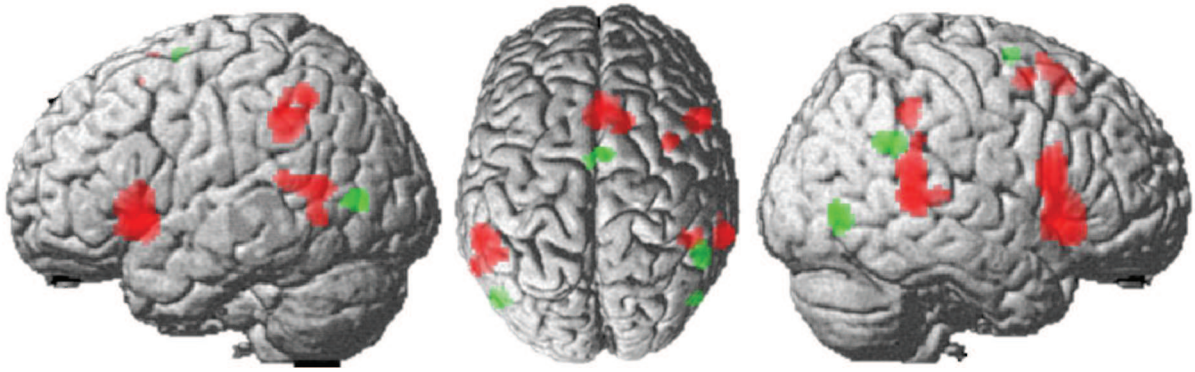

Figure S1:

Meta-analytic contrast analysis between standard event-related go/no-go task experiments (in green) versus standard event-related stop-signal task experiments (in red). The contrast analysis between the standard task versions revealed stronger convergence for standard go/no-go task experiments in bilateral lateral occipital cortex, right inferior parietal lobe, and supplementary motor area. Conversely, stronger convergence for standard stop-signal task versions was found in bilateral temporoparietal junction extending into right inferior parietal lobe and middle temporal gyrus, right intraparietal sulcus, bilateral anterior insula, right precentral gyrus, anterior midcingulate cortex, right superior frontal gyrus, and right caudate nucleus.

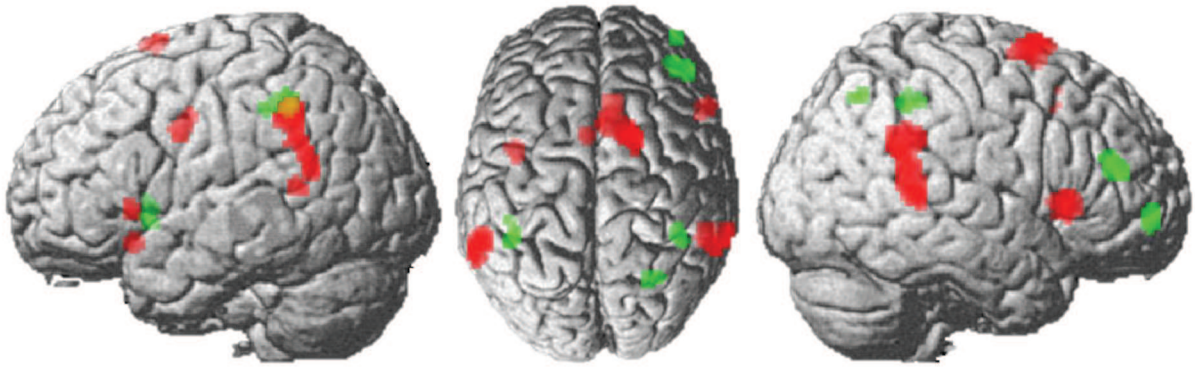

Figure S2:

Meta-analytic contrast analysis between complex event-related go/no-go task experiments (in green) and complex event-related stop-signal task experiments (in red). The contrast analysis between the complex task versions revealed stronger convergence for complex go/no-go task experiments in right anterior- and mid-dorsolateral prefrontal cortex, bilateral intraparietal sulcus, right superior lateral occipital cortex/ superior parietal lobule, and left putamen. Conversely, specific convergence for complex stop-signal task versions was found in bilateral anterior insula and right inferior frontal gyrus, anterior midcingulate cortex/ pre-supplementary motor area, bilateral temporoparietal junction, right superior frontal gyrus, left precentral gyrus, and right thalamus.

Supplementary references:

Eickhoff, Simon B.; Bzdok, Danilo; Laird, Angela R.; Roski, Christian; Caspers, Svenja; Zilles, Karl; Fox, Peter T. (2011): Co-activation patterns distinguish cortical modules, their connectivity and functional differentiation. In: NeuroImage 57 (3), S. 938–949. DOI: 10.1016/j.neuroimage.2011.05.021.

Langner, Robert; Eickhoff, Simon B. (2013): Sustaining attention to simple tasks: a meta-analytic review of the neural mechanisms of vigilant attention. In: Psychological bulletin 139 (4), S. 870–900. DOI: 10.1037/a0030694.

Rottschy, C.; Langner, R.; Dogan, I.; Reetz, K.; Laird, A. R.; Schulz, J. B. et al. (2012): Modelling neural correlates of working memory: a coordinate-based meta-analysis. In: NeuroImage 60 (1), S. 830–846. DOI: 10.1016/j.neuroimage.2011.11.050.

3 Diskussion

In der vorliegenden Arbeit wurden mittels der bildgebenden, koordinatenbasierten, voxelweisen ALE Meta-Analyse die Unterschiede der neuronalen Netzwerke der klassischen und komplexen Varianten des GNGT und des SST sowie der Einfluss der Aufgabenkomplexität untersucht und überprüft, ob ein paradigmen-unspezifisches Inhibitionsnetzwerk identifizierbar ist. Zu diesem Zweck wurden fMRT-Studien eingeschlossen, die den SST und GNGT untersucht haben. Die eingeschlossenen Studien wurden als klassische und komplexe Aufgabenvarianten kategorisiert. Als komplexe Varianten wurden solche Experimente kategorisiert, die durch ihr Design zum Beispiel eine verstärkte Rekrutierung des Arbeitsgedächtnisses oder anderer kognitiver Prozesse fördern oder Stimuli mit besonders emotional-sozialen Inhalt verwenden, wie z.B. Bomben, Superhelden oder Gesichter. Als klassisch wurden solche Experimente kategorisiert, die die Standardversion des GNGT und SST mit klassischen Stimuli wie Buchstaben oder geometrischen Figuren ohne emotional-soziale Inhalte verwenden. Meta-Analysen wurden sowohl für die klassischen als auch für die komplexen Varianten des GNGT und SST durchgeführt und miteinander verglichen.

Obwohl vorangegangene fMRT-Studien und Meta-Analysen den SST und GNGT oft als gleichwertig betrachten, zeigen die Ergebnisse der Meta-Analysen, dass die klassischen GNGT-Varianten überwiegend heteromodale und *„low-level“* Hirnregionen außerhalb des MDN rekrutierten, während die klassischen SST-Varianten konsistent die Regionen des MDN aktivierten. Erst in der Meta-Analyse der komplexen GNGT-Varianten zeigte sich Konvergenz in den typischen Regionen des MDN. Zwischen den klassischen und komplexen SST-Varianten konnten dagegen nur geringe Unterschiede gefunden werden.

3.1 Unterschiede der Netzwerke der klassischen und komplexen Aufgabenvarianten des GNGT und SST

Die Ergebnisse der Meta-Analyse zeigen deutliche Unterschiede in der neuronalen Rekrutierung zwischen den klassischen und der komplexen Varianten des GNGT. In der Meta-Analyse der klassischen Versionen wurden die rechte aI, das preSMA, der rechte IPC, der STS und der bilaterale LOC konsistent aktiviert. Abgesehen von der rechten aI und des preSMA gehören diese Regionen nicht dem fronto-insulo-parietalen Multiple Demand Netzwerk an, welches typischerweise bei der Ausführung von Exekutivfunktionen aktiviert wird.

Erst in der Meta-Analyse der komplexen GNGT-Varianten zeigte sich eine Rekrutierung des typischen MDN mit Konvergenz des rechten IFG, des rechten DLPFC, der rechten IFJ, der bilateralen aI, des bilateralen IPS, des aMCC sowie des rechten SPL.
Diese Ergebnisse spiegeln damit die Resultate einer vorangegangen Meta-Analyse mit einer geringen Anzahl an eingeschlossenen Experimenten wider, welche für die klassischen GNGT-Experimente lediglich Konvergenz in dem rechten preSMA, im rechten Precuneus und im bilateralen Okzipitalcortex berichtete, wohingegen die Meta-Analyse der komplexen GNGT-Variante Konvergenz in einem rechts-lateralisierten fronto-insulo-parietalen Netzwerk zeigte (Simmonds et al., 2008). Eine weitere Meta-Analyse von Criaud und Boulinguez (Criaud und Boulinguez, 2013), welche den Einfluss von verschiedenen Faktoren der Komplexität (Stimuluskomplexität, Wahrscheinlichkeit von No-Go-Signalen, Belastung des Arbeitsgedächtnisses) auf den GNGT untersuchte, zeigte bereits zudem, dass ein Großteil der parietalen und präfrontalen Hirnregionen, welche typischerweise durch den GNGT rekrutiert werden, nicht auf die Ausführung von Inhibitionsprozessen spezialisiert sind. Stattdessen werden diese Regionen vor allem mit allgemeineren Funktionen wie Aufmerksamkeitsprozessen oder der Informationsaufrechterhaltung im Arbeitsgedächtnis assoziiert und nicht mit der Inhibitionskontrolle per se (Criaud und Boulinguez, 2013).

Diese Ergebnisse stehen jedoch im Gegensatz zu den meisten anderen Meta-Analysen, die die neuronalen Korrelate des GNGT untersucht haben und durchgängig von einem umfassenden fronto-insulo-parietalen Netzwerk berichten (z.B. Swick et al. 2011, Hung et al., 2018; Cieslik et al. 2015). Diese abweichenden Ergebnisse können jedoch dadurch erklärt werden, dass die zuvor genannten Meta-Analysen bei den eingeschlossenen Studien nicht zwischen klassischen und komplexen Varianten unterschieden haben, so dass die Konvergenz der fronto-insulo-parietalen Regionen durch den Einfluss der erhöhten Aufgabenkomplexität der komplexen GNGT-Versionen erklärt werden kann. Dies spiegelt sich auch in der vorliegenden Arbeit in den Ergebnissen der generellen Meta-Analyse, die alle vorhandenen GNGT-Experimente einschließt, wider, welche unter anderem Konvergenz im rechten DLPFC, der rechten IFJ, der bilateralen aI sowie dem bilateralen IPS und IPC zeigte.
Insgesamt zeigt die vorliegende Arbeit, dass die meisten Regionen des MDN nicht von den klassischen, sondern nur von den komplexen GNGT-Varianten rekrutiert werden.

Die Meta-Analysen des klassischen und komplexen SST zeigte demgegenüber eine deutlich überlappende Konvergenz von fronto-insulo-parietalen Hirnregionen, welche zum MDN gehören. So zeigte bereits die Meta-Analyse der klassischen SST-Variante eine konsistente Aktivierung des rechten IFG, des rechten DLPFC, der bilateralen aI, des linken IPC und des rechten IPS. Ein Vergleich mit den Ergebnissen aus vorherigen Meta-Analysen ist dabei nicht möglich, da keine der vorherigen durchgeführten Studien die klassischen und komplexen SST-Varianten miteinander verglichen hat. Jedoch zeigte eine vorangegangene EEG-Studie, dass sowohl klassische als auch komplexe SST-Varianten dasselbe Inhibitionsnetzwerk aktivieren (Wessel und Aron, 2014).

Zusammenfassend zeigen die Ergebnisse der Meta-Analyse, dass die klassischen Varianten des GNGT überwiegend basale und heteromodale Hirnregionen konsistent rekrutieren und dass das vollständige MDN nur in der Meta-Analyse der komplexen Varianten des GNGT rekrutiert wurde. Im Gegensatz dazu zeigte die Meta-Analyse der SST-Varianten, dass sowohl die klassischen als auch die komplexen Varianten konsistent das MDN aktivieren.

3.2 Eignung des GNGT und des SST zur Untersuchung der motorischen Antwortsinhibition und der Einfluss der Aufgabenkomplexität

Trotz der Tatsache, dass vorangegangene Meta-Analysen und Bildgebungsstudien die GNGT- und SST-Paradigmen bisher oft als vollkommen gleichwertig bzw. austauschbar behandelt haben, zeigen die Ergebnisse der Meta-Analysen des GNGT und SST deutliche Unterschiede hinsichtlich des Einflusses der Aufgabenkomplexität und in der Rekrutierung der Hirnregionen, insbesondere bei den Standardvarianten.

Während die klassischen SST-Varianten die typischen Regionen des MDN rekrutieren, besteht das Netzwerk des klassischen GNGT schwerpunktmäßig aus heteromodalen bzw. *„low-level*" Hirnregionen, was darauf schließen lässt, dass diese beiden Paradigmen auf grundlegend unterschiedlichen Mechanismen beruhen.
Bereits in vorangegangen Verhaltensstudien wurde berichtet, dass der Inhibitionsmechanismus beim klassischen GNGT nach einiger Zeit automatisiert ablaufen kann, da beim GNGT eine feste Stimulus-Antwort-Verknüpfung verwendet wird, welche nach entsprechender Übung automatisch abgerufen wird (Verbruggen und Logan, 2008a; Verbruggen et al., 2014). Somit werden keine stärkeren Kontrollprozesse zum Ablauf benötigt, was zu einer weniger starken Rekrutierung von Regionen des MDN führt. Die eingeschlossenen Experimente in der Meta-Analyse der klassischen GNGT-Varianten verwendeten zum Großteil einen festen Go-Stimulus sowie einen festen No-Go-Stimulus, wodurch in diesen Studiendesigns schnell eine konsistente Stimulus-Antwort-Verknüpfung gebildet werden konnte, welche den Ablauf von automatischen Prozessen ermöglichte.
Eine weitere EEG-Studie, welche einen GNGT mit konsistenter Stimulus-Antwort-Verknüpfung nutzte, um den Einfluss variierender Stimulus-Stimulus-Intervallen und unterschiedlich hoher No-Go-Wahrscheinlichkeiten zu untersuchen, zeigte, dass nur ein schnell getaktetes Taskdesign mit niedriger No-Go-Wahrscheinlichkeit überhaupt eine starke motorische Antworttendenz

hervorrief (Wessel, 2017). Einfache, d.h. klassische, Aufgabendesigns des GNGT führten zu keiner vorherrschenden motorischen Antworttendenz, weshalb hier auch weniger starke inhibitorische Kontrolle in den No-Go-Durchgängen vonnöten war (Wessel, 2017). Dies legt nahe, dass Inhibitionsprozesse in den klassischen GNGT-Varianten in Abhängigkeit von der Konsistenz der Stimulus-Antwort-Verknüpfung, der Wahrscheinlichkeit von No-Go-Durchgängen als auch dem Stimulus-Stimulus-Intervall getriggert werden.

Zusammenfassend stellen diese Ergebnisse in Frage, ob die klassische GNGT-Version effektiv inhibitorische Kontrolle testet. So kann die Verknüpfung des No-Go-Stimulus mit der korrekten Antwort, in diesem Fall das Ausbleiben einer motorischen Reaktion auf den Stimulus, automatisiert ablaufen sobald eine feste Stimulus-Antwort-Verknüpfung gebildet wurde. Infolgedessen ist für die richtige Antwort keine höhere inhibitorische Kontrolle notwendig. Erst in den komplexen GNGT-Varianten werden diese kognitive Kontrollprozesse notwendig, weshalb erst hier das typische fronto-insulo-parietalen Netzwerk des MDN rekrutiert wurde.

Die klassische SST-Variante dagegen rekrutierte das MDN bereits in seiner Gänze. Im Gegensatz zum Aufgabendesign des GNGT wird beim SST ein Treppenmodell angewendet, um die Schwierigkeit bei jeden Durchgang stets dynamisch anzupassen (Logan & Cowan, 1984). Dabei wird die Zeit zwischen dem "Go"-Signal und dem "Stop"-Signal, welche als Stop-Signal-Verzögerung (engl. *„stop signal delay“*, SSD) bezeichnet wird, individuell basierend auf der Leistung des Probanden angepasst.

Wenn ein Teilnehmer erfolgreich auf das Stop-Signal reagiert und seine bereits vorbereitete Antwort abricht, wird die Stop-Signal-Verzögerung in den folgenden Durchgängen verlängert, wodurch die Aufgabe schwieriger wird. Scheitert der Teilnehmer, wird die SSD verkürzt, was das Stoppen erleichtert (Logan & Cowan, 1984). Dieses adaptive Verfahren strebt ein Verhältnis an, bei dem die Probanden in etwa der Hälfte der Stop-Durchgänge erfolgreich ihre Reaktionen abbrechen. Durch dieses Design ist bereits in der klassischen SST-Variante durchwegs „top-down“ kontrollierte Inhibitionskontrolle notwendig, was sich in der konsistenten Rekrutierung der typischen Regionen des MDN in der Meta-Analyse der klassischen SST-Version widerspiegelt.

Gleichzeitig zeigten die Meta-Analysen über die klassischen und komplexen SST-Varianten jeweils nur geringe Unterschiede, was dafürspricht, dass im SST erhöhte Aufgabenkomplexität eine geringere Rolle spielt und dass das MDN bereits durch die klassische Variante in seiner Gänze rekrutiert wird. Vorangegangene Studien zum Einfluss der Aufgabenschwierigkeit auf die Rekrutierung des Multiple Demand Netzwerks haben zu unterschiedlichen Ergebnissen geführt. So sprechen einige Studien für quantitative Veränderungen innerhalb des MDN bei erhöhter Aufgabenschwierigkeit, während andere qualitative Veränderungen zeigen konnten (Crittenden and Duncan, 2014; Shashidhara et al., 2019). Bei der quantitativen Modulation kommt es zu einer Steigerung des Aktivierungsniveaus innerhalb des MDN als Reaktion auf die steigende Aufgabenschwierigkeit (Crittenden and Duncan, 2014). Wenn Aufgaben anspruchsvoller werden, steigt der Bedarf an kognitiven Ressourcen, was zu einer erhöhten Aktivität in den Regionen des MDN führt. Qualitative Modulationen spiegeln sich in der Aktivierung zusätzlicher, insbesondere weiter frontal gelegenen, Regionen bei erhöhter Aufgabenkomplexität wider (Shashidhara et al., 2019).
Die hier gefundenen nur geringen Unterschiede zwischen den Ergebnissen der klassischen und komplexen SST-Variante deuten darauf hin, dass eine erhöhte Aufgabenkomplexität das MDN vor allem quantitativ und weniger qualitativ moduliert.

Zusammengefasst zeigen die Ergebnisse der hier durchgeführten Meta-Analysen in Zusammenschau mit vorangegangenen Verhaltensstudien, dass die Inhibitionsprozesse beim GNGT zumindest bei konsistenter Stimulus-Antwort-Verknüpfung nach einem Lernprozess automatisch ablaufen, während Inhibition im SST kontinuierlich *„top-down“* kontrolliert erfolgt. Somit deuten diese Ergebnisse darauf hin, dass nur der SST effektiv motorische Antwortsinhibition (und weiter gefasst exekutive Funktionen) untersucht, während das jedoch für den klassischen GNGT fraglich erscheint.

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3.3 Gemeinsamkeiten der Netzwerke des GNGT und SST

Die Konjunktionsanalyse der klassischen GNGT- und SST-Varianten zeigte lediglich überlappende Konvergenz in der rechten, anterioren Insula und des rechten Sulcus temporalis superior.
Die anteriore Insula ist als Teil des ventralen Aufmerksamkeitsnetzwerks mit der Identifikation wichtiger sensorischer und emotionaler Informationen assoziiert und rekrutiert weitere Hirnregionen, die für die Ausführung der jeweiligen Aufgabe relevant sind bzw. deaktiviert auch ebendiese Hirnarale, wenn sie nicht (mehr) benötigt werden (Sridharan et al., 2008). Bereits in vorangegangen Meta-Analysen wurde gezeigt, dass die anteriore Insula in einer Vielzahl von verschiedenen Aufgabenmodellen abseits des SST und GNGT Konvergenz zeigt (Cieslik et al., 2015). Daraus lässt sich ableiten, dass die aI nicht per se die Ausführung von Inhibitionskontrolle vermittelt, sondern in Rahmen von generellen Kontrollprozessen rekrutiert wird, welche unter anderem auch für den geregelten Ablauf automatisch ablaufender Prozesse, wie sie nach einiger Zeit beim GNGT angewendet werden, zuständig sind.
Der STS ist eine Region, welche kaum mit Inhibitionsprozessen an sich oder anderen Exekutivfunktionen in Verbindung gebracht wird. Die Konjunktionsanalyse zeigte dabei vor allem Konvergenz im mittleren Anteil des STS (mid-STS, Erickson et al., 2017). Der mid-STS ist mit der Unterscheidung von sprachlichen und nicht-sprachlichen, auditiven Signalen sowie an der Verarbeitung von Buchstaben an sich assoziiert (Wilson et al., 2018; van Atteveldt et al., 2004; Raij et al., 2000). Da sowohl der GNGT als auch der SST in vielen Aufgabendesigns Buchstaben als Stimuli verwenden und No-Go- und Stop-Stimuli verhältnismäßig seltener dargeboten werden, könnte die gemeinsame Konvergenz innerhalb des mid-STS eine verstärkte Verarbeitung dieser Stimuli aufgrund höherer Salienz widerspiegeln.

In der Konjunktionsanalyse der komplexen GNGT- und SST-Varianten gab es dagegen überlappende Konvergenz in der bilateralen aI, dem aMCC und der rechten IFJ. Diese Hirnareale entsprechen dabei den Kernregionen des erweiterten MDN, welches selektiv weitere Hirnareale wie präfrontale, parietale

und subkortikale Regionen in Abhängigkeit spezifischer Aufgabenanforderungen aktiviert (Camilleri et al., 2018). Da es unterschiedliche Aufgabenanforderungen in den komplexen SST- und GNGT-Varianten gibt, würden nach der Theorie des erweiterten MDN unterschiedliche präfrontale, parietale und subkortikale Regionen durch den GNGT und SST rekrutiert werden, was erklären könnte wieso in der Konjunktionsanalyse keine weitere Überlappungen außerhalb der Kernregionen gefunden wurde.

Die bilaterale aI, der aMCC und die rechte IFJ übernehmen in ihrer Rolle als Kernregionen des erweiterten MDN vor allem Funktionen in Rahmen der übergeordneten Aufmerksamkeitskontrolle ein (Cieslik et al., 2015).

Die rechte aI übernimmt dabei Funktionen in Rahmen der Aufmerksamkeitskontrolle und Detektion salienter Stimuli (Sridharan et al., 2008), während die linke aI eine evaluierende Rolle einnimmt und bewertet, ob Verhaltensänderungen erforderlich sind (Kann et al., 2016; Späti et al., 2014). Dies wird bei den komplexen GNGT- und SST-Varianten insbesondere durch ihre vielseitigen Aufgabendesigns notwendig.

Der aMCC dagegen hat seine Hauptfunktion bei der Erkennung und Bewältigung von Konflikten auf einer höheren kognitiven Ebene (MacDonald et al., 2000; Botvinick et al., 2004; Cieslik et al., 2015), insbesondere durch die Identifikation und Anpassung widersprüchlicher Handlungspläne, welche sowohl in der klassischen und komplexen SST-Variante als auch bei der komplexen GNGT-Variante auftreten. Im Gegensatz dazu scheint, wie oben erwähnt, bei den klassischen GNGT-Varianten oftmals keine vorherrschende motorische Antworttendenz aufgebaut zu werden, die in Rahmen eines Inhibitionsprozesses identifiziert und unterdrückt werden müsste (Wessel, 2017), was erklären kann wieso keine überlappende Konvergenz des aMCC in der klassischen Variante des GNGT und SST gefunden wurde.

Die Beteiligung der rechten IFJ lässt sich durch ihre Rolle bei der ständigen Aktualisierung der relevanten, aber oftmals weniger dominanten Stimulus-Antwort-Verknüpfungen erklären (Cieslik et al., 2015). Dies ist besonders relevant, da in den komplexeren Varianten des GNGT und SST häufig kontextabhängige, variable Stimulus-Antwort-Verknüpfungen verwendet wurden (z.B. GNGT: Garavan et al., 1999; Hester et al., 2004a, b; SST: Lavallee et al., 2014). In einigen SST-Versionen wiesen zudem vorausgehende Signale die

Probanden auf variable Stopp-Wahrscheinlichkeiten hin, was ebenfalls eine flexible Anpassung der Reaktionsstrategie erforderlich machte (z.B. Zandbelt et al., 2010).

Zusammenfassend kann kein paradigmen-unspezifisches Inhibitionsnetzwerk gefunden werden, welches konsistent bei dem klassischen GNGT und SST involviert ist. Die komplexen GNGT und SST-Varianten rekrutieren dagegen beide konsistent die Kernregionen des erweiterten MDN, zeigen jedoch darüber hinaus unterschiedliche Rekrutierung weiterer präfrontaler, parietaler und subkortikaler Regionen des MDN, was als weiteren Hinweis auf die grundlegenden Unterschiede des GNGT und SST interpretiert werden kann.

3.4 Klinische Relevanz der Unterschiede des GNGT und SST

Da die vorliegenden Ergebnisse zeigen, dass nur der SST effektiv motorische Antwortsinhibition (und weiter gefasst exekutive Funktionen) untersucht, während das jedoch für den klassischen GNGT fraglich erscheint, hat dies erwartungsgemäß auch Auswirkungen auf die Interpretation von Verhaltensdaten des GNGT und SST. Darüber hinaus haben die Ergebnisse insbesondere auch hohe Relevanz für das Verständnis kognitiver Defizite bei Patienten mit neurologischen und psychiatrischen Erkrankungen.

So zeigen bekanntermaßen Patienten beispielweise mit Schizophrenie signifikant schlechtere Leistung im GNGT und SST im Vergleich zu gesunden Kontrollpersonen (Sun et al., 2021; Ertekin et al., 2017; Weisbrod et al., 2000).
In Anbetracht der Ergebnisse ist jedoch fraglich, ob die Leistungsdefizite im GNGT wirklich Schwierigkeiten in der Inhibitionskontrolle, oder vielmehr Probleme beim Erlernen und Beibehalten der richtigen Stimulus-Reaktions-Verknüpfungen widerspiegeln (Verbruggen und Logan, 2008a). Diese Interpretation wird durch Studien gestützt, die bei Probanden mit Schizophrenie eine Beeinträchtigungen des assoziativen Lernens fanden (Brambilla et al., 2011; Hall et al., 2009). Durch eine Beeinträchtigung des assoziativen Lernens würde es Probanden mit Schizophrenie schwerer fallen korrekte Stimulus-Reaktions-Verknüpfungen während des GNGT zu erlernen. Dies ist in Einklang mit Studien, die für den GNGT nicht nur schlechtere Performanz, sondern auch verlangsamte Reaktionszeiten für die Go-Antwort fanden (Sun et al., 2021). Ähnlich zeigen auch Probanden mit Aufmerksamkeitsdefizit-/Hyperaktivitätsstörung deutliche Leistungseinschränkungen im GNGT (Trommer et al., 1988; Wright et al., 2014). Neben Defiziten des assoziativen Lernens (Huang-Pollock et al., 2014) kommt es bei ADHS durch die Beeinträchtigung des dopaminergen und noradrenergen Systemen zu Einschränkungen der Aufrechterhaltung von Aufmerksamkeit als auch in der Verarbeitung von Belohnungen (Grimm et al., 2021a/b; Plichta and Scheres, 2014), welche die effektive Ausbildung automatischer Abläufe einschränken. Somit beruhen die Leistungseinschränkungen beim GNGT bei Probanden mit

AHDS sehr wahrscheinlich nicht allein auf verminderte Impulskontrolle, sondern auch in Schwierigkeiten beim Lernen aus Fehlern und Feedback.
Meta-analytische Studien zur Eignung des GNGT und SST zur Erfassung von Defiziten der Inhibitionsleistung bei Patienten mit neurologischen und psychiatrischen Erkrankungen haben zudem beim SST und GNGT jeweils unterschiedlich starke Ausprägungen von Leistungsdefiziten gezeigt (Wright et al., 2014; Lipszyc und Schachar, 2010).

So wird insgesamt deutlich, dass die Wahl zwischen dem GNGT und dem SST vor dem Hintergrund der unterschiedlichen Mechanismen der beiden Tests entscheidend für die präzise Charakterisierung von Defiziten der Exekutivfunktionen bei zugrundeliegenden neurologischen und psychiatrischen Erkrankungen ist.

3.5 Schlussfolgerungen

Der GNGT und SST wurden in vorangegangen fMRT-Studien und Meta-Analysen oft als gleichwertig betrachtet, trotz Evidenz aus Verhaltensstudien, die zeigen konnten, dass den beiden Aufgaben unterschiedliche Prozesse zu Grunde liegen. Zudem wurde über die Zeit eine große Vielfalt an Testdesigns beim GNGT und SST mit variabler Aufgabenkomplexität verwendet, was die Vergleichbarkeit der Ergebnisse vorangegangener fMRT-Studien zusätzlich erschwert.

Die Ergebnisse der vorliegenden Meta-Analyse zeigen, dass die klassischen Varianten des GNGT überwiegend Hirnregionen aktivieren, die nicht Teil des MDN sind. Die typischen MDN-Regionen werden erst in der Meta-Analyse der komplexen Variante des GNGT rekrutiert. Im Gegensatz dazu zeigen die Meta-Analysen des SST, dass sowohl die klassischen als auch die komplexen Aufgabenvarianten konsistent das MDN aktivieren.

In der Konjunktionsanalyse konnte kein paradigmen-unabhängiges Inhibitionsnetzwerk identifiziert werden, das sowohl beim klassischen GNGT als auch beim klassischen SST konsistent beteiligt ist. Demgegenüber zeigte die Konjunktionsanalyse über komplexen Varianten des GNGT und SST eine konsistente Aktivierung der Kernregionen des erweiterten MDN, jedoch fand sich keine Überlappung in weiteren präfrontalen, parietalen und subkortikalen Regionen des MDN, was ebenfalls auf grundlegende Unterschiede zwischen GNGT und SST hinweist.

Die geringen Unterschieden in der Konvergenz der Hirnregionen in den Meta-Analysen der klassischen und komplexen SST-Varianten lassen schlussfolgern, dass eine erhöhte Aufgabenkomplexität das MDN vor allem quantitativ und weniger qualitativ moduliert.

In Zusammenschau mit vorangegangen Verhaltensstudien und EEG-Studien legen diese Ergebnisse nahe, dass die Inhibitionsprozesse im GNGT nach einem Lernprozess zunehmend automatisiert ablaufen, während die Inhibition beim SST kontinuierlich durch *„top-down“*-Kontrolle erfolgt.

Zusammenfassend deuten die Ergebnisse darauf hin, dass nur der SST effektiv motorische Antwortsinhibition (und weiter gefasst exekutive Funktionen) testet, während dies für den klassischen GNGT jedoch fraglich erscheint.

4 Literaturverzeichnis

Ardila, A., Bernal, B., & Rosselli, M [Monica] (2018). Executive Functions Brain System: An Activation Likelihood Estimation Meta-analytic Study. Archives of Clinical Neuropsychology : The Official Journal of the National Academy of Neuropsychologists, 33(4), 379–405. https://doi.org/10.1093/arclin/acx066

Aron, A. R., & Poldrack, R. A. (2006). Cortical and Subcortical Contributions to Stop Signal Response Inhibition: Role of the Subthalamic Nucleus. The Journal of Neuroscience, 26(9), 2424. https://doi.org/10.1523/JNEUROSCI.4682-05.2006

Botvinick, M. M., Cohen, J. D., & Carter, C. S. (2004). Conflict monitoring and anterior cingulate cortex: An update. Trends in Cognitive Sciences, 8(12), 539–546. https://doi.org/10.1016/j.tics.2004.10.003

Brambilla, P., Cerruti, S., Bellani, M., Perlini, C., Ferro, A., Marinelli, V., Giusto, D., Tomelleri, L., Rambaldelli, G., Tansella, M., & Diwadkar, V. A. (2011). Shared impairment in associative learning in schizophrenia and bipolar disorder. Progress in Neuro-Psychopharmacology and Biological Psychiatry, 35(4), 1093–1099. https://doi.org/10.1016/j.pnpbp.2011.03.007

Cai, W., Ryali, S., Chen, T., Li, C.S. R., & Menon, V. (2014). Dissociable roles of right inferior frontal cortex and anterior insula in inhibitory control: Evidence from intrinsic and task-related functional parcellation, connectivity, and response profile analyses across multiple datasets. The Journal of Neuroscience : The Official Journal of the Society for Neuroscience, 34(44), 14652–14667. https://doi.org/10.1523/JNEUROSCI.3048-14.2014

Camilleri, J. A., Müller, V. I [V. I.], Fox, P., Laird, A. R [A. R.], Hoffstaedter, F., Kalenscher, T., & Eickhoff, S. B [S. B.] (2018). Definition and characterization of an extended multiple-demand network. NeuroImage, 165, 138–147. https://doi.org/10.1016/j.neuroimage.2017.10.020

Cieslik, E. C., Mueller, V. I., Eickhoff, C. R., Langner, R [Robert], & Eickhoff, S. B [Simon B.] (2015). Three key regions for supervisory attentional control: Evidence from neuroimaging meta-analyses. Neuroscience and Biobehavioral Reviews, 48, 22–34. https://doi.org/10.1016/j.neubiorev.2014.11.003

Clark, S. V., King, T. Z., & Turner, J. A. (2020). Cerebellar Contributions to Proactive and Reactive Control in the Stop Signal Task: A Systematic Review and Meta-Analysis of Functional Magnetic Resonance Imaging Studies. Neuropsychology Review, 30(3), 362–385. https://doi.org/10.1007/s11065-020-09432-w

Criaud, M., & Boulinguez, P. (2013). Have we been asking the right questions when assessing response inhibition in go/no-go tasks with fMRI? A meta-

analysis and critical review. Neuroscience and Biobehavioral Reviews, 37(1), 11–23. https://doi.org/10.1016/j.neubiorev.2012.11.003

Crittenden, B. M., & Duncan, J. (2014). Task Difficulty Manipulation Reveals Multiple Demand Activity but no Frontal Lobe Hierarchy. Cerebral Cortex, 24(2), 532–540. https://doi.org/10.1093/cercor/bhs333

Diamond, A. (2013). Executive functions. Annual Review of Psychology, 64, 135–168. https://doi.org/10.1146/annurev-psych-113011-143750

Donders, F. C. (1969). On the speed of mental processes. Acta Psychologica, 30, 412–431. https://doi.org/10.1016/0001-6918(69)90065-1

Duncan, J. (2010). The multiple-demand (MD) system of the primate brain: mental programs for intelligent behaviour. Trends in Cognitive Sciences, 14(4), 172–179. https://doi.org/10.1016/j.tics.2010.01.004

Eagle, D. M., Bari, A., & Robbins, T. W. (2008). The neuropsychopharmacology of action inhibition: Cross-species translation of the stop-signal and go/no-go tasks. Psychopharmacology, 199(3), 439–456. https://doi.org/10.1007/s00213-008-1127-6

Eickhoff, S. B [Simon B.], Bzdok, D., Laird, A. R [Angela R.], Kurth, F., & Fox, P. T. (2012). Activation likelihood estimation meta-analysis revisited. NeuroImage, 59(3), 2349–2361. https://doi.org/10.1016/j.neuroimage.2011.09.017

Eickhoff, S. B [Simon B.], Laird, A. R [Angela R.], Grefkes, C., Wang, L. E., Zilles, K., & Fox, P. T. (2009). Coordinate-based activation likelihood estimation meta-analysis of neuroimaging data: A random-effects approach based on empirical estimates of spatial uncertainty. Human Brain Mapping, 30(9), 2907–2926. https://doi.org/10.1002/hbm.20718

Erickson, L. C., Rauschecker, J. P., & Turkeltaub, P. E. (2017). Meta-analytic connectivity modeling of the human superior temporal sulcus. Brain Structure and Function, 222(1), 267–285. https://doi.org/10.1007/s00429-016-1215-z

Ertekin, E., Üçok, A., Keskin-Ergen, Y., & Devrim-Üçok, M. (2017). Deficits in Go and NoGo P3 potentials in patients with schizophrenia. Psychiatry Research, 254, 126–132. https://doi.org/10.1016/j.psychres.2017.04.052

Friedman, N. P., & Robbins, T. W. (2022). The role of prefrontal cortex in cognitive control and executive function. Neuropsychopharmacology, 47(1), 72–89. https://doi.org/10.1038/s41386-021-01132-0

Garavan, H [H.], Ross, T. J., & Stein, E. A. (1999). Right hemispheric dominance of inhibitory control: An event-related functional MRI study. Proceedings of the National Academy of Sciences of the United States of America, 96(14), 8301–8306. https://doi.org/10.1073/pnas.96.14.8301

Glover, G. H. (2011). Overview of functional magnetic resonance imaging. Neurosurgery Clinics of North America, 22(2), 133-9, vii. https://doi.org/10.1016/j.nec.2010.11.001

Grimm, O., van Rooij, D., Hoogman, M., Klein, M., Buitelaar, J., Franke, B., Reif, A., & Plichta, M. M. (2021a). Transdiagnostic neuroimaging of reward system phenotypes in ADHD and comorbid disorders. Neuroscience and Biobehavioral Reviews, 128, 165–181. https://doi.org/10.1016/j.neubiorev.2021.06.025

Grimm, O., van Rooij, D., Tshagharyan, A., Yildiz, D., Leonards, J., Elgohary, A., Buitelaar, J., & Reif, A. (2021b). Effects of comorbid disorders on reward processing and connectivity in adults with ADHD. Translational Psychiatry, 11(1), 636. https://doi.org/10.1038/s41398-021-01758-0

Haber, S. N., Liu, H., Seidlitz, J., & Bullmore, E. (2022). Prefrontal connectomics: from anatomy to human imaging. Neuropsychopharmacology, 47(1), 20–40. https://doi.org/10.1038/s41386-021-01156-6

Hall, J., Romaniuk, L., McIntosh, A. M., Steele, J. D., Johnstone, E. C., & Lawrie, S. M. (2009). Associative learning and the genetics of schizophrenia. Trends in Neurosciences, 32(6), 359–365. https://doi.org/10.1016/j.tins.2009.01.011

Hester, R., Murphy, K., & Garavan, H [Hugh] (2004a). Beyond common resources: the cortical basis for resolving task interference. NeuroImage, 23(1), 202–212. https://doi.org/10.1016/j.neuroimage.2004.05.024

Hester, R. L., Murphy, K., Foxe, J. J., Foxe, D. M., Javitt, D. C., & Garavan, H [Hugh] (2004b). Predicting Success: Patterns of Cortical Activation and Deactivation Prior to Response Inhibition. Journal of Cognitive Neuroscience, 16(5), 776–785. https://doi.org/10.1162/089892904970726

Huang-Pollock, C. L., Maddox, W. T., & Tam, H. (2014). Rule-based and information-integration perceptual category learning in children with attention-deficit/hyperactivity disorder. Neuropsychology, 28(4), 594–604. https://doi.org/10.1037/neu0000075

Hung, Y., Gaillard, S. L., Yarmak, P., & Arsalidou, M. (2018). Dissociations of cognitive inhibition, response inhibition, and emotional interference: Voxelwise ALE meta-analyses of fMRI studies. Human Brain Mapping, 39(10), 4065–4082. https://doi.org/10.1002/hbm.24232

Isherwood, S. J. S., Keuken, M. C., Bazin, P. L., & Forstmann, B. U. (2021). Cortical and subcortical contributions to interference resolution and inhibition - An fMRI ALE meta-analysis. Neuroscience and Biobehavioral Reviews, 129, 245–260. https://doi.org/10.1016/j.neubiorev.2021.07.021

Jonkman, L. M., Lansbergen, M., & Stauder, J. E. A. (2003). Developmental differences in behavioral and event-related brain responses associated with response preparation and inhibition in a go/nogo task. Psychophysiology, 40(5), 752–761. https://doi.org/10.1111/1469-8986.00075

Jurado, M. B., & Rosselli, M [Mónica] (2007). The Elusive Nature of Executive Functions: A Review of our Current Understanding. Neuropsychology Review, 17(3), 213–233. https://doi.org/10.1007/s11065-007-9040-z

Kann, S., Zhang, S., Manza, P., Leung, H.C., & Li, C.S. R. (2016). Hemispheric Lateralization of Resting-State Functional Connectivity of the Anterior Insula: Association with Age, Gender, and a Novelty-Seeking Trait. Brain Connectivity, 6(9), 724–734. https://doi.org/10.1089/brain.2016.0443

Koechlin, E., & Summerfield, C. (2007). An information theoretical approach to prefrontal executive function. Trends in Cognitive Sciences, 11(6), 229–235. https://doi.org/10.1016/j.tics.2007.04.005

Laird, A. R [Angela R.], Eickhoff, S. B [Simon B.], Kurth, F., Fox, P. M., Uecker, A. M., Turner, J. A., Robinson, J. L., Lancaster, J. L., & Fox, P. T. (2009a). Ale Meta-Analysis Workflows Via the Brainmap Database: Progress Towards A Probabilistic Functional Brain Atlas. Frontiers in Neuroinformatics, 3, 23. https://doi.org/10.3389/neuro.11.023.2009

Laird, A. R [Angela R.], Eickhoff, S. B [Simon B.], Li, K., Robin, D. A., Glahn, D. C., & Fox, P. T. (2009b). Investigating the functional heterogeneity of the default mode network using coordinate-based meta-analytic modeling. Journal of Neuroscience, 29(46), 14496–14505. https://doi.org/10.1523/JNEUROSCI.4004-09.2009

Langner, R [Robert], & Eickhoff, S. B [Simon B.] (2013). Sustaining attention to simple tasks: A meta-analytic review of the neural mechanisms of vigilant attention. Psychological Bulletin, 139(4), 870–900. https://doi.org/10.1037/a0030694

Lavallee, C. F., Herrmann, C. S., Weerda, R., & Huster, R. J. (2014). Stimulus-response mappings shape inhibition processes: A combined EEG-fMRI study of contextual stopping. PLoS ONE, 9(4), e96159. https://doi.org/10.1371/journal.pone.0096159

Levy, B. J., & Wagner, A. D. (2011). Cognitive control and right ventrolateral prefrontal cortex: Reflexive reorienting, motor inhibition, and action updating. Annals of the New York Academy of Sciences, 1224(1), 40–62. https://doi.org/10.1111/j.1749-6632.2011.05958.x

Lipszyc, J., & Schachar, R. (2010). Inhibitory control and psychopathology: A meta-analysis of studies using the stop signal task. Journal of the International Neuropsychological Society : JINS, 16(6), 1064–1076. https://doi.org/10.1017/S1355617710000895

Littman, R., & Takács, Á. (2017). Do all inhibitions act alike? A study of go/no-go and stop-signal paradigms. PLoS ONE, 12(10), e0186774. https://doi.org/10.1371/journal.pone.0186774

Logan, G. D., & Cowan, W. B. (1984). On the ability to inhibit thought and action: A theory of an act of control. Psychological Review, 91(3), 295–327. https://doi.org/10.1037/0033-295X.91.3.295

MacDonald, A. W., Cohen, J. D., Stenger, V. A., & Carter, C. S. (2000). Dissociating the Role of the Dorsolateral Prefrontal and Anterior Cingulate Cortex in Cognitive Control. Science, 288(5472), 1835–1838. https://doi.org/10.1126/science.288.5472.1835

Müller, V. I [Veronika I.], Cieslik, E. C., Laird, A. R [Angela R.], Fox, P. T., Radua, J., Mataix-Cols, D., Tench, C. R., Yarkoni, T., Nichols, T. E., Turkeltaub, P. E., Wager, T. D., & Eickhoff, S. B [Simon B.] (2018). Ten simple rules for neuroimaging meta-analysis. Neuroscience and Biobehavioral Reviews, 84, 151–161. https://doi.org/10.1016/j.neubiorev.2017.11.012

Nee, D. E., Wager, T. D., & Jonides, J. (2007). Interference resolution: Insights from a meta-analysis of neuroimaging tasks. Cognitive, Affective & Behavioral Neuroscience, 7(1), 1–17. https://doi.org/10.3758/CABN.7.1.1

Niendam, T. A., Laird, A. R [Angela R.], Ray, K. L., Dean, Y. M., Glahn, D. C., & Carter, C. S. (2012). Meta-analytic evidence for a superordinate cognitive

control network subserving diverse executive functions. Cognitive, Affective, & Behavioral Neuroscience, 12(2), 241–268. https://doi.org/10.3758/s13415-011-0083-5

Plichta, M. M., & Scheres, A. (2014). Ventral–striatal responsiveness during reward anticipation in ADHD and its relation to trait impulsivity in the healthy population: A meta-analytic review of the fMRI literature. Neuroscience and Biobehavioral Reviews, 38, 125–134. https://doi.org/10.1016/j.neubiorev.2013.07.012

Puiu, A. A., Wudarczyk, O., Kohls, G., Bzdok, D., Herpertz-Dahlmann, B., & Konrad, K. (2020). Meta-analytic evidence for a joint neural mechanism underlying response inhibition and state anger. Human Brain Mapping, 41(11), 3147–3160. https://doi.org/10.1002/hbm.25004

Raij, T., Uutela, K., & Hari, R. (2000). Audiovisual Integration of Letters in the Human Brain. Neuron, 28(2), 617–625. https://doi.org/10.1016/S0896-6273(00)00138-0

Rottschy, C., Langner, R [R.], Dogan, I., Reetz, K., Laird, A. R [A. R.], Schulz, J. B., Fox, P. T., & Eickhoff, S. B [S. B.] (2012). Modelling neural correlates of working memory: A coordinate-based meta-analysis. NeuroImage, 60(1), 830–846. https://doi.org/10.1016/j.neuroimage.2011.11.050

Schachar, R., Logan, G. D., Robaey, P., Chen, S., Ickowicz, A., & Barr, C. (2007). Restraint and cancellation: Multiple inhibition deficits in attention deficit hyperactivity disorder. Journal of Abnormal Child Psychology, 35(2), 229–238. https://doi.org/10.1007/s10802-006-9075-2

Schachar, R. J., Forget-Dubois, N., Dionne, G., Boivin, M., & Robaey, P. (2011). Heritability of response inhibition in children. Journal of the International Neuropsychological Society : JINS, 17(2), 238–247. https://doi.org/10.1017/S1355617710001463

Senderecka, M., Grabowska, A., Szewczyk, J., Gerc, K., & Chmylak, R. (2012). Response inhibition of children with ADHD in the stop-signal task: An event-related potential study. International Journal of Psychophysiology: Official Journal of the International Organization of Psychophysiology, 85(1), 93–105. https://doi.org/10.1016/j.ijpsycho.2011.05.007

Shashidhara, S., Mitchell, D. J., Erez, Y., & Duncan, J. (2019). Progressive Recruitment of the Frontoparietal Multiple-demand System with Increased Task Complexity, Time Pressure, and Reward. Journal of Cognitive Neuroscience, 31(11), 1617–1630. https://doi.org/10.1162/jocn_a_01440

Simmonds, D. J., Pekar, J. J., & Mostofsky, S. H. (2008). Meta-analysis of Go/No-go tasks demonstrating that fMRI activation associated with response inhibition is task-dependent. Neuropsychologia, 46(1), 224–232. https://doi.org/10.1016/j.neuropsychologia.2007.07.015

Späti, J., Chumbley, J., Brakowski, J., Dörig, N., Grosse Holtforth, M., Seifritz, E., & Spinelli, S. (2014). Functional lateralization of the anterior insula during feedback processing. Human Brain Mapping, 35(9), 4428–4439. https://doi.org/10.1002/hbm.22484

Sridharan, D., Levitin, D. J., & Menon, V. (2008). A critical role for the right fronto-insular cortex in switching between central-executive and default-

mode networks. Proceedings of the National Academy of Sciences of the United States of America, 105(34), 12569–12574. https://doi.org/10.1073/pnas.0800005105

Steele, V. R., Aharoni, E., Munro, G. E., Calhoun, V. D., Nyalakanti, P., Stevens, M. C., Pearlson, G., & Kiehl, K. A. (2013). A large scale (N=102) functional neuroimaging study of response inhibition in a Go/NoGo task. Behavioural Brain Research, 256, 529–536. https://doi.org/10.1016/j.bbr.2013.06.001

Sun, Q., Fang, Y., Shi, Y., Wang, L., Peng, X., & Tan, L. (2021). Inhibitory Top-Down Control Deficits in Schizophrenia With Auditory Verbal Hallucinations: A Go/NoGo Task. Frontiers in Psychiatry, 12, 544746. https://doi.org/10.3389/fpsyt.2021.544746

Swick, D., Ashley, V., & Turken, U. (2011). Are the neural correlates of stopping and not going identical? Quantitative meta-analysis of two response inhibition tasks. NeuroImage, 56(3), 1655–1665. https://doi.org/10.1016/j.neuroimage.2011.02.070

Trommer, B. L., Hoeppner, J. A., Lorber, R., & Armstrong, K. J. (1988). The go-no-go paradigm in attention deficit disorder. Annals of Neurology, 24(5), 610–614. https://doi.org/10.1002/ana.410240504

Turkeltaub, P. E., Eden, G. F., Jones, K. M., & Zeffiro, T. A. (2002). Meta-analysis of the functional neuroanatomy of single-word reading: Method and validation. NeuroImage, 16(3 Pt 1), 765–780. https://doi.org/10.1006/nimg.2002.1131

van Atteveldt, N., Formisano, E., Goebel, R., & Blomert, L. (2004). Integration of letters and speech sounds in the human brain. Neuron, 43(2), 271–282. https://doi.org/10.1016/j.neuron.2004.06.025

Verbruggen, F., Best, M., Bowditch, W. A., Stevens, T., & McLaren, I. P. (2014). The inhibitory control reflex. Neuropsychologia, 65, 263–278. https://doi.org/10.1016/j.neuropsychologia.2014.08.014

Verbruggen, F., & Logan, G. D. (2008a). Automatic and controlled response inhibition: Associative learning in the go/no-go and stop-signal paradigms. Journal of Experimental Psychology. General, 137(4), 649–672. https://doi.org/10.1037/a0013170

Verbruggen, F., & Logan, G. D. (2008b). Response inhibition in the stop-signal paradigm. Trends in Cognitive Sciences, 12(11), 418–424. https://doi.org/10.1016/j.tics.2008.07.005

Weisbrod, M., Kiefer, M., Marzinzik, F., & Spitzer, M. (2000). Executive control is disturbed in schizophrenia: evidence from event-related potentials in a Go/NoGo task. Biological Psychiatry, 47(1), 51–60. https://doi.org/10.1016/S0006-3223(99)00218-8

Wessel, J. R. (2017). Prepotent motor activity and inhibitory control demands in different variants of the go/no-go paradigm. Psychophysiology, 55(3), e12871. https://doi.org/10.1111/psyp.12871

Wessel, J. R., & Aron, A. R. (2014). Inhibitory motor control based on complex stopping goals relies on the same brain network as simple stopping. NeuroImage, 103, 225–234. https://doi.org/10.1016/j.neuroimage.2014.09.048

Wilson, S. M., Bautista, A., & McCarron, A. (2018). Convergence of spoken and written language processing in the superior temporal sulcus. NeuroImage, 171, 62–74. https://doi.org/10.1016/j.neuroimage.2017.12.068

Worringer, B., Langner, R [Robert], Koch, I., Eickhoff, S. B [Simon B.], Eickhoff, C. R., & Binkofski, F. C. (2019). Common and distinct neural correlates of dual-tasking and task-switching: a meta-analytic review and a neuro-cognitive processing model of human multitasking. Brain Structure and Function, 224(5), 1845–1869. https://doi.org/10.1007/s00429-019-01870-4

Wöstmann, N. M., Aichert, D. S., Costa, A., Rubia, K., Möller, H.J., & Ettinger, U. (2013). Reliability and plasticity of response inhibition and interference control. Brain and Cognition, 81(1), 82–94. https://doi.org/10.1016/j.bandc.2012.09.010

Wright, L., LIPSZYC, J., Dupuis, A., Thayapararajah, S. W., & Schachar, R. (2014). Response inhibition and psychopathology: A meta-analysis of go/no-go task performance. Journal of Abnormal Psychology, 123(2), 429–439. https://doi.org/10.1037/a0036295

Yuan, P., & Raz, N. (2014). Prefrontal cortex and executive functions in healthy adults: A meta-analysis of structural neuroimaging studies. Neuroscience and Biobehavioral Reviews, 42, 180–192. https://doi.org/10.1016/j.neubiorev.2014.02.005

Zandbelt, B. B., & Vink, M. (2010). On the role of the striatum in response inhibition. PLOS ONE, 5(11), e13848. https://doi.org/10.1371/journal.pone.0013848

Zhang, R., Geng, X., & Lee, T. M. C. (2017). Large-scale functional neural network correlates of response inhibition: An fMRI meta-analysis. Brain Structure and Function, 222(9), 3973–3990. https://doi.org/10.1007/s00429-017-1443-x