



عنوان طرح

کاربرد مداخلات مبتنی بر آموزش شناختی (Cognitive Training) در اختلال طیف اتیسم
یک مطالعه مروری منظم

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معرفی و خلاصه مراحل اجرای طرح

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معرفی و خلاصه مراحل اجرای طرح

عنوان طرح به فارسی: مطالعه مروری روش‌ها و ابزارهای درمان و توان بخشی عصب شناختی در اختلالات طیف اوتیسم کودکان و

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عنوان طرح به انگلیسی:

Literature review of neurocognitive intervention and rehabilitation methods and tools in children and adolescents with autism spectrum disorder

خلاصه دقیق طرح (فارسی، حداکثر ۳۰۰ کلمه)

به منظور بررسی متون موجود مرتبط با انواع روش‌ها و ابزارهای درمان و توان بخشی عصب شناختی به کار رفته در اختلال طیف اوتیسم، مطالعه مروری با استفاده از بانک‌های اطلاعاتی معتبر انجام شد و نتایج به دست آمده بر اساس انواع ویژگی‌های سنجشی روش‌ها و ابزارها طبقه‌بندی شد.

خلاصه دقیق طرح (انگلیسی، حداکثر ۳۰۰ کلمه)

To investigate the existing literature on different tools and methods of neurocognitive intervention and rehabilitation being used in autism spectrum disorder, we will review databases. The results will be categorized based on metric characteristics of the tools and methods.

کلمات کلیدی و تخصصی طرح (فارسی حداکثر ۵ کلمه)

طیف اوتیسم، درمان و توانبخشی عصب شناختی، ابزار، کودکان و نوجوانان

کلمات کلیدی و تخصصی طرح (انگلیسی حداکثر ۵ کلمه)

Autism spectrum, Neurocognitive Intervention and Rehabilitation, Tool, Children and Adolescents

مطالعه حاضر با هدف تهیه فهرست و مشخصات انواع روش‌ها و ابزارهای مورد استفاده در درمان و توانبخشی عصب شناختی اختلال طیف اوتیسم و طبقه‌بندی این روش‌ها و ابزارها از نظر کارکرد مورد هدف، ویژگی‌های تکنیکی، شکل اجرا، جمعیت هدف، اثربخشی، قابلیت اجرا، و هزینه - اثربخشی انجام شد. با توجه به اهداف تعیین شده برای مطالعه مروری و مراحل اجرای طرح طبق پروپوزال ارائه شده، اقدامات انجام گرفته به شرح زیر است:

مرحله شماره ۱:

نظرخواهی از صاحب نظران حوزه درمان و توانبخشی شناختی اختلالات طیف اوتیسم، جمع‌بندی و نتیجه‌گیری اطلاعات به دست آمده جهت تعیین نقشه راه اجرای مرور سیستماتیک

جهت انجام این مرحله طی جلساتی از صاحب نظران حیطه درمان و توانبخشی شناختی اوتیسم دعوت به عمل آمد و در مورد حیطه‌های مختلف شناختی در توانبخشی طیف اوتیسم تبادل نظر صورت گرفت و حیطه‌های شناختی بر اساس اهمیت و تکرار در متون و مجامع معتبر علمی، جهت بررسی در این مطالعه تعیین گردید. همچنین با توجه به وسعت مقالات مرتبط با حیطه‌های مذکور، نقشه راه اجرای مرور سیستماتیک تدوین شد. مرحله دوم طرح معطوف به این نقشه توضیح داده می‌شود.

مرحله شماره ۲:

بررسی ادبیات علمی مرتبط با کاربرد ابزارها و روش‌های درمان و توانبخشی عصب شناختی اختلالات طیف اوتیسم (مشمول بر Cognitive Rehabilitation in Autism, Cognitive Treatment in Autism)

پس از جستجوهای اولیه با کلید واژه‌های عمومی در دو مرحله مقالات مرور سیستماتیک و متاآنالیزها و سپس بخشی از مقالات غیر مروری شامل مقالات تجربی و مداخله‌ای استخراج و بررسی شدند. بر اساس یافته‌های این مرور اولیه در مورد چهارچوب و استراتژی ادامه جستجوی آنلاین بحث و تبادل نظر صورت گرفت. سه پایگاه داده شامل ISI Web of Science, MEDLINE, Scopus انتخاب و طی چند جلسه کلمات مورد نظر جهت جستجوی آنلاین به شرح ذیل در سه دسته نهایی شدند:

- Autism, Pervasive Developmental Disorder, PDD, ASD, Autistic, Asperger;
- Intervention, Treatment, Therapy, Training, Education, Rehabilitation, Virtual, Augmented, Robotic, Transcranial, EEG, MRI, DTI, ERP, PET, SPECT, MRS, modeling, computational;
- Cognition, Emotion, Face, Perception, Recognition, Theory of Mind, Attention, Executive Function, Intelligence, Learning, Shifting, Switching, Memory, Inhibition, Flexibility, Visual, Eye Tracking, Planning, Gaze.

بر اساس فرمت جستجوی هر یک از پایگاه‌های داده، جستجو برای کلید واژه‌های مذکور از ابتدای سال ۱۹۷۰ لغایت ۲۰۱۷ صورت گرفت. مقالات مورد نظر استخراج و به ترتیب به نرم افزار مدیریت منابع اندنوت Export شدند. مقالات تکراری در نرم افزار حذف شد. در طی چند نوبت غربالگری و جلسات متعدد بین اعضا تیم تحقیق جهت یکسان سازی روند انتخاب مقالات بر اساس عنوان و چکیده، مقالات باقیمانده شامل مقالات مربوط به درمان و توانبخشی عصب شناختی در طیف اوتیسم جهت استخراج داده از Full Text تعیین شده و در اختیار اعضا گروه قرار گرفتند.

معیارهای اصلی جهت انتخاب مقالات شامل موارد زیر بود:

- سن نمونه‌های مورد بررسی از ۰ تا ۱۸ سال باشد.
- کل گروه یا بخشی از گروه نمونه پژوهش بر اساس بهترین تخمین بالینی مبتلا به اختلال اوتیستیک، اسپرگر، اختلال نافذ رشد، اوتیسم، اختلال طیف اوتیسم، اختلال به صورت دیگر مشخص نشده (NOS) تشخیص داده شده باشند.
- طراحی مطالعه شامل مداخلات مرتبط با تقویت نظریه ذهن، مهارت‌های اجرایی، شناخت هیجان، توانمندی‌های عصب شناختی زبان، ... مانند داستان‌های اجتماعی، آموزش شناختی (تقویت حافظه کاری و توجه)، تصویرهای ثابت و متحرک، باشد.

مرحله شماره ۳:

استخراج اطلاعات از مقالات به دست آمده

در این مرحله، چهارچوب خاصی جهت استخراج اطلاعات از متون کامل مقالات مداخله‌ای مربوط به درمان و توانبخشی عصب شناختی اوتیسم طی چند جلسه طراحی شده و بعد از پایلوت بر روی تعدادی از مقالات موجود به تصویب نهایی رسید. براین اساس برای هریک از مقالات اصلی (Original Article) اطلاعات مورد نظر شامل ۲۷ آیتم در نرم افزار اکسل ثبت می‌گردد. این آیتم‌ها شامل موارد زیر بوده‌اند:

عنوان مقاله، نام نویسنده اول، سال چاپ، مجله محل چاپ، نوع مقاله (Original Article, Letter, Short Communication, Brief Report, etc.)، نوع طراحی مطالعه (Single Case Experiment, Randomized Clinical Trial, Non-Randomized Trial, etc.)، وضعیت کورسازی در مطالعه (دو سوکور، یکسو کور، بدون کورسازی)، نوع گروه کنترل در مداخلات دو بازویی (پلاسیبو، کنترل سالم، غیره)، نام مداخله اصلی مورد بررسی، حیطه شناختی اصلی مورد بررسی و توانبخشی، نوع مداخله (کامپیوتری، دستی، غیره)، نتایج حاصل از هر یک از مداخلات انجام شده، سایز اثر (Effect Size)، معیارهای ورود و خروج شرکت کنندگان گروه‌های مداخله و کنترل، تعداد شرکت کنندگان، گروه سنی شرکت کنندگان، جنسیت شرکت کنندگان، تعداد آیتم‌های مورد بررسی در ابزار یا مداخله، مدت انجام تست و مداخله، زبان مورد نیاز برای استفاده از ابزار و مداخله، قابلیت ترجمه یا بومی سازی، هزینه تهیه ابزارها و قابلیت دسترسی آنها، نتایج کلی روش مداخله، توانبخشی یا درمان عصب شناختی.

توضیح اختلال

اختلال طیف اتیسم یکی از اختلال‌های عصبی-تکاملی است که با نقص در مهارت‌های ارتباطی اجتماعی و علاقه‌مندی‌ها و رفتارهای محدود و تکراری مشخص می‌شود [۱]. بر اساس ویراست پنجم راهنمای تشخیصی و آماری اختلالات روان‌پزشکی (DSM-5) شیوع جهانی اتیسم ۱ درصد می‌باشد [۱]، اما بررسی‌های جدیدتر نشان می‌دهند شیوع این اختلال در برخی از کشورها در حدود ۱ در ۶۸ گزارش شده است [۲].

علی‌رغم اینکه اتیسم با نشانه‌های رفتاری تعریف می‌شود، اعتقاد بر این است که این نشانه‌ها بازتاب وجود نقایص / تفاوت‌ها در عملکردهای عصب‌شناختی زیربنایی هستند [۳]. دسته‌بندی‌های مختلفی از عملکردهای عصب‌شناختی وجود دارد که از آن جمله می‌توان به دسته‌بندی ویراست پنجم راهنمای تشخیصی و آماری اختلالات روان‌پزشکی (DSM-5) اشاره کرد [۴]. براساس این دسته‌بندی عملکردهای عصب‌شناختی به شش حوزه کلی توجه (شامل توجه پایدار، توجه انتخابی، توجه تقسیم شده و سرعت پردازش)، کارکردهای اجرایی (شامل برنامه‌ریزی، تصمیم‌گیری، حافظه کاری، پاسخ به بازخورد، بازداری و انعطاف‌پذیری)، حافظه و یادگیری (شامل یادآوری آزاد، یادآوری هدایت شده، حافظه بازشناسی، حافظه بلند مدت معنایی و خود زندگی‌نامه‌ای و یادگیری درونی)، زبان (شامل نامیدن اشیاء، یافتن واژگان، روانی، دستور زبان و نحو و زبان دریافتی)، ادراکی-حرکتی (شامل ادراک بینایی، استدلال دیداری-فضایی، هماهنگی ادراکی-حرکتی) و شناخت اجتماعی (شامل شناخت هیجانات، نظریه ذهن و بینش) تقسیم می‌شوند [۴].

یافته‌هایی که در زمینه ویژگی‌های عصب‌شناختی اتیسم وجود دارند تاحدی ناهمسان بوده که دلیل آن تفاوت‌های روش‌شناختی در مطالعات صورت گرفته و تنوع ذاتی موجود در طیف اتیسم است. تبیین‌های شناختی اتیسم می‌توانند به طور کلی به دو دسته‌ی تئوری‌های حوزه-خاص (Domain-Specific) و حوزه-گسترده (Domain-General) تقسیم شوند [۵]. تئوری‌های حوزه-خاص نارسایی اصلی را در پردازش اجتماعی می‌دانند [۶]. مهم‌ترین تبیین این حوزه نقص در «نظریه ذهن» می‌باشد که نارسایی‌های ارتباطی اجتماعی اتیسم را ناشی از مشکل در بازنمایی حالت‌های ذهنی می‌داند. تئوری‌های حوزه-گسترده در زمینه اتیسم عنوان می‌کنند که نارسایی اصلی اختصاصاً شناخت اجتماعی نبوده بلکه مشکلاتی مانند نقص در «کارکردهای اجرایی» می‌باشد [۷]. نقص در کارکردهای اجرایی به سبب ایجاد محدودیت در تولید رفتارهای جدید یا انتقال زمینه‌ساز رفتارهای تکراری و کلیشه‌ای دانسته می‌شوند. این مسأله به عنوان فرضیه‌ای برای تبیین نارسایی‌های ارتباطی اجتماعی نیز دانسته شده است [۷]. تعدادی از تبیین‌های حوزه-گسترده حوزه‌هایی از پردازش‌های سطح بالا یا تفاوت‌های موجود در سبک شناختی را معرفی می‌کنند. مانند «ارتباط مرکزی ضعیف» که گرایشی به سمت پردازش خصیصه‌ای (جزء نگر) و کاهش پردازش پیکربندی (کل نگر) می‌باشد [۸].

توضیح مداخله

با توجه به اهمیت نارسایی‌های شناختی در تبیین علائم اصلی و اختلالات همبود اتیسم، مداخله بر روی این حوزه‌ها در سال‌های اخیر مورد تأکید بیشتری قرار گرفته است و مطالعات مختلفی به بررسی اثربخشی این گروه از مداخلات پرداخته‌اند. این مداخلات براساس چهارچوب مفهومی مورد استفاده خود فرایندهای مداخله و حوزه‌های مختلفی را مورد تأکید قرار داده‌اند. فرآیندها و پروتکل‌های مداخله در برخی از مطالعات بیشتر جنبه‌ی رفتاری داشته و در برخی دیگر جنبه‌ی شناختی. برخی از این مداخلات بیشتر بر در موقعیت‌های آزمایشگاهی اجرا شده و برخی دیگر در محیط‌های واقعی. نظریه ذهن و کارکردهای اجرایی دو حوزه اصلی مورد تمرکز این مطالعات هستند.

با توجه به گستردگی و تنوع مطالعات صورت گرفته در این حوزه، چند مطالعه‌ی مروری نظام‌مند با هدف جمع‌بندی و ارائه تصویری روشن و مبتنی بر شواهد از اثربخشی این مداخلات در حوزه‌ی اتیسم انجام شده است. در یک مطالعه مروری که به بررسی مداخلات شناختی مبتنی بر نظریه ذهن در حوزه اتیسم پرداخته است، در مجموع ۲۲ مقاله کارآزمایی بالینی با نمونه‌ای به حجم ۶۹۵ نفر ارزیابی شدند [۹]. این مطالعات از نظر حجم نمونه، سن شرکت‌کنندگان، نوع ارائه مداخله و خروجی‌های مورد بررسی از تنوع زیادی برخوردار بوده‌اند. مطالعات بسیار اندکی بوده‌اند که در آنها کورسازی شرکت‌کنندگان و پرسنل به خوبی انجام گرفته بود و برخی از مطالعات ریسک بسیار بالایی در زمینه کورسازی ارزیاب‌ها در مطالعه بوده‌اند. بسیاری از مطالعات پیامدهایی را گزارش کرده بودند که وابسته به روش مداخله بوده‌اند (مانند بازشناسی چهره). تنوع مقیاس‌های ارزیابی مورد استفاده در هر دسته از پیامدها و نتایج آمیخته به دست آمده از این مقیاس‌ها پیچیدگی بیشتری در راه تفسیر نتایج ایجاد می‌کنند.

¹ Featural Processing

² Configural Processing

مطالعات بر اساس هدف مداخله/پیامد مورد اندازه‌گیری اصلی به چهار طبقه اصلی دسته‌بندی شدند که عبارتند از: بازشناسی هیجان، توجه مشترک و ارتباط اجتماعی، تقلید و آموزش مستقیم نظریه ذهن. براساس نتایج به دست آمده از ۳ مطالعه سطح کیفی شواهد درباره تأثیر مثبت بر مقیاس‌های ارتباطی بسیار پایین بود. بر اساس ۱۱ مطالعه که نتایج مختلفی از مداخلات انجام شده بر روی مقیاس‌های تعامل اجتماعی گزارش کرده‌اند، سطح کیفی شواهد پایین بود. بر اساس چهار مطالعه که نتایج متضادی در زمینه مقیاس‌های ارتباط عمومی گزارش کرده‌اند سطح کیفی شواهد بسیار پایین بود و همچنین شواهد به دست آمده از چهار مطالعه که نتایج متضادی در زمینه مقیاس‌های نظریه ذهن گزارش کردند از سطح کیفی بسیار پایینی برخوردار هستند.

نتیجه انجام فرا تحلیل بر روی مطالعاتی که امکان استفاده از آنها وجود داشت نشان می‌دهد مداخلاتی که بازشناسی هیجان را در میان افراد دارای توانایی هوشی متوسط در سنین مختلف هدف قرار داده‌اند تأثیر مثبتی بر مهارت هدف داشته‌اند که از طریق یک آزمون حامل تصاویر چهره سنجیده شده است (Mean Increase of 0.75 Points, 95% Confidence Interval (CI) 0.22 to 1.29 Points, Z=2.75, P<0.006, Four Studies, N=105). همچنین مداخلات درمانگر محور انجام شده بر روی توجه مشترک می‌تواند منجر به افزایش تولید رفتارهای توجه مشترک در تعامل بین کودک و بزرگسال شوند (Mean Increase of 0.55 Points, 95% CI 0.11 to 0.99 Points, Z=2.45, Pvalue=0.01, Two Studies, N=88). بررسی بیشتر تاحدی باعث تضعیف این نتیجه‌گیری می‌شود، زیرا نشان می‌دهد هنگامی که سنجش با استفاده از ابزارهای استاندارد صورت می‌گیرد شواهد روشنی دال بر تأثیر مثبت بر آغازگری در توجه مشترک وجود ندارد (Mean Increase of 0.23 Points, 95% CI -0.48 to 0.94 Points, Z=0.63, Pvalue=0.53, Three Studies, N=92).

یک مطالعه مروری دیگر به بررسی تعمیم‌پذیری نتایج مداخلات انجام شده در زمینه بازشناسی هیجان پرداخته شده است [۱۰]. در این مطالعه تعمیم‌پذیری یافته‌ها به سایر موقعیت‌ها، جمعیت‌ها، محیط‌ها، روش‌های ارائه مداخله و انواع مداخله مورد تأکید قرار گرفته است. ۱۳ مقاله کارآزمایی بالینی واجد شرایط وارد مطالعه شده که اکثر شرکت‌کنندگان پسرهای دارای تشخیص اتیسم با بهره هوشی بالاتر از ۷۰ در دامنه سنی ۴ تا ۱۸ سال بودند. نوع مداخلات و پیامدهای مورد بررسی بسیار متنوع بودند. مطالعات مختلف نشان دهنده اثربخشی مداخلات مبتنی بر بازشناسی هیجان هستند اما میزان تعمیم این یادگیری‌ها به محیط‌های واقعی کاملاً نامشخص است.

مکانیزم احتمالی اثرگذاری مداخله

آموزش شناختی یکی از زیر مجموعه‌های مداخله‌های رفتاری است که به منظور ارتقاء عملکرد شناختی صورت می‌گیرد و که شامل روش‌های دیگری مانند فعالیت فیزیکی، تمرین تفکر مبتنی بر ذهن آگاهی و رویکردهای دیگر نیز می‌شود. آموزش شناختی در روان‌پزشکی از رویکردهای مختلف (مداد و کاغذ، تمرین‌های مبتنی بر کامپیوتر یا تمرین‌های رفتاری هدایت شده) به منظور ارتقاء شناختی و بهینه‌سازی سلامت در اختلالات روان‌پزشکی استفاده می‌کند. آموزش شناختی مداخله‌ای است که از رویدادهای یادگیری اجتماعی-هیجانی یا شناختی دارای طراحی خاص و محدودیت‌های رفتاری که به شیوه‌ای قابل اندازه‌گیری و باز تولید ارائه می‌شوند، استفاده کرده تا به شکل بالقوه عملکردهای سیستم عصبی را ارتقاء دهد. هدف نهایی از آموزش شناختی هدف قرار دادن مکانیزم‌های عصبی شناخته شده‌ی نارسایی‌های رفتاری به منظور ایجاد تغییرات بالینی است.

هدف از آموزش شناختی ایجاد یادگیری و تغییرات سازگارانه در انعطاف‌پذیری عصبی سیستم‌های بازنمودی عصبی یک فرد به واسطه رویدادهای یادگیری با مشخصات خاص، کنترل شده و مبتنی بر علوم شناختی است. رویدادهای یادگیری کنترل شده و با مشخصات خاص که در آموزش شناختی ارائه می‌شوند با رویکردهای نسبتاً بدون ساختار، کنترل نشده و غیر قابل پیش‌بینی در یادگیری متفاوت هستند، برای مثال روش‌هایی که با رفتار درمانی شناختی مرتبط هستند یا از خودآموزهای کامپیوتری روانی-آموزشی استفاده می‌کنند.

اهمیت انجام این مطالعه مروری

علیرغم تلاش‌های صورت گرفته، شواهد موجود در زمینه اثربخشی مداخلات مبتنی بر آموزش و توانبخشی شناختی ناهمسان بوده و این مسأله تا حد زیادی به دلیل تفاوت‌های روش شناختی در مطالعات صورت گرفته می‌باشد. با توجه به اهمیت این مسأله، گروهی متشکل از متخصصین حوزه آموزش شناختی توسط مؤسسه ملی سلامت روان (National Institute of Mental Health) شکل گرفته و به بررسی سطح شواهد موجود در زمینه اثربخشی رویکردهای

¹ Emotion Recognition

² Joint Attention and Social Communication

³ Imitation

فعلی مداخلات شناختی در حوزه‌ی سلامت روان پرداخته‌اند تا چالش‌ها و نارسایی‌های موجود در پژوهش‌های این حوزه و کاربست نتایج آن در موقعیت‌های بالینی را شناسایی کنند [۱۱]. این کارگروه در غالب یک کار مروری به ارائه تعاریف، اهداف و کاربرد آموزش شناختی و همچنین راهنمایی جهت طراحی، اجرا و بررسی مروری مداخلات حوزه آموزش شناختی پرداخته‌اند (نمودار ۱ و جدول ۱).

با توجه به ناهمسانی یافته‌های موجود در زمینه آموزش شناختی، مطالعه حاضر قصد اجرای یک مطالعه مروری نظام‌مند براساس راهنمای ارائه شده دارد.

اهداف

هدف از مطالعه مروری حاضر بررسی اثربخشی مداخلات مبتنی بر رویکردهای شناختی بر کودکان و نوجوانان دچار افسردگی می‌باشد.

Figure 1

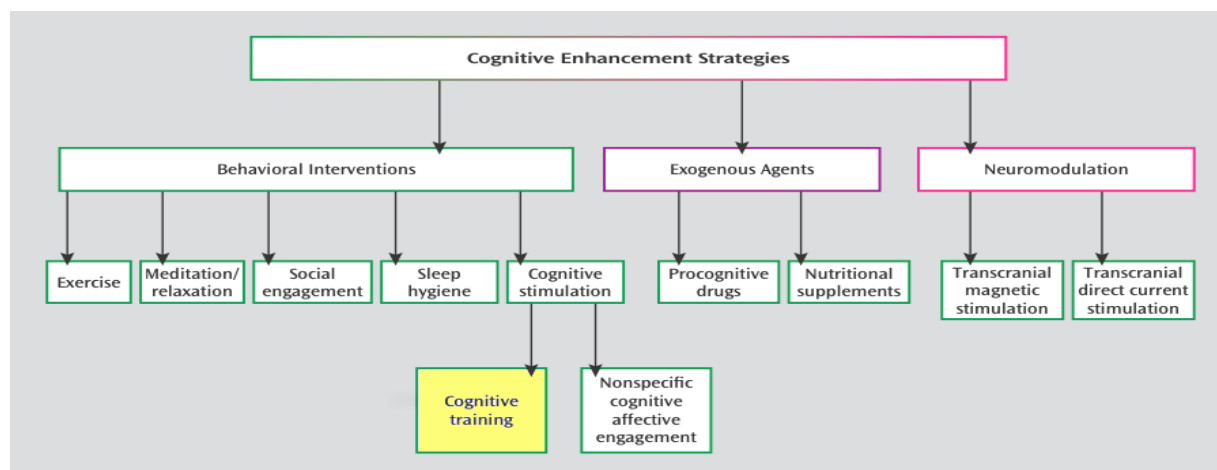


Table 1 - Points for Consideration in the Design, Conduct, and Review of Cognitive Training Intervention Research

Item	Description
Participant Characterization	<ul style="list-style-type: none"> • Are potential predictors/moderators (e.g., baseline cognitive function, psychopathology, and neural reserve) assessed? • Are inclusion/exclusion criteria (e.g., presence of targeted cognitive capacity/deficits) justified?
Intervention Targets	<ul style="list-style-type: none"> • Are cognitive targets (deficits/capacities) linked to clinical status and functioning? • Do the cognitive training interventions match the perceptual/cognitive/affective processes that characterize the disorder and/or neural circuits implicated? • Is the hypothesized therapeutic mechanism supported by research and theory?
Outcome Assessment	<ul style="list-style-type: none"> • Are potential predictors/moderators (e.g., medications, therapist engagement) of outcomes considered? • Do assessments provide for the elucidation of intervention mechanisms (e.g., temporal precedence between putative mediators/mechanisms and target outcomes)? • Are retention/completion rates assessed and reported? • Are cognitive/functional outcomes distinguishable from practice effects? • Are valid measures of proximal (e.g., performance on training tasks, neurocognitive measures) and more distal outcomes (clinical status, functioning, adverse effects, durability, generalization of cognitive and affective outcomes distinct from training tasks) included? • Does the plan include measures at multiple levels of analysis (e.g., genes, molecules, cells, circuits, physiology, behavior, and self-report) as appropriate?
Concomitant Treatments	<ul style="list-style-type: none"> • Is cognitive training intended as a monotherapy or as an adjunctive treatment? • Are concomitant treatments considered in the assessment and analysis plan? • How might the proposed concomitant therapies potentiate (e.g., promoting plasticity; generalization of skills) or interfere with (e.g., medication side effects) cognitive training effects? • Are concomitant treatments held constant across treatment conditions and/or quantified and considered in analyses?
Comparison Condition	<ul style="list-style-type: none"> • Is the comparison condition justified in terms of the research question and stage of intervention development/testing? • Does the comparison condition control for attention, expectations, and potential practice effects associated with training/assessment protocols, as appropriate?
Scalability/Potential for Dissemination	<ul style="list-style-type: none"> • Are all relevant stakeholders considered (i.e., patients/families [e.g., acceptability], clinicians [availability of an appropriately trained workforce], and policymakers [competing demands, therapist time/involvement, and other costs])? • What are the implementation strategies (e.g., delivery within existing services, such as employment training; use of Internet or other facilitative technology for conducting assessments and delivering the intervention; provisions to facilitate motivation/engagement)?
Design Considerations	<ul style="list-style-type: none"> • Are randomization procedures clearly detailed and justified? • Are intervention protocols standardized and manualized? • Are there plans to monitor fidelity and operationalize the delivery of the experimental and comparison conditions? • Are statistical approaches state of the art and appropriately matched to the research question and data structure?

روش

معیارهای ورود مطالعات

همان طور که در مقدمه اشاره شد، بررسی حاضر بر اساس معیارهای ارائه شده توسط کشوان و همکاران صورت گرفته است (جدول ۱). بر همین اساس معیارهای زیر برای مطالعات در نظر گرفته شدند.

انواع مطالعات

در این بررسی محدودیتی برای نوع مطالعات ورودی در نظر گرفته نشده است.

انواع شرکت کنندگان

شرکت کنندگانی وارد این بررسی شدند که معیارهای زیر را دارا باشند:

- تشخیص طیف اتیسم
- زیر ۱۸ سال

انواع مداخله‌ها

- مداخله مورد نظر بر مبنای اصول شناختی باشد.
- مداخله مورد نظر یکی از حوزه‌های شناختی را هدف قرار داده باشد.
- مبتنی بر اصول رفتاری (ABA) نباشند.
- مداخلات گروه درمانی نباشند.

روش جستجو برای شناسایی مطالعات

جستجوی الکترونیک

به منظور به دست آوردن حداکثر مقالات مرتبط با سؤال تحقیق، کلمات رایج در ادبیات پژوهش مرتبط با «اختلال طیف اتیسم» و «توانبخشی شناختی» توسط تیم تحقیق مورد بحث قرار گرفت و پس از چند بررسی مقدماتی مناسب‌ترین عبارت جستجو انتخاب و متناسب با هر پایگاه داده تنظیم گردید. با استفاده از عبارات جستجوی متناسب سه پایگاه داده‌ی ISI، Scopus و PubMed

جمع‌آوری و تحلیل داده‌ها

انتخاب مطالعات

پس از حذف موارد تکراری از میان رفرنس‌های وارد شده به EndNote، بررسی مقالات توسط سه نفر از اعضای تیم تحقیق به صورت مستقل گرفت (یک نفر دکترای روان‌شناسی بالینی فعال در حوزه اتیسم و دو نفر فوق تخصص روانپزشکی کودک و نوجوان). در ابتدا مقالات به دست آمده بر اساس عنوان و چکیده بررسی و سپس بر اساس متن کامل بررسی شدند و مقالاتی که واجد شرایط ورود به مطالعه بودند انتخاب شدند (نمودار ۲). مقالاتی که گزارش تکراری از یک مطالعه بودند نیز در مرحله بررسی متن کامل حذف شدند. فهرست مقالات وارد شده و خارج شده بر اساس بررسی متن کامل و همچنین دلایل آنها در جدول ۲ و پیوست ۱۴ آمده است.

استخراج و مدیریت داده‌ها

اطلاعات مقالات به دست آمده در یک جدول از پیش طراحی شده استخراج گردید. در طراحی این جدول موارد ارائه شده توسط کشوان و همکاران نیز مد نظر قرار گرفت تا بتوان بر اساس اطلاعات استخراج شده به آنها پاسخ داد.

جدول استخراج داده‌ها در برگیرنده این موارد بود: نام نویسنده اول، سال انتشار، نوع مطالعه، شرکت‌کنندگان (سن، جنس، تعداد، تشخیص، معیارهای ورود و خروج)، مداخله، حوزه شناختی هدف، ابزارهای اندازه‌گیری و نتایج. استخراج داده‌ها توسط دو نفر از اعضای تیم پژوهش و به صورت مستقل از یکدیگر صورت گرفت.

ارزیابی کیفی مطالعات

به منظور بررسی کیفی مقالات معیارهای توصیه شده توسط کشوان و همکاران مورد استفاده قرار گرفت (جدول ۱). برای هر یک از موارد ذکر شده چهار پاسخ احتمالی در نظر گرفته شد: بلی، خیر، فقدان شواهد و فاقد کاربرد.

نتایج

توصیف مطالعات

نتیجه جستجو

تعداد رفرنس‌های به دست آمده از سه پایگاه داده برابر با ۴۰۰۳ عنوان بود که پس از حذف موارد تکراری ۲۲۸۱ عنوان مقاله به دست آمد. این مقالات در ابتدا بر اساس عنوان و چکیده بررسی شدند که از میان آنها ۱۸۳ مقاله مرتبط به دست آمد. سپس این مقالات براساس متن کامل بررسی شدند که از آن میان ۶۱ مقاله واجد شرایط ورود به مطالعه بودند (نمودار ۲ و پیوست ۱). در جدول ۲ دلایل و تعداد مقالات حذف شده در زمان بررسی متن کامل آمده است.

Figure 2

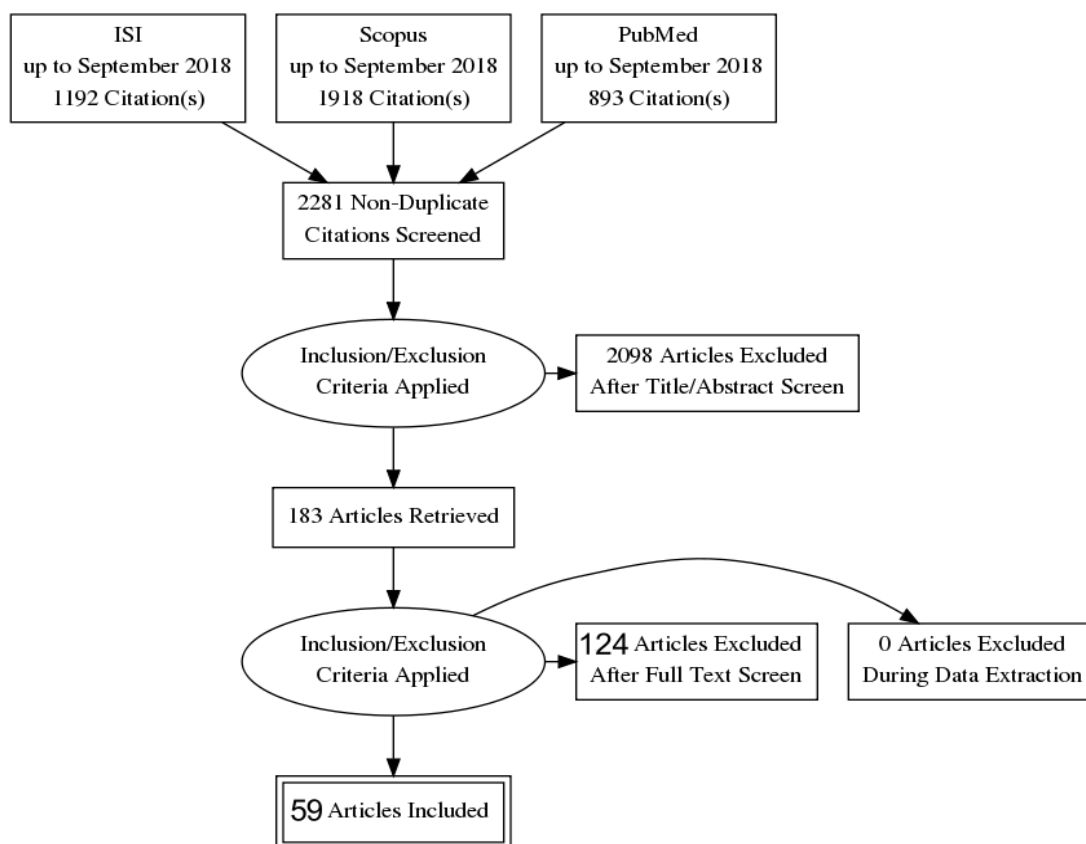


Table 2 Frequency of included and reason of excluded studies		
Labels	Reason	Frequency
Included	Meet inclusion criteria	59
Excluded	Non interventional	10
	Not ASD cases	6
	Not Cognitive Based Intervention	51
	Not Cognitive Domain	20
	Not English	2
	Not Found	15
	On adult sample	3
	Duplicated Article	7
	Review article	10
Total		183

مطالعات وارد شده

تعداد ۵۹ مطالعه واجد شرایط ورود به مطالعه بودند و بر اساس حوزه شناختی مورد مداخله گروه‌بندی شدند (حوزه‌های مورد مداخله براساس حوزه‌های شناختی مورد استفاده در DSM-5 تعریف شدند) (جدول ۳).

طرح مطالعه

فراوانی مطالعات به دست آمده بر اساس طرح مطالعاتی در جدول ۴ آمده است. همان طور که مشاهده می‌شود مطالعات کارآزمایی بالینی تصادفی شده از بیشترین فراوانی برخوردار هستند.

شرکت کنندگان

شرکت کنندگان مطالعات افراد دارای طیف اتیسم بودند که براساس نتایج یکی از ابزارهای تشخیصی و یا ارزیابی بالینی بر اساس معیارهای DSM-5 یا ICD-10 تشخیص اتیسم دریافت کرده‌اند. مشخصات جمعیت شناختی و معیارهای ورود و خروج شرکت کنندگان در جدول خلاصه یافته‌ها ارائه شده است.

Table 3 - Cognitive Targets			
Category	N	Sub-Category	N
Attention	7		
		Attention	3
		Visual Attention	3
		Contextual Processing	1
Auditory	2		
		Auditory Integration	1
		Auditory Processing	1
Executive Function	14		
		Executive Function	14
Social cognition	36		
		Emotion Recognition	10
		Emotion Regulation	2
		Imitation	1
		Joint Attention	12
		Social Cognition	6
		Social Interaction	1
		TOM	4
Total			59

Table 4 Study design of included studies	
Labels	Frequency
Case-Control	1
Non-Randomized Clinical Trial	6
Single Subject	12
Before-After	15
Randomized Clinical Trial	25
Total	59

مداخله

بر اساس راهنمای ارائه شده توسط کشوان و همکاران مداخلاتی در این بررسی مد نظر قرار گرفتند که با داشتن یک رویکرد شناختی بر یکی از حوزه‌های شناختی تمرکز داشته‌اند (بر اساس DSM-5 به شش حوزه کلی توجه (شامل توجه پایدار، توجه انتخابی، توجه تقسیم شده و سرعت پردازش)، کارکردهای اجرایی (شامل برنامه‌ریزی، تصمیم‌گیری، حافظه کاری، پاسخ به بازخورد، بازداری و انعطاف‌پذیری)، حافظه و یادگیری (شامل یادآوری آزاد، یادآوری هدایت شده، حافظه بازسناسی، حافظه بلند مدت معنایی و خود زندگی‌نامه‌ای و یادگیری درونی)، زبان (شامل نامیدن اشیاء، یافتن واژگان، روانی، دستور زبان و نحو و زبان دریافتی)، ادراکی-حرکتی (شامل ادراک بینایی، استدلال دیداری-فضایی، هماهنگی ادراکی-حرکتی) و شناخت اجتماعی (شامل شناخت هیجانات، نظریه ذهن و بینش) تقسیم می‌شوند). مداخلات مبتنی بر رویکردهای رفتاری و گروه درمانی مورد هدف مطالعه حاضر نبوده‌اند. بر اساس تقسیم‌بندی ارائه شده توسط DSM-5، مطالعات به دست آمده در چهار حوزه کلی دسته‌بندی و نتایج آنها مورد بررسی قرار گرفت. این حوزه‌ها عبارتند از:

- (۱) توجه،
- (۲) پردازش شنیداری،
- (۳) کارکردهای اجرایی و
- (۴) شناخت اجتماعی (جدول ۳).

مطالعات خارج شده

در هنگام بررسی متن کامل مقالات ۱۲۴ مطالعه از این بررسی خارج شدند که دلایل آنها در جدول ۲ و پیوست ۱۴ آمده است.

اثربخشی مداخلات/ارزیابی کیفی مطالعات

همان طور که اشاره شد، مطالعات به دست آمده به چهار حوزه کلی (۱) توجه، (۲) پردازش شنیداری، (۳) کارکردهای اجرایی و (۴) شناخت اجتماعی دسته‌بندی شده و نتایج آنها مورد بررسی قرار گرفت.

توجه

اطلاعات مربوط به این حوزه در جدول خلاصه یافته‌ها آمده است (پیوست ۲)

از میان مطالعات به دست آمده ۷ مقاله به بررسی مداخله در حوزه توجه پرداخته‌اند. ۳ مطالعه بر روی توجه به صورت کلی [۱۲-۱۴]، ۳ مطالعه بر روی توجه دیداری [۱۵-۱۷] و ۱ مطالعه بر پردازش زمینه‌ای [۱۸] تمرکز داشته‌اند. طرح آزمایشی ۲ مطالعه کارآزمایی بالینی تصادفی شده، ۲ مطالعه کارآزمایی بالینی تصادفی نشده، ۲ مطالعه پیش‌آزمون-پس‌آزمون و ۱ مطالعه تک آزمودنی است.

این مطالعات نشان دادند که مداخلات انجام شده بر روی توجه باعث بهبود عملکرد افراد دارای اتیسم در حوزه‌هایی مانند کنترل توجه، جابجایی توجه و توجه انتخابی (روش مداخله: موسیقی درمانی) [۱۳]، دامنه توجه، توجه پایدار، توجه فضایی (روش مداخله: بازی کامپیوتری) [۱۵]، عملکرد پیوسته (روش مداخله: تمرینات ادراکی حرکتی) [۱۴]، مهارت‌های شناختی و تحصیلی (روش مداخله: بازی کامپیوتری) [۱۲]، پردازش زمینه‌ای (روش مداخله: واقعیت مجازی) [۱۸]، توجه پایدار دیداری (روش مداخله: تمرینات توجه دیداری با استفاده از کامپیوتر) [۱۶] و توجه دیداری (روش مداخله: بازی کامپیوتری) [۱۷] شده است. نمونه مورد بررسی در تمامی مطالعات دارای تشخیص اتیسم بوده و به استثناء یک مطالعه که میانگین هوشی شرکت کنندگان ۸۶/۲۵ بوده است [۱۲]، شرکت کنندگان سایر مطالعات دارای عملکرد پایین بوده‌اند.

همانطور که در پیوست ۳ و ۴ مشاهده می‌شود، سطح کیفی شواهد به دست آمده قوی نمی‌باشد. تنها ۲ مطالعه کارآزمایی بالینی تصادفی سازی شده در میان مطالعات وجود دارد [۱۲، ۱۶] که در هر دو مطالعه معیارهای ورود و خروج آزمودنی‌ها به خوبی تعریف نشده است. همچنین در مطالعات صورت گرفته برای کنترل عوامل احتمالی تأثیرگذار بر اثربخشی مداخله (i.e. potential predictors/moderators) اقدامی صورت نگرفته است.

پردازش شنیداری

اطلاعات مربوط به این حوزه در جدول خلاصه یافته‌ها آمده است (پیوست ۵)

در مجموع ۲ مطالعه واجد شرایط در زمینه اثربخشی مداخلات حوزه پردازش شنیداری به دست آمده است. طرح آزمایشی یکی از مطالعات پیش‌آزمون-پس‌آزمون با گروه کنترل [۱۹] و مطالعه دیگر کارآزمایی بالینی تصادفی نشده [۲۰] می‌باشد. نتایج این مطالعات نشان دهنده اثربخشی مداخلات انجام شده بر مهارت‌های پردازش شنیداری و زبانی، گوش دادن دایکوتیک (روش مداخله: Dichotic Inter-Aural Intensity Difference (DIID) training) [۲۰] و همچنین پتانسیل برانگیخته و نشانه‌های رفتاری اتیسم (روش مداخله: آموزش یکپارچگی شنیداری) [۱۹] بوده است. همان طور که در پیوست ۶ و ۷ مشاهده می‌شود، سطح کیفی شواهد به دست آمده قوی نیست.

کارکردهای اجرایی

اطلاعات مربوط به این حوزه در جدول خلاصه یافته‌ها آمده است (پیوست ۸)

از میان مطالعات به دست آمده ۱۴ مقاله به بررسی اثر مداخلات مبتنی بر کارکردهای اجرایی پرداخته‌اند. طرح آزمایشی مطالعه ۸ پیش‌آزمون-پس‌آزمون، ۵ مطالعه کارآزمایی بالینی تصادفی شده و ۱ مطالعه تک آزمودنی بوده است. نمونه مورد بررسی این مطالعات بر اساس آزمون‌های تشخیصی استاندارد یا ارزیابی بالینی بر اساس معیارهای تشخیصی DSM و یا ICD تشخیص طیف اتیسم داشته و در سنین بین ۵ تا ۱۹ سال قرار داشتند. این مطالعات نشان دادند که مداخلات مبتنی بر کارکردهای اجرایی باعث بهبود عملکرد افراد دچار اتیسم در این حوزه‌ها می‌شود از جمله:

توجه و تمرکز، تکانشگری، واکنش هیجانی، عملکرد تحصیلی و تعاملات و آگاهی اجتماعی (روش مداخله: تکالیف کامپیوتری شنیداری، دیداری و دیداری-فضایی) [۲۱]، پرتحرکی، همکاری و همدلی و تفکر منعطف (روش مداخله: فعالیت‌های گروهی شامل داستان خوانی و ایفای نقش) [۲۲]، حافظه کاری، حفظ توجه، توجه تفکیکی و عملکرد تحصیلی (روش مداخله: بازی جدی متمرکز بر توجه و حافظه کاری) [۲۳]، اثربخشی مداخلات گفتاری بر مشارکت در ارتباط و تعاملات اجتماعی (روش مداخله: تمرینات کارکردهای اجرایی در طی جلسات گفتار درمانی) [۲۴، ۲۵]، حافظه کاری، فراشناخت و قدرت و چابکی حرکتی (روش مداخله: بازی حرکتی Makoto Arena) [۲۶]، توانایی‌های هوشی، انعطاف‌پذیری واجی، حافظه کاری، نشانه‌های بالینی و عملکرد تحصیلی (روش مداخله: تمرینات مداد و کاغذی کارکردهای اجرایی) [۲۷]، توانایی بازداری، جابجایی و برنامه‌ریزی (روش مداخله: تمرینات محرک دیداری شنیداری با استفاده از وسایل) [۲۸]، تعامل‌های اجتماعی، جابجایی توجه (روش مداخله: نوروفیدبک) [۲۹]، حل مسأله، انعطاف‌پذیری، برنامه‌ریزی/سازماندهی و پیروی از قوانین (روش مداخله: تمرینات کارکردهای اجرایی شامل پوستر، مداد و کاغذ و تخته‌ای Unstuck and On Target) [۳۰]، حافظه کاری و انعطاف‌پذیری (روش مداخله: تمرینات کامپیوتری کارکردهای اجرایی) [۳۱]، حافظه کاری و بازداری (روش مداخله: تمرینات کارکردهای اجرایی) [۳۲]. همان طور که در پیوست ۹ و ۱۰ مشاهده می‌شود، سطح کیفی شواهد به دست آمده قوی نیست.

شناخت اجتماعی

اطلاعات مربوط به این حوزه در جدول خلاصه یافته‌ها آمده است (پیوست ۱۱)

در مجموع ۳۶ مطالعه به بررسی اثربخشی مداخلات مبتنی بر شناخت اجتماعی پرداخته‌اند که از میان آنها ۱۰ مطالعه مبتنی بر بازشناسی هیجان [۳۳-۴۲]، ۲ مطالعه مبتنی بر تنظیم هیجان [۴۳، ۴۴]، یک مطالعه مبتنی بر تقلید [۴۵]، ۱۲ مطالعه مبتنی بر توجه مشترک [۴۶-۵۷]، ۶ مطالعه مبتنی بر شناخت اجتماعی [۵۸-۶۴]، یک مطالعه مبتنی بر تعامل اجتماعی [۱۶] و ۴ مطالعه مبتنی بر نظریه ذهن [۶۵-۶۸] بودند. طرح آزمایشی ۱ مطالعه مورد-شاهدی، ۴ مطالعه پیش‌آزمون-پس‌آزمون، ۱۰ مطالعه تک آزمودنی، ۱۸ مطالعه کارآزمایی بالینی تصادفی شده و ۳ مطالعه کارآزمایی بالینی تصادفی نشده بوده است.

حوزه‌های مختلفی که بر اساس مداخلات صورت گرفته مبتنی بر بازشناسی هیجان بهبود پیدا کرده‌اند عبارتند از:

بازشناسی هیجان‌ها (روش‌های مداخله: تمرینات کامپیوتری آموزش هیجان، ویدئو موقعیت‌های مختلف و تصاویر هیجان‌ها مختلف چهره، برنامه کامپیوتری آموزش هیجان‌ها، ویدئو قطارها در ۳ مطالعه، نرم‌افزار کامپیوتری آموزش هیجان‌ها، برنامه آموزشی روانی اجتماعی، برنامه کامپیوتری آموزش ابراز هیجان‌ها) [۲۲، ۳۳، ۳۵-۳۹، ۴۲، ۴۸] و بازشناسی هیجان‌ها و تعاملات اجتماعی با همسالان (روش مداخله: برنامه کامپیوتری) [۳۴].

مداخلات مبتنی بر تنظیم هیجانی باعث بهبود تنظیم هیجان‌ها، نشانه‌های درون‌نمود و برون‌نمود و رفتارهای سازشی هستند (روش مداخله: بازی کامپیوتری شامل فعالیت‌های مبتنی بر آموزش شناخت و مهارت‌های اجتماعی) [۴۳، ۴۴].

مطالعه انجام شده بر روی تقلید نشان دهنده بهبود گروه مداخله در مهارت‌های توجه مشترک و عملکرد اجتماعی هیجانی بوده است (روش مداخله: آموزش تقلید اجتماعی در طول بازی‌های تعاملی) [۴۵].

حوزه‌های مختلفی که بر اساس مداخلات صورت گرفته مبتنی بر توجه مشترک بهبود پیدا کرده‌اند عبارتند از:

- مهارت‌های بازی و مشارکت در کلاس (روش مداخله: مشارکت دادن کودکان توسط معلم در فعالیت‌های مشترک) [۶۹]،
- آغازگری و طول مدت رفتارهای توجه مشترک [۴۷، ۴۸ و ۵۰]،
- توجه به چهره، واکنش به توجه مشترک، زبان دریافتی و ارتباط (روش مداخله: آموزش مهارت‌های ارتباطی پیش کلامی) [۴۹]،
- زبان بیانی، فراوانی توجه مشترک، پاسخ به توجه مشترک، سطح و نوع بازی‌های نمادین (روش مداخله: آموزش توجه مشترک و بازی نمادین) [۵۱]،
- آغازگری در طول بازی (روش مداخله: آموزش توجه مشترک و بازی نمادین) [۵۲]،
- تعمیم مهارت‌های توجه مشترک (روش مداخله: آموزش ارتباط اجتماعی و نگاه) [۵۴]،
- آغازگری‌های اجتماعی، عاطفه مثبت، تقلید و گفتار خود انگیزه (روش مداخله: آموزش پاسخ به توجه مشترک) [۵۵] و
- نگاه هماهنگ با اشاره (روش مداخله: آموزش توجه مشترک و بازی نمادین) [۵۷]

حوزه‌های مختلفی که بر اساس مداخلات صورت گرفته مبتنی بر شناخت اجتماعی بهبود پیدا کرده‌اند عبارتند از:

- کیفیت ارتباط اجتماعی و واکنش صحیح به هیجانات چهره (روش مداخله: بازی گروهی مبتنی بر درمان شناختی رفتاری) [۷۰]،
- هدفمندی و نظریه ذهن (روش مداخله: برنامه مهارت آموزی) [۵۹]،
- درک معنا و هدف تعامل‌های اجتماعی (روش مداخله: روش ارتباطی مکمل و جایگزین با استفاده از iPad) [۶۰]،
- ارتباط غیرکلامی، واکنشی همدلانه و ارتباطات اجتماعی (روش مداخله: آموزش مهارت‌های اجتماعی) [۶۱]،
- شناخت اجتماعی، بازشناسی هیجان و عملکرد اجتماعی و شغلی در زندگی واقعی (روش مداخله: آموزش شناخت اجتماعی با استفاده از واقعیت مجازی) [۶۲] و
- کفایت اجتماعی (روش مداخله: آموزش مهارت‌های اجتماعی) [۶۳]،
- یک مطالعه نیز نشان دهنده تأثیر نوروفیدبک بر بهبود تعامل‌های اجتماعی (بازشناسی هیجان، تقلید خودانگیزه و رفتار مناسب در زندگی روزمره) بوده است [۶۴].

در میان این مطالعات چهار مداخله مهارت نظریه ذهن را به صورت مستقیم هدف قرار داده‌اند که نشان‌دهنده کاهش آزار توسط همسالان در مدرسه (روش مداخله: برنامه آموزش عملکرد نظریه ذهن) [۶۵]، تعمیم مهارت‌های آموخته شده (روش مداخله: استفاده از شخصیت‌های مقوایی دو بعدی) [۶۶]، بهبود نشانه‌های اتیسم و مهارت‌های نظریه ذهن (روش مداخله: جلسات آموزش هفتگی) [۶۷] و تعامل‌های اجتماعی مناسب (روش مداخله: آموزش مهارت‌ها) [۶۸] بوده‌اند.

همان طور که در پیوست‌های ۱۲ و ۱۳ مشاهده می‌شود، مطالعات این حوزه از سطح کیفی مناسبی برخوردار هستند.

بحث و نتیجه گیری

خلاصه یافته‌های اصلی

در مجموع ۵۹ مطالعه وارد این بررسی مروری شدند که به چهار حوزه کلی (۱) توجه، (۲) پردازش شنیداری، (۳) کارکردهای اجرایی و (۴) شناخت اجتماعی قابل دسته‌بندی هستند.

از میان مطالعات به دست آمده هفت مقاله به بررسی مداخله در حوزه توجه پرداخته‌اند. این مطالعات نشان دادند که مداخلات انجام شده بر روی توجه باعث بهبود عملکرد افراد دارای اتیسم در حوزه‌هایی مانند کنترل توجه، جابجایی توجه و توجه انتخابی (روش مداخله: موسیقی درمانی) [۱۳]، دامنه توجه، توجه پایدار، توجه فضایی (روش مداخله: بازی کامپیوتری) [۱۵]، عملکرد پیوسته (روش مداخله: تمرینات ادراکی حرکتی) [۱۴]، مهارت‌های شناختی و تحصیلی (روش مداخله: بازی کامپیوتری) [۱۲]، پردازش زمینه‌ای (روش مداخله: واقعیت مجازی) [۱۸]، توجه پایدار دیداری (روش مداخله: تمرینات توجه دیداری با استفاده از کامپیوتر) [۱۶] و توجه دیداری (روش مداخله: بازی کامپیوتری) [۱۷] شده است.

در مجموع دو مطالعه واجد شرایط در زمینه اثربخشی مداخلات حوزه‌ی پردازش شنیداری به دست آمده است. طرح آزمایشی یکی از مطالعات پیش‌آزمون-پس‌آزمون با گروه کنترل [۱۹] و مطالعه دیگر کارآزمایی بالینی تصادفی نشده [۲۰] می‌باشد. نتایج این مطالعات نشان دهنده اثربخشی مداخلات انجام شده بر مهارت‌های پردازش شنیداری و زبانی، گوش دادن دایکوتیک (روش مداخله: Dichotic Intermural Intensity Difference (DIID) Training) [۲۰] و همچنین پتانسیل برانگیخته و نشانه‌های رفتاری اتیسم (روش مداخله: آموزش یکپارچگی شنیداری) [۱۹] بوده است.

از میان مطالعات به دست آمده ۱۴ مقاله به بررسی اثر مداخلات مبتنی بر کارکردهای اجرایی پرداخته‌اند. این مطالعات نشان دادند که مداخلات مبتنی بر کارکردهای اجرایی باعث بهبود عملکرد افراد دچار اتیسم در توجه و تمرکز، تکانشگری، واکنش هیجانی، عملکرد تحصیلی و تعاملات و آگاهی اجتماعی (روش مداخله: تکالیف کامپیوتری شنیداری، دیداری و دیداری-فضایی) [۲۱]، پرتحرکی، همکاری و همدلی و تفکر منعطف (روش مداخله: فعالیت‌های گروهی شامل داستان خوانی و ایفای نقش) [۲۲]، حافظه کاری، حفظ توجه، توجه تفکیکی و عملکرد تحصیلی (روش مداخله: بازی جدی متمرکز بر توجه و حافظه کاری) [۲۳]، اثربخشی مداخلات گفتاری بر مشارکت در ارتباط و تعاملات اجتماعی (روش مداخله: تمرینات کارکردهای اجرایی در طی جلسات گفتار درمانی) [۲۴ و ۲۵]، حافظه کاری، فراشناخت و قدرت و چابکی حرکتی (روش مداخله: بازی حرکتی Makoto Arena) [۲۶]، توانایی‌های هوشی، انعطاف‌پذیری واجی، حافظه کاری، نشانه‌های بالینی و عملکرد تحصیلی (روش مداخله: تمرینات مداد و کاغذی کارکردهای اجرایی) [۲۷]، توانایی بازداری، جابجایی و برنامه‌ریزی (روش مداخله: تمرینات محرک دیداری شنیداری با استفاده از وسایل) [۲۸]، تعامل‌های اجتماعی، جابجایی توجه (روش مداخله: نوروفیدبک) [۲۹]، حل مسأله، انعطاف‌پذیری، برنامه‌ریزی/ سازماندهی و پیروی از قوانین (روش مداخله: تمرینات کارکردهای اجرایی شامل پوستر، مداد و کاغذی و تخته‌ای Unstuck and On Target) [۳۰]، حافظه کاری و انعطاف‌پذیری (روش مداخله: تمرینات کامپیوتری کارکردهای اجرایی) [۳۱]، حافظه کاری و بازداری (روش مداخله: تمرینات کارکردهای اجرایی) [۳۲] می‌شوند.

در مجموع ۳۶ مطالعه به بررسی اثربخشی مداخلات مبتنی بر شناخت اجتماعی پرداخته‌اند. این مطالعات نشان دادند که مداخلات مبتنی بر بازشناسی هیجان بر بهبود عملکرد افراد دچار اتیسم در بازشناسی هیجانات چهره (روش‌های مداخله: تمرینات کامپیوتری آموزش هیجان، ویدئو موقعیت‌های مختلف و تصاویر هیجانات مختلف چهره، برنامه کامپیوتری آموزش هیجانات، ویدئوی قطارها در سه مطالعه، نرم‌افزار کامپیوتری آموزش هیجانات، برنامه آموزشی روانی اجتماعی، برنامه کامپیوتری آموزش ابراز هیجانات) [۲۲، ۳۳، ۳۵-۳۹، ۴۲ و ۴۸] و بازشناسی هیجانات و تعاملات اجتماعی با همسالان (روش مداخله: برنامه کامپیوتری) [۳۴] داشته‌اند. مداخلات مبتنی بر تنظیم هیجانی باعث بهبود تنظیم هیجان‌ها، نشانه‌های درون‌نمود و برون‌نمود و رفتارهای سازشی هستند (روش مداخله: بازی کامپیوتری شامل فعالیت‌های مبتنی بر آموزش شناخت و مهارت‌های اجتماعی) [۴۳ و ۴۴]. مطالعه انجام شده بر روی تقلید نشان دهنده بهبود گروه مداخله در مهارت‌های توجه مشترک و عملکرد اجتماعی هیجانی بوده است (روش مداخله: آموزش تقلید اجتماعی در طول بازی‌های تعاملی) [۴۵]. مداخلات صورت گرفته مبتنی بر توجه مشترک باعث بهبود عملکرد افراد دچار اتیسم در مهارت‌های بازی و مشارکت در کلاس (روش مداخله: مشارکت دادن کودکان توسط معلم در فعالیت‌های مشترک) [۶۹]، آغازگری و طول مدت رفتارهای توجه مشترک [۴۷، ۴۸ و ۵۰]، توجه به چهره، واکنش به توجه مشترک، زبان دریافتی و ارتباط (روش مداخله: آموزش مهارت‌های ارتباطی پیش کلامی) [۴۹]، زبان بیانی، فراوانی توجه مشترک، پاسخ به توجه مشترک، سطح و نوع بازی‌های نمادین (روش مداخله: آموزش توجه مشترک و بازی نمادین) [۵۱]، آغازگری در طول بازی (روش مداخله: آموزش توجه مشترک و بازی نمادین) [۵۲]، تعمیم مهارت‌های توجه مشترک (روش مداخله: آموزش ارتباط اجتماعی و نگاه) [۵۴]، آغازگری‌های اجتماعی، عاطفه مثبت، تقلید و گفتار خود انگیخته (روش مداخله: آموزش پاسخ به توجه مشترک) [۵۵] و نگاه هماهنگ با اشاره (روش مداخله: آموزش توجه مشترک و بازی نمادین) [۵۷] هستند. مداخلات مبتنی بر شناخت اجتماعی باعث بهبود عملکرد افراد دچار اتیسم در کیفیت ارتباط اجتماعی و واکنش صحیح به هیجانات چهره (روش مداخله: بازی

گروهی مبتنی بر درمان شناختی رفتاری) [۷۰]، هدفمندی و نظریه ذهن (روش مداخله: برنامه مهارت‌آموزی) [۵۹]، درک معنا و هدف تعامل‌های اجتماعی (روش مداخله: روش ارتباطی مکمل و جایگزین با استفاده از iPad) [۶۰]، ارتباط غیرکلامی، واکنشی همدلانه و ارتباطات اجتماعی (روش مداخله: آموزش مهارت‌های اجتماعی) [۶۱]، شناخت اجتماعی، بازشناسی هیجان و عملکرد اجتماعی و شغلی در زندگی واقعی (روش مداخله: آموزش شناخت اجتماعی با استفاده از واقعیت مجازی) [۶۲] و کفایت اجتماعی (روش مداخله: آموزش مهارت‌های اجتماعی) [۶۳] می‌باشند. یک مطالعه نیز نشان دهنده تأثیر نوروفیدبک بر بهبود تعامل‌های اجتماعی (بازشناسی هیجان، تقلید خودانگیخته و رفتار مناسب در زندگی روزمره) بوده است [۶۴]. در میان این مطالعات چهار مداخله مهارت نظریه ذهن را به صورت مستقیم هدف قرار داده‌اند که نشان‌دهنده کاهش آزار توسط همسالان در مدرسه (روش مداخله: برنامه آموزش عملکرد نظریه ذهن) [۶۵]، تعمیم مهارت‌های آموخته شده (روش مداخله: استفاده از شخصیت‌های مقوایی دو بعدی) [۶۶]، بهبود نشانه‌های اتیسم و مهارت‌های نظریه ذهن (روش مداخله: جلسات آموزش هفتگی) [۶۷] و تعامل‌های اجتماعی مناسب (روش مداخله: آموزش مهارت‌ها) [۶۸] بوده‌اند.

نتیجه‌گیری نویسندگان

در مجموع می‌توان گفت مداخلات مبتنی بر نقایص شناختی می‌توانند باعث بهبود نشانه‌های اصلی و عملکرد افراد دچار اتیسم شوند. هرچند شواهد کافی برای ماندگاری و تعمیم اثرات این مداخلات در زندگی روزمره این افراد وجود ندارد. اثربخشی بهتر مداخلات شناختی زمانی ایجاد خواهد شد که به عنوان بخشی از یک برنامه مداخلاتی جامع در نظر گرفته و در شرایط مشابه فعالیت‌های واقعی آموزش داده شوند.

کاربرد بالینی

در ارتباط با کاربرد بالینی یافته‌های مطالعه حاضر باید تأکید کرد که استفاده از مداخلات شناختی هم به عنوان یک بخش نسبتاً مؤثر و هم به عنوان مکمل برنامه‌های آموزشی و توانبخشی همه‌جانبه سودمند خواهد بود و همچنین با توجه به تنوع نقایص شناختی در افراد دچار اتیسم مداخله هم زمان بر روی چند حوزه شناختی ضروری است.

کاربرد پژوهشی

به منظور دسترسی به تصویری روشن‌تر از اثربخشی مداخلات شناختی و مکانیزم‌های احتمالی آن انجام پژوهش‌هایی با نمونه‌های بیشتر و طرح‌های دقیق‌تر ضروری می‌باشد. همچنین بررسی ماندگاری و تعمیم اثرات مداخلات صورت گرفته مورد دیگری است که نیاز به بررسی دقیق‌تر دارد. تعریف دقیق پروتکل‌های مداخله نیز می‌تواند به استفاده بالینی و تکرار نتایج به دست آمده کمک کند.

پیوست‌ها

Appendix 1 - Search Strategy		
پایگاه داده	عبارت جستجو سازگار شده با پایگاه داده	تعداد مقالات به دست آمده
Scopus	(TITLE-ABS-KEY (autism OR "Developmental Disorder" OR PDD OR ASD OR autistic OR Asperger) AND TITLE (intervention OR treatment OR therapy OR training OR education OR rehabilitation OR remediation OR effect OR effectiveness OR efficacy OR trial) AND TITLE (process OR cognition OR cognitive OR emotion OR emotional OR perception OR recognition OR "Theory of Mind" OR attention OR "Executive Function" OR intelligence OR shift OR switch OR memory OR inhibition OR flexibility OR visual OR planning OR gaze OR auditory OR social OR awareness OR "centralcoherence" OR reasoning)) AND (LIMIT-TO (LANGUAGE , "English"))	1918
ISI	TITLE: (Autism OR "Developmental Disorder" OR PDD OR ASD OR Autistic OR Asperger) AND TITLE: (Intervention OR Treatment OR Therapy OR Training OR Education OR Rehabilitation OR remediation OR effect OR effectiveness OR efficacy OR trial) AND TITLE: (Process OR Cognition OR Cognitive OR Emotion OR Emotional OR Perception OR Recognition OR "Theory of Mind" OR Attention OR "Executive Function" OR Intelligence OR Shift OR Switch OR Memory OR Inhibition OR Flexibility OR visual OR Planning OR Gaze OR Auditory OR social OR awareness OR "central coherence" OR reasoning) Timespan: All years. Indexes: SCI-EXPANDED, SSCI, CPCI-S, CPCI-SSH, ESCI.	1192
PubMed	((Autism[Title/Abstract] OR "Developmental Disorder"[Title/Abstract] OR PDD[Title/Abstract] OR ASD[Title/Abstract] OR Autistic[Title/Abstract] OR Asperger[Title/Abstract])) AND (Intervention[Title] OR Treatment[Title] OR Therapy[Title] OR Training[Title] OR Education[Title] OR Rehabilitation[Title] OR remediation[Title] OR effect[Title] OR effectiveness[Title] OR efficacy[Title] OR trial[Title])) AND (Process[Title] OR Cognition[Title] OR Cognitive[Title] OR Emotion[Title] OR Emotional[Title] OR Perception[Title] OR Recognition[Title] OR "Theory of Mind"[Title] OR Attention[Title] OR "Executive Function"[Title] OR Intelligence[Title] OR Shift[Title] OR Switch[Title] OR Memory[Title] OR Inhibition[Title] OR Flexibility[Title] OR visual[Title] OR Planning[Title] OR Gaze[Title] OR Auditory[Title] OR social[Title] OR awareness[Title] OR "central coherence"[Title] OR reasoning[Title])	893
	After removing duplicates	2281

Appendix 2 - Summary of Findings in Attention Domain

No	Author	Year	Design	Diagnosis /N /Age /Sex		Inclusion/ Exclusion Criteria	Intervention		Implementatio n strategies	Cognitive target	Measures	Results
				Case	Control		Case	Control		Sub Category		
13	Spaniol, M. M.	2018	Randomized Clinical Trial	ASD N=8 6male 2Femal Mean age:8.13- 0.99 IQ:86.25-19.04	ASD N=7 6male 1Female Mean age:7.86- 1.26 IQ:92.86- 15.5	No	Attention training was employed using the CPAT, which was developed based on Tsal et al. (2005) four-functions of attention model. In this study, three training tasks from the CPAT protocol were used, each separately focusing on either, sustained, selective- spatial or executive attention.	For the active control group, three readily available computer games were used. Participant s in this group took part in a similar number of sessions as the CPAT group.	PC based game at home	Attention	Cognitive ability (Raven CPM), and children's academic performance in math, reading and copying. The views of the class teaching staff were also captured via semi-structured interviews.	Children in the CPAT group showed cognitive and academic improvements over and above the active control group, while children in both groups showed improvements in behavior.
53	Varvara Pasiali	2014	Before-After	ASD/N=9/Ages range:13to20/4 male, 5 female/recrui ted from a private school for high- functioning adolescents with neurodevelopm ental disabilities.	N=0	NA	The music therapy intervention involved participating in eight 45-min sessions over a period of 6 weeks. The technique employed was Musical Attention Control Training.		computer based game	Attention	Test of Everyday Attention for Children (TEA- Ch).	Average participation rate was 97%. Data analysis showed positive trends and improvements on measures of attentional control/switchin g and selective attention.

Appendix 2 - Summary of Findings in Attention Domain

No	Author	Year	Design	Diagnosis /N /Age /Sex		Inclusion/ Exclusion Criteria	Intervention		Implementatio n strategies	Cognitive target	Measures	Results
				Case	Control		Case	Control		Sub Category		
54	Javad Afshari	2012	Non-randomized clinical trial	ASD/N=20/10 male,10 female	N=20/10 male,10 female	The criteria for entering the second phase	Perceptual motor skills training: This method has been referred to as the interventional program and was designed and conducted by Kurtz (2008) and includes physical awareness, motor planning, mutual motor integrity, balancing skills, fine motor harmony, visual performance skills and oral motor skills.			Attention	SDQ/Raven IQTest/Lincoln Ozertesky Skill Tests/Continuous Performance Tests (CPT)	The significance in the pretest results shows that these scores have a significant correlation with the scores of independent variables (posttest) and this effect (the effect of pretest on posttest) has been controlled by the analysis of covariance.

Appendix 2 - Summary of Findings in Attention Domain

No	Author	Year	Design	Diagnosis /N /Age /Sex		Inclusion/ Exclusion Criteria	Intervention		Implementatio n strategies	Cognitive target	Measures	Results
				Case	Control		Case	Control		Sub Category		
60	Michelle Wang	2013	Single subject	ASD/3 male, 1 female/Age range= 6y 7m to 8y 11m		The inclusion criteria: (1) diagnosis of an ASD by a specialist; (2) chronological age between 5 and 10 years old; (3) Childhood Autism Rating Scale score of 30–36); and (4) average or above-average nonverbal IQ.	This pilot study investigated the efficacy of a novel virtual reality cognitive rehabilitation (VR-CR) intervention to improve contextual processing of objects in children with autism.		Tablet based	Contextual processing	Virtual Reality Test of Contextual Processing of Objects (VR Test) Modified Version of the Flexible Item Selection Task (FIST-m) Attention Sustained Subtest	Overall, the results demonstrate improvements in contextual processing ability from baseline to treatment for each child, with average increases from 15% (Child 2) to 46% (Child 4).
1	Leanne Chukoskie	2018	Before-After	ASD/N=8/5 male, 3 female/ Mean age= 13.9 years/		No	The game developers created three colorful and engaging games with interesting sound effects. These games were designed with principles to train fixation, speed and accuracy of eye movements & control of visuo-spatial attention.			Visual attention	Spatial Attention Task (E Task) Gap-Overlap Saccade Task	All 6 of the 8 participants who completed the training showed significant improvement on one or more outcome measures.

Appendix 2 - Summary of Findings in Attention Domain

No	Author	Year	Design	Diagnosis /N /Age /Sex		Inclusion/ Exclusion Criteria	Intervention		Implementatio n strategies	Cognitive target	Measures	Results
				Case	Control		Case	Control		Sub Category		
33	Georgina Powell	2016	Randomized Clinical Trial	ASD/N=9/ 8 male, 1 female/ Mean age:6 years 5months.	ASD/N=8/ 7 male, 1 female/ Mean age: 7 years 2 months.	No exclusion criteria were specified because we wanted the study to be as inclusive as possible.	The training battery consisted of four different training tasks, targeting a combination of interference resolution, inhibition, visual search, online goal maintenance and task-switching. These were presented in rotation, in an order that was counterbalanced between visits and between participants. All four tasks were presented at each training session, until the participant refused to engage further with that task.			Visual attention	Testing equipment consisted of (1) a Tobii X2-60 portable eye tracker; (2) a 23" external monitor; (3) a laptop running Windows 7	Following training, significant and selective changes in visual sustained attention were observed. Trend training effects were also noted on disengaging visual attention, but no convincing evidence of transfer was found to non-trained assessments of saccadic reaction time and anticipatory looking.

Appendix 2 - Summary of Findings in Attention Domain

No	Author	Year	Design	Diagnosis /N /Age /Sex		Inclusion/ Exclusion Criteria	Intervention		Implementatio n strategies	Cognitive target	Measures	Results
				Case	Control		Case	Control		Sub Category		
46	María Vélez-Coto	2017	Non-randomized clinical trial	ASD-low/N=74/ Mean age= 13.47 years.	ASD-low/N=28/ Mean age= 12.61 years.	Children were between 3 and 16 years old/Children had been professionally diagnosed with ASD and/or as cognitively low-functioning	SIGUEME consists of six phases with different exercises each one, which range from gathering the attention of the user to the classification of pictograms and text, with the additional use of sounds, music, videos, gestures and words. It offers two tools: a customization tool for educators and another for people with low-functioning disabilities and ASD in particular.			Visual attention	battery	There was a statistically significant improvement in the experimental group in Attention ($W = -5.497$, $p < 0.001$). There was also a significant change in Association and Categorization ($W = 2.721$, $p = 0.007$) and Interaction ($W = -3.287$, $p = 0.001$).

Appendix 3 - Quality Assessment of Articles in Attention Domain							
Author	Leanne Chukoskie	Spaniol, M. M.	Georgina Powell	María Vélez-Coto	Varvara Pasiali	Javad Afshari	Michelle Wang
Year	2018	2018	2016	2017	2014	2012	2013
Sub-Category	Visual attention	Attention	Visual attention	Visual attention	Attention	Attention	Contextual processing
Design	Before-After	Randomized Clinical Trial	Randomized Clinical Trial	Non-randomized clinical trial	Before-After	Non-randomized clinical trial	Single subject
Are randomization procedures clearly detailed and justified?	No	No	yes	No	No	No	NA
Are intervention protocols standardized and manualized?	No	Yes	yes	Yes	No	Yes	Yes
Are there plans to monitor fidelity and operationalize the delivery of the experimental and comparison conditions?	No	Yes	yes	yes	NA	NA	Yes
Are statistical approaches state of the art and appropriately matched to the research question and data structure?	Yes	Yes	yes	yes	Yes	Yes	Yes
Diagnosis confirmation	Yes	Yes	Yes	No	Yes	Yes	Yes
Are potential predictors/moderators assessed?	No	Yes	No	NI	NI	Yes	No
Are inclusion/exclusion criteria justified?	No	No	No	Yes	NI	Yes	Yes
Are cognitive targets linked to clinical status and functioning?	Yes	Yes	yes	yes	Yes	Yes	Yes
Do the cognitive training interventions match the perceptual/cognitive/affective processes that characterize the disorder and/or neural circuits implicated?	Yes	Yes	yes	yes	Yes	Yes	Yes
Is the hypothesized therapeutic mechanism supported by research and theory?	Yes	Yes	yes	yes	NA	Yes	Yes
Are potential predictors/moderators of outcomes considered?	No	No	No	Yes	No	No	yes
Do assessments provide for the elucidation of intervention mechanisms?	No	Yes	Yes	no	Yes	Yes	NA
Are retention/completion rates assessed and reported?	Yes	Yes	yes	yes	No	Yes	Yes
Are cognitive/functional outcomes distinguishable from practice effects?	No	Yes	yes	yes	No	Yes	Yes
Are valid measures of proximal and more distal outcomes included?	No	Yes	no	yes	No	No	Yes
Does the plan include measures at multiple levels of analysis as appropriate?	No	No	no	no	No	No	No
Is cognitive training intended as a monotherapy or as an adjunctive treatment?	monotherapy	Monotherapy	adjunctive	monotherapy	Monother	Monotherap	Monotherap
Are concomitant treatments considered in the assessment and analysis plan?					apy	y	y
How might the proposed concomitant therapies potentiate or interfere with cognitive training effects?	NA	NA	NI	NA	NA	NA	NA
Are concomitant treatments held constant across treatment conditions and/or quantified and considered in analyses?	NA	NA	yes	NA	NA	NA	NA
Is the comparison condition justified in terms of the research question and stage of intervention development/testing?	NA	Yes	na	NA	NA	NA	NA
Does the comparison condition control for attention, expectations, and potential practice effects associated with training/assessment protocols, as appropriate?	NA	Yes	na	NA	NA	NA	NA
Are all relevant stakeholders considered?	No	No	no	No	No	No	NA

Attention

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%



Appendix 4 - Quality of Evidence in Attention Domain

Appendix 5 - Summary of Findings in Auditory Processing Domain

No	Author	Year	Design	Diagnosis/N/Age/Sex		Inclusion/ Exclusion Criteria	Intervention		Implemen tation strategies	Cognitive target Sub-Group	Measures	Results
				Case	Control		Case	control				
27	Estate M. Sokhadz e	2016	Before- After	ASD N=18 15 males 3 females Mean age = 11.06 ± 2.26 years.	TD N = 16 12 males 4 females Mean age= 12.6 ± 3.14 years.	No	The present study used Berard's technique of auditory integration training (AIT) to improve sound integration in children with autism.			Auditory integration	Post-AIT changes in evoked potentials	Post-AIT changes in evoked potentials could be summarized as a decreased magnitude of N1 to rare stimuli, marginally lower negativity of MMN, and decrease of the P3a to frequent stimuli along with delayed latency and higher amplitude of the P3b to the rare stimuli. These evoked potential changes following completion of Berard AIT course are in a positive direction, making them less distinct from those recorded in age-matched group of typical children, thus could be considered as changes towards normalization. Parental questionnaires clearly demonstrated improvements in behavioral symptoms such as irritability, hyperactivity, repetitive behaviors and other important behavioral domains.

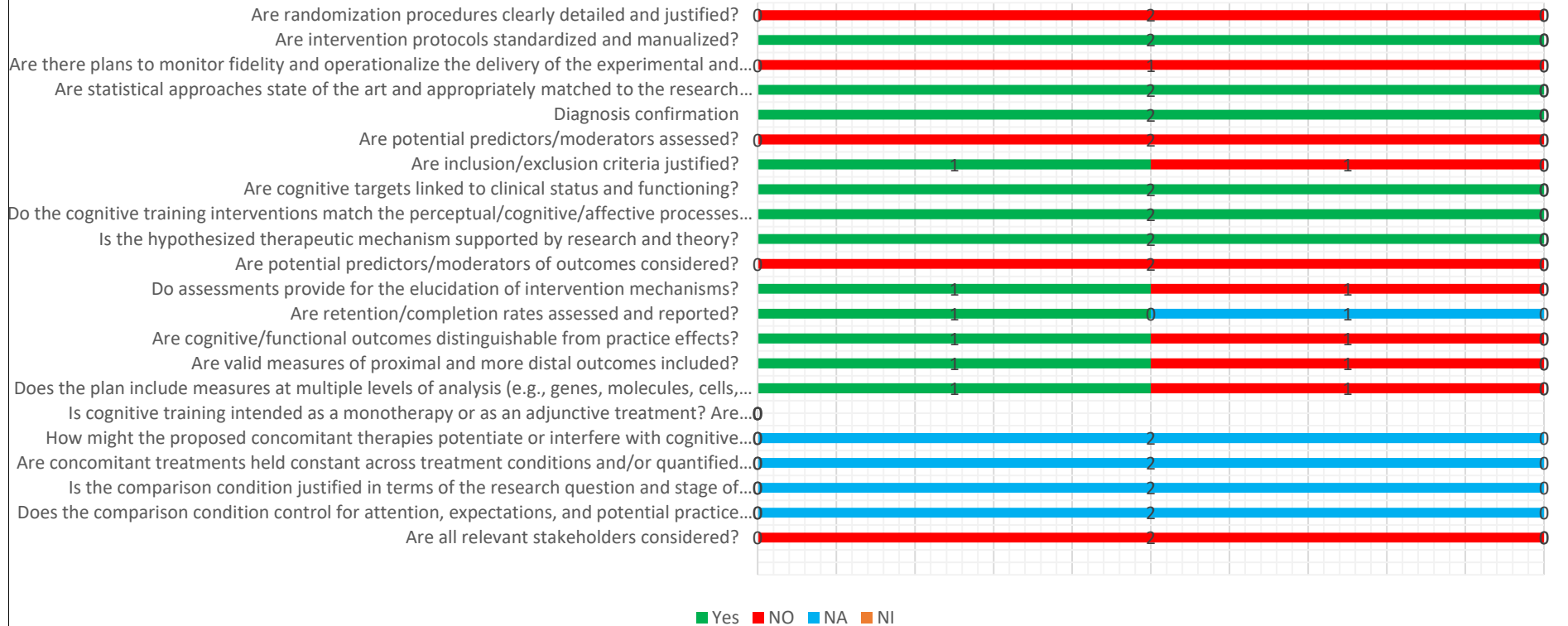
Appendix 5 - Summary of Findings in Auditory Processing Domain

No	Author	Year	Design	Diagnosis/N/Age/Sex		Inclusion/ Exclusion Criteria	Intervention		Implemen tation strategies	Cognitive target Sub-Group	Measures	Results
				Case	Control		Case	control				
29	Hesham Kozou	2018	Non-randomized clinical trial	ASD N=30 25 males 5 females Mean age: 7-years		IQ>70, were verbal, a language age of at least six years, with normal peripheral hearing, free from neurological and genetic disorders.	The remediation was based on dichotic interaural intensity difference (DIID) training. The protocol of training was adapted from constraint induced auditory training (CIAT) program (30-min sessions, two times per week, for six weeks).			Auditory processing	The Arabic version of dichotic digit test (DDT), A test that assesses the process of binaural integration, Auditory processing skills were measured by using an Arabic version of three subtests of SCAN3-C.	Scores of CAP skills in ASD children are wide-ranging from completely normal to substantially defective and generally lower than those of typically developing children. By auditory training, ASD children improved their dichotic deficits as well as other untrained areas of auditory and language processing skills.

Appendix 6 - Quality Assessment of Articles in Auditory Processing Domain		
Author	Estate M. Sokhadze	Hesham Kozou
Year	2016	2018
Sub-Category	Auditory integration	Auditory processing
Design	Before-After	Non-randomized clinical trial
Are randomization procedures clearly detailed and justified?	No	No
Are intervention protocols standardized and manualized?	yes	Yes
Are there plans to monitor fidelity and operationalize the delivery of the experimental and comparison conditions?	No	No
Are statistical approaches state of the art and appropriately matched to the research question and data structure?	yes	yes
Diagnosis confirmation	Yes	Yes
Are potential predictors/moderators assessed?	No	No
Are inclusion/exclusion criteria justified?	No	Yes
Are cognitive targets linked to clinical status and functioning?	yes	yes
Do the cognitive training interventions match the perceptual/cognitive/affective processes that characterize the disorder and/or neural circuits implicated?	yes	yes
Is the hypothesized therapeutic mechanism supported by research and theory?	yes	yes
Are potential predictors/moderators of outcomes considered?	No	No
Do assessments provide for the elucidation of intervention mechanisms?	Yes	No
Are retention/completion rates assessed and reported?	yes	NA
Are cognitive/functional outcomes distinguishable from practice effects?	yes	No
Are valid measures of proximal and more distal outcomes included?	yes	No
Does the plan include measures at multiple levels of analysis (e.g., genes, molecules, cells, circuits, physiology, behavior, and self-report) as appropriate?	yes	No
Is cognitive training intended as a monotherapy or as an adjunctive treatment? Are concomitant treatments considered in the assessment and analysis plan?	Monotherapy	Monotherapy
How might the proposed concomitant therapies potentiate or interfere with cognitive training effects?	NA	NA
Are concomitant treatments held constant across treatment conditions and/or quantified and considered in analyses?	NA	NA
Is the comparison condition justified in terms of the research question and stage of intervention development/testing?	NA	NA
Does the comparison condition control for attention, expectations, and potential practice effects associated with training/assessment protocols, as appropriate?	NA	NA
Are all relevant stakeholders considered?	No	No

Auditory

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%



Appendix 7 - Quality of Evidence in Auditory Processing Domain

Appendix 8 - Summary of Findings in Executive Function Domain

No	Author	Year	Design	Diagnosis/N/Age/Sex		Inclusion/ Exclusion Criteria	Intervention		Implement ation strategies	Measures	Results
				Case	Control		Case	Control			
7	Wecks tein, S. M.	2017	Before-After	Fifteen children/adolesc ents between the ages of 9 and 19 years with ASD and comorbid ADHD		No	CWMT is a computer- based program that consists of 13 auditory, visual, visual spatial, and combined exercises that are practiced for 45 minutes a day, 5 days a week, for 5 weeks.		computer based game play	Battery of tests	The retrospective chart analysis and follow-up demonstrated improvement in attention and focus, impulsivity, emotional reactivity, and academic achievement in individuals with ASD and comorbid ADHD. Those benefits remained the same or increased over time. A number of participants also had benefits in their social interaction/social awareness.
11	Sophie Goldin gay	2015	Before-After	ASD N=5 4 males 1 female Mean age=13.5 years		No	The intervention had a number of activities. Firstly, it included activities designed to develop flexible thinking. The main activity each week was to work as a group to develop a storyboard with accompanying characters and narrative, with the group aim being to prepare a 'movie' to film on the final week of the study. They then negotiated a storyboard with their fellow participants and designed and set up props for the movie.		Group based intervention	Hayes Ability Screening Index. Associate Fluency Tests. Social Skills Improvement System. Animated Movie Test.	A large decrease was found in parent rating of their child's level of hyperactivity (12.8, SD= 2.3; 11, SD = 2.2) (p = 0.034) (Cohen's d = 0.95). Parents increased their rating of their child's cooperation and empathy (Cohen's d = 0.71 and 0.56, respectively). A medium effect for flexible thinking was observed in three items (Cohen's d = 0.5 to 0.62) and a large effect for one item (Cohen's d =1.35). Adolescents decreased self-scoring on the social scale post intervention.

Appendix 8 - Summary of Findings in Executive Function Domain

No	Author	Year	Design	Diagnosis/N/Age/Sex		Inclusion/ Exclusion Criteria	Intervention		Implement ation strategies	Measures	Results
				Case	Control		Case	Control			
12	Kerns, K. A.	2017	Before-After	ASD N=7 4 Males 3 Females Mean Age:8.17 years		Exclusion: Any history of traumatic brain injury, chronic health problem, inability to verbally communicate, or diagnosis of an intellectual disability based on information provided by special education staff and parent or caregiver.	The Caribbean Quest (CQ) is a 'serious game' that consists of five hierarchically structured tasks, delivered in an adaptive format, targeting different aspects of attention and/or working memory. In addition to game play, the intervention incorporates metacognitive strategies provided by trained educational assistants (EAs), to facilitate generalization and far transfer to academic and daily skills.		Computer Game	Measures of distractibility (The Sad and the Happy Ghost), divided attention (The Owls), and attention shifting=flexibility (The Dragons' House) were administered from the computerized battery of the Test of Attentional Performance for Children./Psychometri c evaluations of WM included the Digit and Spatial Span tasks from the WISC-IV – Integrated./ The study utilized the AIMS web curriculum-based measure of oral reading fluency.	Pre- and post-test analyses revealed significant improvement on measures of working memory and attention, including reduced distractibility and improved divided attention skills. Additionally, children showed significant gains in performance on an academic measure of reading fluency, suggesting that training-related gains in attention and working memory transferred to classroom performance. Exit interviews with EAs revealed that the intervention was easily delivered within the school day, that children enjoyed the intervention, and that children transferred metacognitive strategies learned in game play into the classroom.

Appendix 8 - Summary of Findings in Executive Function Domain

No	Author	Year	Design	Diagnosis/N/Age/Sex		Inclusion/ Exclusion Criteria	Intervention		Implement ation strategies	Measures	Results
				Case	Control		Case	Control			
18	Benyakorn, S.	2018	Before-After	ASD-low N=26 Mean age=11.1 years.		Children aged 8-17 years with a diagnosis of ASD, IQ \leq 85, and normal to corrected normal vision and hearing. Exclusion: if there were plans to change current behavioral or pharmacological treatment during the course of the study, if a caregiver reported disruptive behaviors that would interfere with WMT, or if the participant was unable to use a computer or tablet.	All participants were instructed to complete 5 Web-based Cogmed Working Memory Training sessions per week for 5 weeks, for a total of 25 training sessions. There were 2 difficulty levels for participants. Cogmed RM was developed for school-aged TD children, whereas Cogmed JM was for preschool TD children.		web based	The completion rate was defined as the percentage of participants who completed 25 sessions of Cogmed WMT. Participants were considered "adherent" if they finished 25 sessions within 6 weeks. Participants who took longer than 6 weeks to complete the training were considered "nonadherent" with the training protocol. The combined attrition rate was defined as the percentage of participants who did not complete 25 sessions and who were nonadherent with the training protocol. At the end of training, parents completed a questionnaire with 16 Likert-scale and 3 open-ended questions.	Most participants (96%, 25/26) completed the training and indicated high satisfaction (>88%). However, among the participants who completed the training, 5 participants (19%) were unable to finish in 6 weeks, the recommended training period by Cogmed. Parents noted various positive (eg, voice-overs) and negative (eg, particular graphic and sounds associated with a stimulus) features of the game that they thought affected their child's response.

Appendix 8 - Summary of Findings in Executive Function Domain

No	Author	Year	Design	Diagnosis/N/Age/Sex		Inclusion/ Exclusion Criteria	Intervention		Implement ation strategies	Measures	Results
				Case	Control		Case	Control			
21	Sun, I.	2017	Before-After	14 ASD children		NA	This study was designed to verify the effectiveness of an executive functions stimulation program (EFS) during the regular speech-language therapy sessions. During a 12-week period of regular speech-language therapy, the following areas were focused: working memory, cognitive flexibility, central coherence, inhibitory control and specific language aspects.		Individual session		The average performance of children in the stimulation was 85%, ensuring the effectiveness of EFS. The association analysis between pre- and post-EFS performance with FCP a significant improvement was observed in the occupation of the communicative space and the percentage of interactivity.
22	Claudia List Hilton	2014	Before-After	ASD N=7 4 males 3 females Mean age=9.86 years.		A diagnosis of ASD, a full-scale IQ score of ≥ 70 , and a willingness to participate in the Makoto arena intervention approximately 3 times per week were required for inclusion in this study.	Participants completed 2-min sessions of Makoto arena intervention a minimum of 3 times per week until 30 intervention sessions were completed, with each participant attempting to strike the target approximately 1,800 times.			Behavior Rating Inventory of Executive Function (BRIEF) BOT-2	Strong correlations were seen between certain EF and motor scores, suggesting a relationship between the two constructs. Participants increased their average reaction speed (effect size 5 1.18). Significant improvement was seen in the EF areas of working memory and metacognition and the motor area of strength and agility. Findings suggest that use of exergaming, specifically the Makoto arena, has the potential to be a valuable addition to standard intervention for children with ASD who have motor and EF impairments.

Appendix 8 - Summary of Findings in Executive Function Domain

No	Author	Year	Design	Diagnosis/N/Age/Sex		Inclusion/ Exclusion Criteria	Intervention		Implement ation strategies	Measures	Results
				Case	Control		Case	Control			
40	Hajri, M.	2017	Before-After	ASD N=16 Mean age= 10.87 years.		<p>The inclusion criteria are:</p> <ul style="list-style-type: none"> -Diagnosis of ASD according to the DSM-5. -Cognitive difficulties reported by parents. -On a stable dose and type of medication, for at least one month prior to inclusion. -Age between 6 and 21. -Regular school curriculum. <p>Participants are not included if they had:</p> <ul style="list-style-type: none"> -a history of seizures or any other neurological disorder -a history of a chronic medical condition -mental retardation. 	<p>Cognitive remediation therapy CRT was set out in the Frontal/Executive program. It is an individual treatment mostly using pencil and paper tasks and relying on cognitive strategy instruction. It is implemented once a week for between 45 and 90 minutes. The duration of the intervention generally ranges between four and six months. In the program three modules are included, and delivered in the following order: cognitive flexibility, working memory and planning.</p>		Individual sessions	<p>IQ: Raven Progressive Matrices (CPM). Cognitive flexibility: verbal and semantic fluency tests. Inhibition: using either the Hayling Sentence Completion Task, or the Colors and Animals Attention Test (CAAT). Working memory: the mean of forward and backward digit span. Planning: the mean of The Rey-Osterrieth Complex Figure (ROCF).</p>	<p>Twenty-five subjects were included. 16 patients completed the program. After cognitive remediation, children showed significant improvement in intellectual abilities ($p < 0.05$), scores of phonemic flexibility ($p = 0.027$), working memory ($p = 0.003$ for the forward digit-span and $p = 0.003$ for the backward digit-span), clinical symptoms ($p < 0.05$) and school results ($p = 0.001$).</p>

Appendix 8 - Summary of Findings in Executive Function Domain

No	Author	Year	Design	Diagnosis/N/Age/Sex		Inclusion/ Exclusion Criteria	Intervention		Implement ation strategies	Measures	Results
				Case	Control		Case	Control			
48	Sun, I. Y. I.	2017	Before-After	ASD N=20 Age range =5 to 12 years.			The SEF program involved the use of game activities to facilitate the child's cognitive flexibility, operational memory, inhibitory control, and central coherence.			The data used in this study referred to: • the number of communicative acts expressed per minute, • occupation of the communicative space • percentage of interactivity, and • the use of different communicative means (verbal, vocal, or gestural)	The findings suggested that there were differences between the children's pre- and posttest performance. Significantly different performances were observed in the areas of occupation of communication space, proportion of communicative interactivity, and social-cognitive performance.
20	Majid Naeei mi	2013	Randomized Clinical Trial	ASD-H N=41 Age rang= 5 to 8 years.		All children who participated in the study needed to 5 to 8 years old diagnosed as high functioning autism by a verified child psychiatrist.	Experimental instrument in this study was David Pal's unit that is manufactured by Mind Alive Inc. This device consists of a main controller, a headset, a forward glass a wire and power supply interface. There are buttons on the unit to adjust the power button, select button (to select the type of incentive program), light intensity and volume buttons, as well as a part input adapter to connect with. It has 18 default programs of audiovisual stimulation that have been used in children with ADHD or LD. The audiovisual stimulation plan in this study was A 5.		Individual sessions	Behavior Rating Inventory of Executive Function (BRIEF)	Considering significance level, outcome indicates that audio visual stimulation used in the present study increased executive function (inhibition, shifting and planning ability) based on Behavior Rating Inventory of Executive Functioning measures ($F=5/55$, $P<0/05$, $F=24/587$, $P<0/05$, $F=15/28$, $p<0/05$).

Appendix 8 - Summary of Findings in Executive Function Domain

No	Author	Year	Design	Diagnosis/N/Age/Sex		Inclusion/ Exclusion Criteria	Intervention		Implement ation strategies	Measures	Results
				Case	Control		Case	Control			
31	de Vries, M.	2018	Randomized Clinical Trial	WM: ASD 37 Males 4 Females Age:10.5 years Flexibility: ASD 356,4F/Age:10.5	Mock: ASD 35 Males 5 Females Age:10. 6	Yes	The WM training includes five adaptive visual-spatial WM training tasks with increasing difficulty (repeating sequences of blocks in a grid), and the flexibility and inhibition task remained at a low, nonadaptive level. The flexibility training includes an adaptive switch task and the WM and inhibition task remained at a low, nonadaptive level.	In the mock training, all tasks remain at a low, nonadaptive level; hence, children do not differ in their reached level. In each intervention condition, all tasks are performed, although only the task being trained is adaptive.	Individual sessions	The effects of intelligence, autism traits, WM, flexibility, reward sensitivity and Theory of Mind on dropout, improvement during training, and improvement in everyday executive functioning (EF), ASD-like behavior, and Quality of Life (QoL) were studied.	None of the predictors influenced dropout or training improvement. However, 1) more pre-training autism traits related to less improvement in EF and QoL, and 2) higher reward sensitivity was related to more improvement in QoL and ASD-like behavior. These findings suggest that these EF-training procedures may be beneficial for children with fewer autism traits and higher reward sensitivity. However, the exploratory nature of the analyses warrants further research before applying the findings clinically.

Appendix 8 - Summary of Findings in Executive Function Domain

No	Author	Year	Design	Diagnosis/N/Age/Sex		Inclusion/ Exclusion Criteria	Intervention		Implement ation strategies	Measures	Results
				Case	Control		Case	Control			
39	Kouijzer, M. E. J.	2010	Randomized Clinical Trial	ASD N=10 9 males 1 female Mean age=10.43 years.	ASD N=10 8 males 2 females Mean age= 9.14 years.	Inclusion criteria: age between 8 and 12 years, an IQ-score of 80 and above, and the presence of autistic disorder, Asperger disorder or PDD-NOS according to the DSM-IV criteria as clinically diagnosed by a certified child psychiatrist or health care psychologist. Excluded were children using medication, children with a history of severe brain injury, and children with co-morbidity such as ADHD and epilepsy.	The neurofeedback treatment protocol of each participant aimed at decreasing excessive theta power at central and frontal brain areas. Frequency band and electrode placement on the scalp varied across participants and were based on the comparison between the participant's individual QEEG and the Neuroguide database that provides reliable descriptors of normative brain electrical activity and z-scores indicating deviances from normality per Hertz and per scalp location. More information about the QEEG measures can be found under Neurophysiological measures in the Method section. Treatment protocols included Cz (n = 5), Fz (n = 2), and F4 (n = 3) as the main scalp locations that were used for neurofeedback training. The theta frequency bands that were used ranged from 3 to 7 Hz (n = 3), 3 to 8 Hz (n = 2), 3 to 6 Hz (n = 1), 4 to 7 Hz (n = 1), 4 to 8 Hz (n = 1), 5 to 7 Hz (n = 1), and 5 to 8 Hz (n = 1).		School based	Test of Sustained Selective Attention (TOSSA) Trail Making Test (TMT) Tower of London (TOL) Social Communication Questionnaire (SCQ) Social Responsiveness Scale (SRS) Children's Communication Checklist (CCC-2) QEEG	Parents of participants in the neurofeedback treatment group reported significant improvements in reciprocal social interactions and communication skills, relative to the parents of the control group. Set shifting skills improved following neurofeedback treatment relative to the control group. The reduction of theta power is assumed to reflect modulation of activity in the anterior cingulate cortex (ACC), which is known to be involved in social and executive dysfunctions in autism.

Appendix 8 - Summary of Findings in Executive Function Domain

No	Author	Year	Design	Diagnosis/N/Age/Sex		Inclusion/ Exclusion Criteria	Intervention		Implement ation strategies	Measures	Results
				Case	Control		Case	Control			
43	Kenworthy, L.	2014	Randomized clinical trial	ASD N=47 87% male Mean age=9.49 years.	ASD N=20 90% male Mean age=9.5 8 years.	NA	Unstuck and On Target (UOT) is an executive function (EF) intervention for children with autism spectrum disorders (ASD) targeting insistence on sameness, flexibility, goal setting, and planning through a cognitive-behavioral program of self-regulatory scripts, guided/faded practice, and visual/verbal cueing. UOT is contextually-based because it is implemented in school and at home, the contexts in which a child uses EF skills.	Social skills intervention (SS)		Measures of pre–post change included classroom observations, parent/teacher report, and direct child measures of problem-solving, EF, and social skills.	Interventions were administered with high fidelity. Children in both groups improved with intervention, but mean change scores from pre- to postintervention indicated significantly greater improvements for UOT than SS groups in: problem-solving, flexibility, and planning/organizing. Also, classroom observations revealed that participants in UOT made greater improvements than SS participants in their ability to follow rules, make transitions, and be flexible. Children in both groups made equivalent improvements in social skills.

Appendix 8 - Summary of Findings in Executive Function Domain

No	Author	Year	Design	Diagnosis/N/Age/Sex		Inclusion/ Exclusion Criteria	Intervention		Implement ation strategies	Measures	Results
				Case	Control		Case	Control			
62	de Vries, M.	2015	Randomized Clinical Trial	VM=ASD 27 males 4 females Mean age:10.5 years IQ:112 Flexibility:ASD 25 males 2 females Age:10.7 IQ:112.7	Mock=A SD 30 males 2 females Age:10. 5 IQ:106.8	The WISC-III subtests Vocabulary and Block Design, used to estimate IQ, correlate highly with Full Scale IQ, and have good reliability	Each child performed one of three intervention-conditions of “Braingame Brian” (Prins et al., 2013); a WM training, a flexibility-training, or a mock-training. In each intervention-condition all EF tasks were performed but whether the level was adaptive differed per intervention-condition. The WM-training included five adaptive WM-training-tasks with increasing difficulty, and the other tasks remained at a low level. The flexibility-training included an adaptive flexibility task, and the other tasks remained at a low level.	In the mock-training all tasks remained at a low, non-adaptive level. In the flexibility-training and mock-training only the first most basic task of the five WM-training tasks was performed .	computer based game	1) near-transfer to WM and flexibility tasks resembling the training-tasks; 2) near-transfer to WM and flexibility tasks differing from the training tasks; 3) far-transfer to inhibition and sustained attention tasks; and 4) far-transfer to daily life.	Attrition-rate was 26%. Children in all conditions who completed the training improved in WM, cognitive flexibility, attention, and on parent’s ratings, but not in inhibition. There were no significant differential intervention effects, although children in the WM condition showed a trend toward improvement on near-transfer WM and ADHD-behavior, and children in the cognitive flexibility condition showed a trend toward improvement on near-transfer flexibility.

Appendix 8 - Summary of Findings in Executive Function Domain

No	Author	Year	Design	Diagnosis/N/Age/Sex		Inclusion/ Exclusion Criteria	Intervention		Implement ation strategies	Measures	Results
				Case	Control		Case	Control			
57	Acero-Ferrero, M.	2017	Single subject	ASD N=7 Mean age=7.7 years.		Inclusion: be aged between five and 12; not presenting any associated physical disability; reflected the severity and ongoing involvement of each of the domains under study.	The Executive Functions Intervention Programme for Children with Autism (PIFENA). During the initial stage the evolution data of each participant were collected through the PIFENA programme level testing. This initial stage was set at three, four, five, six, eight, nine and 10 sessions respectively for the seven participants, from which the treatment stage was introduced. (36 treatment sessions over three months, three weekly sessions lasting 30 minutes each, in which a task from each of the blocks was performed)		computer based game	The Childhood Executive Function Inventory (CHEXI) The evolution of each participant was recorded weekly.	The results of the pre-test-post-test analysis in both groups of respondents show statistically significant differences in the two questionnaire factors: Total working memory and Total inhibition. The need to focus assessment and intervention for people with autism on difficulties in everyday executive functioning for optimal psycho-social adaptation of the individual to their environment is emphasized.

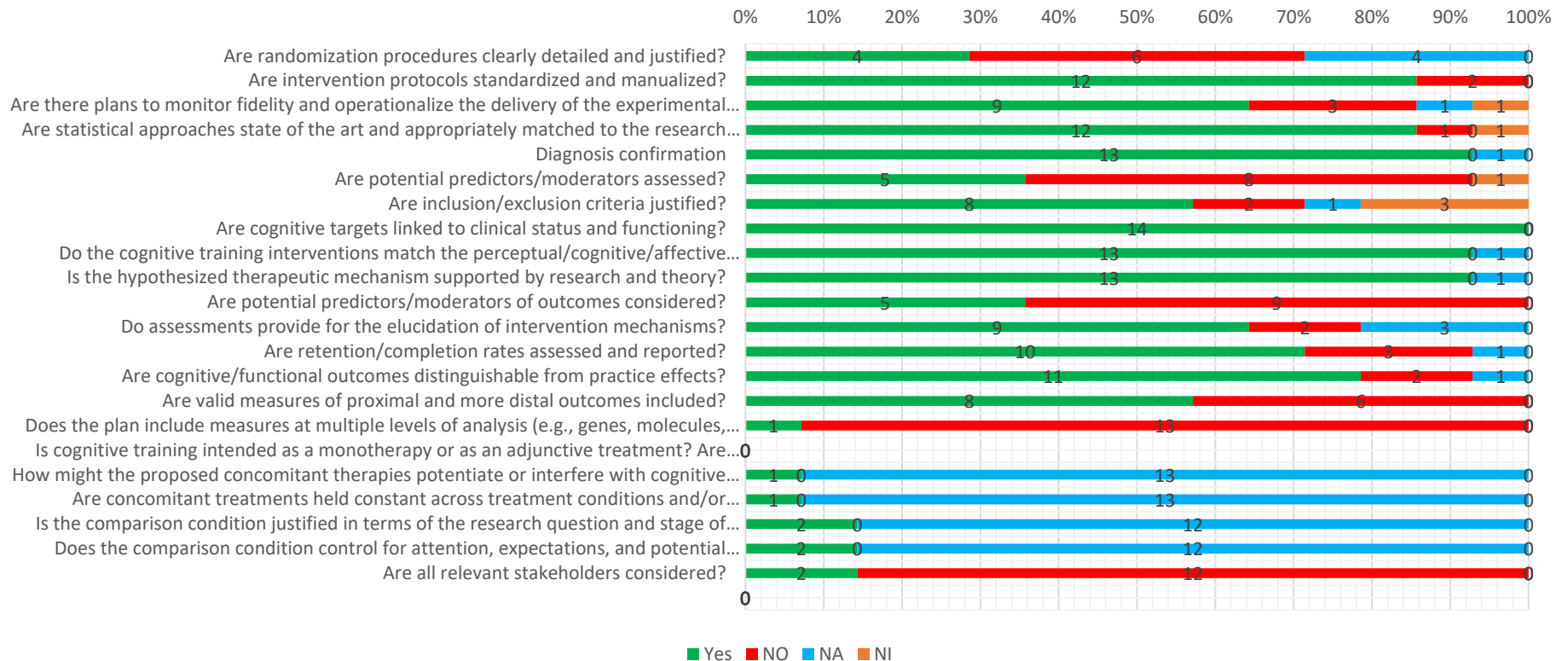
Appendix 9 - Quality Assessment of Articles in Executive Function Domain

Author	Sander M. Weckstein	Sophie Goldingay	Kerns, K. A.	Songpoom Benyakorn	Majid Naeimi	Sun, I.	Claudia List Hilton	de Vries, M.	Mirjam E.J. Kouijzer	Hajri, M.	Lauren Kenworthy	Sun, I. Y. I.	Acero-Ferrero, M.	Marieke de Vries
Year	2017	2013	2017	2018	2013	2017	2014	2018	2009	2017	2014	2017	2017	2014
Sub-Category	EF	EF	EF	EF	EF	EF	EF	EF	EF	EF	EF	EF	EF	EF
Design	Before-After	Before-After	Before-After	Before-After	RCT	Before-After	Before-After	RCT	RCT	Before-After	RCT	Before-After	Single subject	RCT
Are randomization procedures clearly detailed and justified?	NA	NA	No	No	No	No	NA	Yes	Yes	NO	Yes	No	NA	Yes
Are intervention protocols standardized and manualized?	yes	Yes	Yes	Yes	yes	Yes	Yes	Yes	Yes	NO	Yes	No	Yes	Yes
Are there plans to monitor fidelity and operationalize the delivery of the experimental and comparison conditions?	yes	NA	Yes	NI	yes	No	Yes	Yes	Yes	NO	Yes	No	Yes	Yes
Are statistical approaches state of the art and appropriately matched to the research question and data structure?	yes	Yes	Yes	NI	yes	Yes	Yes	yes	Yes	NO	Yes	yes	Yes	Yes
Diagnosis confirmation	Yes	Yes	Yes	Yes	Yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Are potential predictors/moderators assessed?	No	No	No	Yes	NI	No	No	Yes	No	Yes	Yes	No	No	yes
Are inclusion/exclusion criteria justified?	No	No	Yes	Yes	NI	NA	Yes	Yes	Yes	Yes	NI	NI	Yes	Yes
Are cognitive targets linked to clinical status and functioning?	Yes	yes	Yes	yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Do the cognitive training interventions match the perceptual/cognitive/affective processes that characterize the disorder and/or neural circuits implicated?	yes	yes	Yes	yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	yes	Yes	yes
Is the hypothesized therapeutic mechanism supported by research and theory?	yes	yes	Yes	yes	NA	Yes	Yes	Yes	Yes	Yes	Yes	yes	Yes	Yes
Are potential predictors/moderators of outcomes considered?	No	Yes	No	No	No	NO	No	Yes	Yes	No	Yes	No	No	yes

Appendix 9 - Quality Assessment of Articles in Executive Function Domain

Do assessments provide for the elucidation of intervention mechanisms?	No	Yes	Yes	Yes	NA	NA	NA	Yes	Yes	Yes	Yes	No	Yes	yes
Are retention/completion rates assessed and reported?	No	NA	Yes	Yes	yes	NO	Yes	Yes	Yes	No	Yes	yes	Yes	yes
Are cognitive/functional outcomes distinguishable from practice effects?	yes	yes	Yes	NA	Yes	NO	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Are valid measures of proximal and more distal outcomes included?	No	No	No	Yes	Yes	NO	Yes	Yes	Yes	Yes	Yes	No	No	yes
Does the plan include measures at multiple levels of analysis as appropriate?	No	No	No	No	No	NO	No	No	No	No	No	No	No	Yes
Is cognitive training intended as a monotherapy or as an adjunctive treatment? Are concomitant treatments considered in the assessment and analysis plan?	monoth erapy	Monoth erapy	Monoth erapy	Monoth erapy	Monoth erapy		Monoth erapy	Monoth erapy	Monoth erapy	Monoth erapy	Monoth erapy	speech therapy	Monoth erapy	Monoth erapy
How might the proposed concomitant therapies potentiate or interfere with cognitive training effects?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	yes	NA	NA
Are concomitant treatments held constant across treatment conditions and/or quantified and considered in analyses?	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	yes	NA	NA
Is the comparison condition justified in terms of the research question and stage of intervention development/testing?	NA	NA	NA	NA	NA	NA	NA	Yes	NA	NA	NA	NA	NA	Yes
Does the comparison condition control for attention, expectations, and potential practice effects associated with training/assessment protocols, as appropriate?	NA	NA	NA	NA	NA	NA	NA	Yes	NA	NA	NA	NA	NA	Yes
Are all relevant stakeholders considered?	Yes	No	No	Yes	No	No	No	No	No	No	No	No	No	No

Executive Function



Appendix 10 - Quality of Evidence in Executive Function Domain

Appendix 11 - Summary of Findings in Social Cognition Domain

No	Author	Year	Design	Diagnosis/N/ Age/Sex		Inclusion/ Exclusion Criteria	Intervention		Implemen tation strategies	Cognitive Target	Measures	Results
				Case	Control		Case	Control		Sub- Category		
2	Russo- Ponsara n, N. M.	2014	Single subject	ASD N=3		Eligible children (a) were verbal, (b) between the ages of 8 and 14 years old, (c) had a full-scale IQ greater than 80 on the Wechsler Abbreviated Scale of Intelligence (WASI), (d) were diagnosed with an ASD, and (e) screened in with deficits in facial emotion recognition.	The MiXTM includes opportunities for repeated practice, progress monitoring and testing modules, and didactic instruction on facial displays of emotion. Accordingly, the MiXTM was used as both an assessment measure (pretest, proficiency tests, and posttests) and an intervention mechanism. The MiXTM provides training of seven emotions—joy, sadness, anger, fear, surprise, disgust, and contempt.) and augmenting with coaching and imitation components.			Emotion recognition	Social Communication Questionnaire (SCQ) Autism Diagnostic Observation Scale (ADOS) Wechsler Abbreviated Scale of Intelligence (WASI) Comprehensive Affective Testing System (CATS) Name Affect Comprehensive Affective Testing System (CATS) Three Faces Diagnostic Analysis of Nonverbal Accuracy (DANVA) Child Faces Test Nonverbal Awareness Composite	Three pilot participants demonstrated improved facial emotion recognition (accuracy and speed) of dynamic and static presentations of facial expressions and self-expression. Some improvements persisted 5 weeks after training. Results support the acceptability and feasibility of the training program."
8	Lacava, P. G.	2010	Single subject	ASD/N=4/ Age range 7 to 9 year		NA	Computer software (Mind Reading: The Interactive Guide to Emotions)		Computer based training game	Emotion recognition	Cambridge Mindreading Face- Voice Battery for Children (CAM-C)	After using Mind Reading for 7 to 10 weeks with a tutor, four boys with ASD improved ER scores and social interactions with peers. However, observed behavior changes were not strong enough to claim a causal relationship between variables.

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				Case	Control		Case	Control		Sub- Category		
17	Matsuda, S	2014	Single subject	2 boys with autism/4 years and 8 years		No	The movies of situations and pictures of facial expressions represented happy, surprised, angry and sad emotions. The child with ASD was required to select the picture of facial expression when presented with the movie of socio-emotional situations as a sample stimulus, and if so, whether these skills can be generalized to untrained stimuli.		Computer based training	Emotion recognition	Correct response rate	The results demonstrated that both children learned the relationships and improved their performance with untrained stimuli.

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No	Author	Year	Design	Diagnosis/N/ Age/Sex		Inclusion/ Exclusion Criteria	Intervention		Implemen tation strategies	Cognitive Target Sub- Category	Measures	Results
				Case	Control		Case	Control				
26	Russo-Ponsara n, N. M.	2016	Random ized Clinical Trial	ASD/N=12/ Mean age= 10.6 years.	ASD/N= 13/ Mean age= 12.4 years.	Eligible participants (a) were between the ages of eight and 15 years old, (b) were diagnosed with an ASD, (c) had a full- scale IQ \geq 80, (d) were verbal, and (e) demonstrated deficits in facial emotion recognition.	The intervention was a modification of a commercially-available, computerized, dynamic facial emotion training tool, the MiX by Humintell. Modifications were introduced to address the special learning needs of individuals with ASD and to address limitations in current emotion recognition programs. Modifications included: coach-assistance, a combination of didactic instruction for seven basic emotions, scaffold instruction which included repeated practice with increased presentation speeds, guided attention to relevant facial cues, and imitation of expressions. Training occurred twice each week for 45–60 min across an average of six sessions.	Waitlist control	web based	Emotion Recognition	Outcome measures included (a) direct assessment of facial emotion recognition, (b) emotion self- expression, and (c) generalization through emotion awareness in videos and stories, use of emotion words, and self-, parent-, and teacher-report on social functioning questionnaires.	The facial emotion training program enabled children and adolescents with ASD to more accurately and quickly identify feelings in facial expressions with stimuli from both the training tool and generalization measures and demonstrate improved self- expression of facial emotion.

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				Case	Control		Case	Control		Sub- Category		
28	Golan, O.	2010	Non- randomi zed clinical trial	ASD/N=20/1 5 male,5 female/Age range=4-7y	ASD/N= 19/ 15 male/ 4 female/ & Normal, N=18/ 12 male, 6 females.	NA	This study assessed whether independent use of The Transporters DVD, with parental supervision, improves emotion recognition and contextual understanding of emotions in children between the ages of four and seven with ASC. The intervention took place over a period of 4 weeks.		watching a DVD at home	Emotion recognition	British Picture Vocabulary Scale (BPVS) Children's Autism Spectrum Test (CAST)	The intervention group improved significantly more than the clinical control group on all task levels, performing comparably to typical controls at Time 2. We conclude that using The Transporters significantly improves emotion recognition in children with ASC.
30	Silver, M.	2001	Random ized Clinical Trial	ASD/ N= 11/ Mean age= 13 y 11m.	ASD/ N= 11/ Mean age= 14 y 11 m.		The experimental group used the Emotion Trainer during 10 daily computer sessions (over 2 to 3 weeks)		daily computer sessions	Emotion Recognition	The British Picture Vocabulary Scale (BPVS) The Facial Expression Photographs from Spence, Emotion Recognition Happe's Strange Stories	Within-program data showed a significant reduction in errors made from first to last use. Students were assessed pre- and post- intervention using facial expression photographs, cartoons depicting emotion- laden situations, and non-literal stories. Scores were not related to age or verbal ability. The experimental group made gains relative to the control group on all three measures. Gains correlated significantly with the number of times the computer program was used and results suggest positive effects.

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				Case	Control		Case	Control				
44	Rodgers, J. D.	2015	Random ized Clinical Trial	ASD/N= 30/ 26 male, 4 female/ Mean age= 9.33 years/Mean IQ=102	ASD/N= 30/ 28male, 2 female/ Mean age=9.3 3/Mean IQ=103	Inclusion criteria: a prior diagnosis of ASD from a licensed physician or psychologist, a WISC-IV short-form IQ score >70 (and a Verbal Comprehensio n Index [VCI] or Perceptual Reasoning Index [PRI] score ≥80), a Comprehensiv e Assessment of Spoken Language (CASL) short- form expressive or receptive language score ≥80, and no significant problems with aggressive or self-injurious behavior.	The summer MAX program is a comprehensive psychosocial intervention that targets social skills, non- verbal communication/emotio n-decoding skills, nonliteral language skills, and interest expansion. It was conducted approximately 7.5 h per day, 5 days a week, over a 5-week period during the summer. Each day included five 70-min treatment cycles that involved 20-min of intensive skills instruction and practice, followed by a specially designed 50-min therapeutic activity that allowed for practice of the skill targeted during the skills instruction. A majority of the 20-min instruction periods was dedicated to social skills instruction.		group based psychosoc ial interventi on	Emotion recognition	Wechsler Intelligence Scales for Children – Fourth Edition (WISC-IV) IQ was assessed using a 4- subtest short form of the WISC-IV (Wechsler 2003) consisting of Block Design, Similarities, Vocabulary, and Matrix Reasoning subtests. /Comprehensive Assessment of Spoken Language (CASL)./Autism Diagnostic Interview-Revised (ADI-R)./Facial Decoding Competency Test./Encoding Photographs./The Facial Affect Rating Form (researcher- developed).	Results indicated significantly better encoding of sad at posttest for the treatment group on the extent (d=.58) and forced-choice (d=.56) ratings. Between- groups differences in encoding of the other emotions at posttest were non-significant.

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49	Williams , B. T.	2012	Random ized Clinical Trial	ASD/ N=28/89% male/Age range=62.83 months.	ASD/N=27/85% male/Ag e range=61.93 months.	Inclusion criteria: (a) met criteria for a diagnosis of autistic disorders based on current assessments, and case reviews by the author; (b) were aged from 4 to 7 years at baseline; (c) were able to complete a WPPSI-III cognitive assessment at baseline or had completed one in the past 12 months; and (d) had not previously watched the Transporters.	The Transporters is an animated and narrated children's television series designed to provide training in emotion recognition skills to children with ASDs aged 3–8 years. The programme consists of 15 five- minute episodes portraying 15 key emotions, including the six basic emotions and nine more complex emotions and mental states (e.g. excited, unfriendly, proud and jealous). The Transporters programme includes interactive quizzes to reinforce emotional learning and a Parent User Guide. Parents were encouraged to use the guide and help their child complete the quizzes.	Thomas the Tank Engine series five was used to control for time spent watching children's DVDs. It was chosen due to similarities with the Transport ers programm e.	watching a DVD	Emotion Recognition	WPPSI-III/NEPSY- II/ADOS/Emotion identification and emotion matching tasks	Analyses controlled for the effect of chronological age, verbal intelligence, gender and DVD viewing time on outcomes. Children in the intervention group showed improved performance in the recognition of anger compared with the control group, with few improvements maintained at 3-month follow-up. There was no generalization of skills to TOM or social skills. The Transporters programme showed limited efficacy in teaching basic emotion recognition skills to young children with autism with a lower range of cognitive ability. Improvements were limited to the recognition of expressions of anger, with poor maintenance of these skills at follow- up.

59	Gev, T.	2017	Random ized Clinical Trial	ASD-HF/ N=77 / Age rang= 4-7 years devided to 4 groups: 1. Transporter s with Parental Support (TT+PS): N=15, 13 male, 2 females, Mean age= 5.99 years/ 2. Transporter s with no parental support (TT): N=14, 13 male, 1 female, Mean age=5.89 years/ 3. Control series with parental support (CS+PS): N=16, 14 male, 2 females, Mean age=m.34 years/4. Control series with no parental support (CS): N=14, 10 male, 4 females, Mean age= 5.30 years.	Typically Developi ng (TD)/N= 25, 21 male, 4 females, Mean age= 4.86.	WPPSI subtest standardized scores >6, and VABS communicatio n score>80. diagnosed with ASD according to established DSM-IV-TR criteria, and meeting criteria for ASD on the Autism Diagnostic Observation Schedule (ADOS-2).	The Transporters (TT) animated series. TT aims to teach children with ASD about emotions, their causes and effects, and their corresponding facial expressions. In order to motivate children with ASD to learn about emotions and to look at facial expressions, real- life faces of actors expressing emotions were grafted onto eight rail-based vehicle characters, who take part in the series' fifteen five-minute long episodes. Each episode focuses on a key emotion or mental state.		computer based	Emotion recognition	Emotion Recognition tasks: Emotion recognition skills were tested using a Hebrew translation of the original 3 level computerized tasks (CT), used to evaluate TT in the UK/ Emotion Vocabulary Task: This verbal task was also adapted from Golan et al. (2009), and was administered three times, at times 1-3. The task evaluates participants' emotional vocabulary by asking them to define the 16 emotion words included in TT.	Compared to the control series, watching TT significantly improved children's ER skills at all generalization levels, with good skill maintenance. All groups improved equally on EV. The amount of parental support given, in the groups that had received it, contributed to the generalization and maintenance of ER skills. Autism severity negatively correlated with ER improvement.
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				Case	Control		Case	Control		Sub- Category		
32	White, S. W.	2018	Case- Control	ASD/N=20/ 18 male, 2 female/Mea n age:122.50 months.	TD/N=2 0/ 14 male/6 female/ Mean age=129 .75 months.	clinical diagnoses of ASD & confirmation with standard tools	A novel system to detect and give real- time feedback on these processes, termed facial emotion expression training (FEET), an automated, game like system that is based on 3-dimensional sensing (Kinect) technology.	#	Face to face individual training sessions using PC.	Emotion recognition	NEPSY-II Facial Affect Recognition Test./Feasibility Questionnaire: The questionnaire comprised six questions, the first four of which were answered on a Likert scale from 1 (very easy/very fun/absolutely) to 5 (very hard/very not fun/absolutely not).	There were group differences with respect to the enjoyability of FEET. The ASD group reported a higher mean enjoyability rating for FEET than did the TD group. / the ASD group demonstrated more impairment in FER based on the NEPSY-II AR, even when controlling for IQ. The ASD group had a mean standard score on the AR test of 10.50 (2.54) and the TD group's mean standard score was 12.00 (1.97), both of which fall in the average range.

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6	Weiss, J. A.	2018	Random ized Clinical Trial	ASD children and their parents/N=35/ Mean age=9.63 years/ 11.4% female.	ASD children and their parents/ N=33/ Mean age=9.8 years/ 12.1% female.	inclusion criteria: (a) an ASD diagnosis from a qualified clinician, (b) scores above the cutoff on (SCQ cutoff >14) or SRS-2 Total T-Score (cutoff >59); (c) 8–12 years of age; (d) parent report of child difficulties managing emotions; and (e) a willingness to attend research and therapy appointments.	Secret Agent Society: Operation Regulation. The SAS: OR intervention targets ER in children with ASD through 10 sessions of manualized, individual tCBT. The original Secret Agent Society employed a group- based spy-themed curriculum to address social skills in children with ASD. SAS: OR employs the same spy theme, and some of the same materials and activities, but omits the social skills curriculum. Instead, SAS: OR includes specific activities meant to improve emotion regulation.			Emotion Regulation	The Children's Emotion Management Scales. /The Dylan is Being Teased and James and the Maths Test open- ended tasks. /Parent report of child ER ability was assessed using the 24- item Emotion Regulation Checklist. / The Emotion Regulation subscale measures empathy, understanding of emotions, and appropriate displays of emotion. / The Emotion Regulation and Social Skills Questionnaire (ERSSQ-P) a 27-item parent-report measure.	Children in the treatment immediate condition demonstrated significant improvements on measures of emotion regulation (i.e., emotionality, emotion regulation abilities with social skills) and aspects of psychopathology (i.e., a composite measure of internalizing and externalizing symptoms, adaptive behaviors) compared to those in the waitlist control condition. Treatment gains were maintained at follow- up.

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14	Thomson, K.	2015	Before- After	ASD/N=14/ 13 male, 1 female/Age range 8 to 12 years.		inclusion criteria: (a) a confirmed ASD diagnosis; (b) average intellectual functioning (IQ>80); (c) between the ages of 8 and 12 years; and (d) demonstrated willingness to attend research and therapy sessions.	The Secret Agent Society: Operation Regulation, is an individualized spy themed intervention that instead targets ER. Each 1-h session was made up of a progress check, multimedia activities such as computer games, modeling and roleplaying to practice skills, education based in cognitive behavior therapy, relaxation and mindfulness activities, strategies to promote generalization to home and school, and a token reinforcement system to maintain attention and motivation.		face to face/using Multimedia	Emotion Regulation	Emotion Regulation Checklist (ERC) Anxiety Disorders Interview Schedule: Parent Interview- 4th Edition (ADIS-P- IV)/ Behavior Assessment System for Children-2nd Edition (BASC- 2)/Children's Emotion Management Scale: Anger, Sadness, Worry (CEM)/Scenarios. Experimenters read children two scenarios: (1) James and the Math Test and (2) Dylan is Being Teased /Clinical Global Impressions Scale (CGI).	Improvements were noted on parent reported child emotional lability, internalizing symptoms, behavioral dysregulation, and adaptive behavior. Improvements were also found based on clinician rated overall severity and number of diagnoses on the ADIS- P-IV.

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				Case	Control		Case	Control				
15	Ingersoll , B.	2012	Random ized Clinical Trial	ASD N=14 13 males 1 female Mean age:39.3 months.	ASD N=13 11 males 2 females Mean age:36.5 months.	No	Reciprocal Imitation Training (RIT) was developed to teach the social function of imitation to young children with autism. RIT uses a blend of naturalistic behavioral and developmental strategies to teach imitation within a social-interactive context. Children in the treatment group received 3 hours per week of RIT for 10 weeks. All children continued to receive their existing educational programming throughout the study.	treatment as usual in the communit y		Focused Imitation	Preschool Language Scale, 4 th Edition (PLS-4) Autism Diagnostic Observation Schedule-Generic (ADOS-G) Early Social Communication Scales (ESCS) Motor Imitation Scale (MIS) The Social- Emotional Scale of the Bayley Scales of Infant Development, 3 rd Edition.	Results indicated the treatment group made significantly more gains in joint attention initiations at post- treatment and follow- up and social-emotional functioning at follow-up than the control group. Although gains in social functioning were associated with treatment, a mediation analysis did not support imitation as the mechanism of action.
3	Wong, C.	2013	Random ized Clinical Trial	between the ages of 3 and 6 years/SP Intervention Teachers, n=5 Children, n=10,JA Intervention Teachers, n=4 Children, n=14	Control (Wait) Teacher s, n=5 Children , n=10	NA	The intervention includes an individualized approach where teachers could choose to implement activities for the whole class, in small groups, and/or in a one-on-one individualized setting.		School Based	Joint attention	Direct observation of Behavior Childhood Autism Rating Scale (CARS) Early Social- Communication Scales (ESCS) Structured play assessment/MSEL	Findings indicate that teachers can implement an intervention to significantly improve joint engagement of young children with autism in their classrooms. Furthermore, multilevel analyses showed significant increases in joint attention and symbolic play skills.

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5	Kaale, A.	2012	Random ized Clinical Trial	ASD/26m/8f /age:47.6m/ mental age:25	ASD/22 m/5f/ag e:50.3m /mental age:30m	inclusion criteria: (a) a chronological age of 24–60 months, (b) a confirmed ICD-10 diagnosis of childhood autism, and (c) attendance in preschool. Exclusion criteria were (a) central nervous system disorders, and (b) non- Norwegian speaking parents.	Receiving JA intervention in addition to ordinary preschool program	ordinary preschool program	school based program	Joint attention	Mullen Scale of Early Learning (MSEL)---	there was a statistically significant effect of JA- intervention on frequency of JA-skills during preschool teacher–child play at post-intervention. Adjusted ER showed that children in the JA- intervention group were almost five times more likely to demonstrate initiation of JA-skills during the 10 min play with preschool teachers as compared to the children in the control group. /There was a statistically significant effect on duration of JE during mother–child play at post- intervention. After adjusting for baseline JE the children in the JA- intervention group were on average 12.2% longer in JE with their mothers compared to the children in the control group. Effect size was moderate (d = .67).

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16	Hansen, S. G.	2018	Single subject	cross 3 caregiver– child dyads to train caregivers to teach response to joint attention behaviors to their 3– 6 years old children with moderate to severe autism spectrum disorder			Caregiver training involved an individual session including a 30- min PowerPoint® presentation covering (a) general information about joint attention, (b) two prompting hierarchies, and (c) time delay.			Joint attention	Observation	Following caregiver training and coaching, the mean treatment fidelity in the intervention phase was 87.0%. A follow-up session occurred 3 weeks after the intervention ended, and mean treatment fidelity was 83.3%. During baseline, mean percentage of independent child responses was 34.3% for Zoe, 21.5% for Sam, and 38.8% for Josh. During training and coaching, Zoe's mean responses were 46.5%. Following caregiver training, Zoe's mean responses were 45.3%. During training and coaching, Sam's mean responses were 54.0%. Following caregiver training, Sam's mean responses were 48.1% and 56.0% during the 3- week follow-up probe. During training and coaching, Josh's mean responses were 61.7%. Following caregiver training, Josh's mean responses were 79.7% and 75.0% during the 3- week follow-up probe.

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23	Schertz, H. H.	2013	Random ized Clinical Trial	11 toddlers with ASD/age:24. 6m	12 toddlers with ASD/age :27.5m	criteria: scores above the designated cut-off levels on the ADOS, absence of joint attention during interaction with parents, and chronological age below 30 months at the onset of intervention.	The JAML intervention directly and exclusively addresses the social functions of preverbal communication, targeting engagement at progressively complex levels that begin just beyond the toddler's current capabilities. In the Focusing on Faces (FF) phase, the child is helped to look freely and often to the parent's face. In Turn- Taking (TT) the child engages with the parent in reciprocal repetitive play that acknowledges the other's shared interest by accommodating the parent's turn. Finally, triadic engagement is promoted using toys in the Joint Attention (JA) phase.	Children and parents in the control group participat ed in all assessme nt activities but no JAML interventi on during the study, instead receiving services commonly available in their communit ies as described below.	parent education	Joint attention	The Precursors of Joint Attention Measure (PJAM)--- Mullen Scales of Early Learning (MSEL) --- Vineland Adaptive Behavior Scales (VABS)--- Modified Checklist for Autism in Toddlers (M- CHAT)---Autism Diagnostic Observation Schedule (ADOS)	Significant intervention- x-time interactions, favoring the intervention group, occurred for the observational measures Focusing on Faces and Responding to Joint Attention, with both having large effect sizes that maintained at follow-up. In addition, significant intervention- x-time effects, also favoring the JAML group were found for receptive language on the Mullen Scales of Early Learning and the Communication sub- domain of the Vineland Adaptive Behavior Scale.
25	Rudy, N. A.	2014	Single subject	Three participants, two boys and one girl, 4-5-year- old.		No	The video model consisted of a child demonstrating three components of a bid for joint attention with an adult conversational partner: orienting toward the object, emitting a vocal statement, and eye gaze shift toward unique objects in the environment.		Video modeling	Joint attention	Behavioral rating	Results indicated that video modeling alone was effective in teaching all components of joint attention for two of the three children, whereas video modeling plus in vivo prompting was effective for the third participant. Further, bids for joint attention did not generalize across novel items for any of the participants.

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35	Yoder, P.	2008	Random ized Clinical Trial	The total number of children assessed for eligibility was 65. Of these, 58 met criteria for inclusion in the study. Using a 'randomized list', children were assigned to joint-attention (n = 20), symbolic-play (n = 21), or control (n = 17) groups upon entry into the feeder early-intervention program, and were then assessed for inclusion and pre-treatment status.		NA	The treatments were administered 4–5 times a week for 30 min per session for 12 weeks. The staff implemented a combination of didactic (5–8 min) and Milieu teaching (15–25 min), used to teach either joint-attention or symbolic-play goals. The staff–graduate students–were trained to administer both treatments, but once assigned, the interventionist remained with a child for the entire treatment phase.		Individual sessions	Joint attention	The tools used to assess joint attention were a structured experimental procedure called the Early Social Communication Scales (ESCS) and a mother– child free-play session (MCFP). The tools used to assess symbolic play were an experimental procedure called the Structured Play Assessment and the MCFP. The aggregated frequency of child-initiated joint-attention acts (from the ESCS and MCFP) and the duration of child-initiated joint-attention episodes (from the MCFP) were the two joint-attention dependent variables.	The symbolic-play and joint-attention treatments facilitated expressive, but not receptive, global language scores. / Pre-treatment correlates of growth rate of receptive and expressive language, respectively, were initiating joint-attention frequency aggregate, responding joint-attention aggregate, symbolic-play level aggregate, and symbolic-play types aggregate. Additionally, duration of child-initiated joint engagement episodes with the mother predicted growth rate of expressive language /the joint-attention and symbolic-play treatments both facilitated long-term growth of aggregated initiating joint-attention skills, compared with the control condition. Similarly, the joint-attention and symbolic-play treatments both facilitated long term improvement in the duration of child-initiated joint engagement in MCFP, compared with the control condition. The symbolic-play treatment facilitated the long-term growth of the number of symbolic play types in MCFP to a greater degree than the joint-attention and control conditions did (respectively).

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36	Nye, C.	2012	Random ized Clinical Trial	ASD/N= 26/18 male, 8 female/ Age rang 24 to 60 months.	ASD/N= 22/17 male, 5 female/ Age rang 24 to 60 months.	inclusion criteria: (a) between 24 and 60 months of age; (b) confirmed ICD-10 diagnosis of childhood autism; (c) attendance in preschool from October 2006 to August 2008. Participants were excluded if they had a record of (a) central nervous system disorder and/or if (b) the parents were non-Norwegian speakers.	Using a modified joint attention approach developed by Kasari, Freeman, and Paparella (2006), the 8-week intervention program was administered on 1:1 ratio by 34 preschool teachers twice a day for 20 min five days per week, for a total of 80 sessions. Teachers participated in a 6-hour pre-intervention training program provided by counselors from the local CAMHC. The counselors had received a 3-day training program on the intervention approach to be implemented prior to their training the teachers.			Joint attention	(a) joint attention: the child's ability to coordinate attention of a social partner on an object or event and (b) joint engagement: a common engagement of both the child and the social partner on the same object or event without the child recognizing the social partner's attention to the object or event. The frequency and duration of joint attention was measured during (a) the administration of the Early Social Communication Scale (child-examiner dyad), (b) the teacher-child play activity, and (c) the mother-child play activity.	Effect on joint attention and joint engagement teacher-child play: A statistically significant effect was shown in favor of the intervention group, who were over four times as likely to exhibit initiation during play with the preschool teacher. No statistical difference was observed on the joint engagement measure of teacher-child play interactions.

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38	Charman, T.	2012	Random ized Clinical Trial	These were 52 preschoolers meeting criteria for autism following a clinical assessment.		NA	Intervention occurred daily in 30-min one-to-one therapy sessions. The intervention involved application of procedures based on the principles of applied behavior analysis (e.g., prompting, shaping, reinforcement) and developmental approaches (milieu teaching—following child's lead, commenting and expanding, repeating back). Therapists (graduate students) focused on engaging the child in joint attention activities or symbolic (pretend) play activities.		Individual sessions	Joint attention	Outcome measures were counts of shared positive affect and shared positive affect combined with vocalizations during a structured joint attention interaction with an unfamiliar adult (the Early Social Communication Scale; ESCS). High interrater reliability of the outcome variables was reported.	No group differences were found immediately post-treatment for the two shared positive affect variables. However, at the 6- and 12-month follow-ups, both the joint attention and the symbolic play groups showed higher rates of shared positive affect and shared positive affect with vocalizations, as compared to the treatment-as usual control group.
47	Muzammar, M. S.	2017	Single subject	Three 2–3-year-old toddlers diagnosed with an ASD participated .		Toddlers must have been between 2 and 3 years of age, have a diagnosis of ASD, be able to track a desired item to at least four different positions, reach/look at a desired item, respond when someone points to an item by looking at the item, clean up in response to the direction to clean up, and sit while playing with toys for at least 5 min.	We examined a brief social-communication intervention teaching eye gaze in select social-communication contexts while examining generalization to initiating joint attention and interactions with participants' mothers.		Individual Sessions	Joint attention	Behavioral Observation	Two toddlers showed generalization from requesting to joint attention with the interventionist; all three showed generalization to interactions with their mothers in a semi structured play interaction.

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No	Author	Year	Design	Diagnosis/N/ Age/Sex		Inclusion/ Exclusion Criteria	Intervention		Implemen tation strategies	Cognitive Target	Measures	Results
				Case	Control		Case	Control		Sub- Category		
51	Whalen, C.	2006	Single subject	ASD/N=4/ Average age=4 years 2 months/ Average mental age=1 year 5 months/average language-age equivalent for participants was 1 year, 5 months		NA	Treatment consisted of two phases. In the first phase, Response Training, the child was taught to respond appropriately to joint attention bids of the experimenter. This phase took roughly 3 weeks for each child. In the second phase, Initiation Training, the child was taught to initiate joint attention bids to the experimenter, including coordinated gaze shifting and proto declarative pointing.			Joint attention	Unstructured Joint Attention Assessment Structured Play Assessment Structured Joint Attention Assessment Empathic Response Mastery of each behavior at 30% of opportunities for coordinated gaze shifting and 15% of opportunities for proto declarative pointing was required before teaching the next behavior.	Following participation in the intervention, positive collateral changes were observed in social initiations, positive affect, imitation, play, and spontaneous speech. Results support the hypothesis that teaching joint attention skills leads to improvement in a variety of related skills and have implications for the treatment of young children with autism.

Appendix 11 - Summary of Findings in Social Cognition Domain

No	Author	Year	Design	Diagnosis/N/ Age/Sex		Inclusion/ Exclusion Criteria	Intervention		Implemen tation strategies	Cognitive Target Sub- Category	Measures	Results
				Case	Control		Case	Control				
52	Chiengc hana, N.	2014	Single subject	ASD N=3 Age range 7.8 to 11.5 years.		No	Kodály- based music experiences on joint attention behaviors --- The treatment was based on three key elements of the Kodály method that consists of: (1) the emphasis on singing; (2) the use of folk music; and (3) the use of Solfège learning.		individual sessions	Joint attention	SCERTS assessment process (SAP)	During baseline sessions, the three participants rarely engaged in joint attention with others. Their behaviors were stable during the first three sessions, with mean occurrence of 5, 9.3, and 4. In the course of the music intervention, they positively responded to the intervention. The frequencies of their behaviors continuously increased from the first group intervention sessions until the second group intervention sessions. Finally, the second group intervention sessions showed that most of the data points were above the mean of all previous sessions, with mean occurrence of 43.8, 34.1, and 18.8.

Appendix 11 - Summary of Findings in Social Cognition Domain

No	Author	Year	Design	Diagnosis/N/ Age/Sex		Inclusion/ Exclusion Criteria	Intervention		Implemen tation strategies	Cognitive Target	Measures	Results
				Case	Control		Case	Control		Sub- Category		
58	Gulsrud, A. C.	2014	Random ized Clinical Trial	The present sample of 40 children consists of mostly males (82%) with an average age of 8.8 years (SD= .6 years). The mothers of these children were on average 42 years old (SD= 4.9 years) at follow-up and highly educated with a mean of 16.9 years (SD=2.5 years) of education.		NA	These children were participants in a randomized controlled early intervention trial that found that children who received either a joint attention or a symbolic play intervention yielded higher scores in joint attention and play (Kasari et al., 2006) and had greater expressive language outcomes one year (Kasari et al., 2008) and four years later (Kasari et al., 2012).			Joint attention	Adjusted expressive language standard scores--The Expressive Vocabulary Test (EVT)-- coordinated joint looking (CJL)-- ESCS -- ADOS -- ADI-R	Results showed that joint attention skills of coordinated joint looking and showing increased over time and pointing to share interest increased over the first year measured and decreased thereafter. These trajectories were influenced by both original treatment assignment and diagnostic status at the follow-up. In addition, a cross lagged panel analysis revealed a causal relationship between early pointing and later language development. This study highlights the longitudinal and developmental importance of measures of early core deficits in autism and suggests that both treatment and ASD symptomatology may influence growth in these skills over time.

4	Chung, U. S.	2016	Random ized Clinical Trial	ASD N=10 8 males 2 females Mean age: 15.8 years Mean IQ:80	ASD N=10 9 males 1 female Mean age:16.3 years Mean IQ:80	Inclusion criteria: 1) between the ages of 13 and 18 years, 2) diagnosed with ASD, 3) having an intelligence quotient (IQ) ≥70, and 4) having an ADOS score in the range of 4–7./Exclusion criteria: 1) comorbid Axis I Disorders; 2) history of head trauma; 3) serious or chronic medical illness; 4) IQ <70; and/or 5) a history of substance abuse.	The ASD adolescents in the game-CBT group were asked to sit in a closed room, log onto the game website, and play the online prosocial game, “Poki-Poki (http://www.pokipoki.co.kr/)”, for 1 h/d, 3 times/wk with study personnel (two psychiatric social workers and one psychologist) for 6 weeks.	ASD adolescents in the offline-CBT group were asked to participate in offline-CBT for 1 h/d, 3 times/wk with study personnel for 6 weeks.	online vs offline	Social cognition	At baseline, all ASD adolescents in both groups were evaluated using K-SADS-PL, ADOS, the Social Communication Questionnaire Current form-Korean version (SCQ-K), an activity in which they identified emotional words and facial emoticons, and fMRI. After the last CBT session, all ASD adolescents in both groups repeated the SCQ-K, the activity where they identify emotional words and facial emoticons, and fMRI scanning.	Social communication quality and correct response rate of emotional words and facial emoticons improved in both groups over the course of the intervention, and there were no significant differences between groups. In response to the emotional words, the brain activity within the temporal and parietal cortices increased in the game-CBT group, while the brain activity within cingulate and parietal cortices increased in the offline-CBT group. In addition, ASD adolescents in the game-CBT group showed increased brain activity within the right cingulate gyrus, left medial frontal gyrus, left cerebellum, left fusiform gyrus, left insular cortex, and sub lobar area in response to facial emoticons. A prosocial online game designed for CBT was as effective as offline-CBT in ASD adolescents. Participation in the game especially increased social arousal and aided ASD adolescents in recognizing emotion. The therapy also helped participants more accurately consider associated environments in
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Appendix 11 - Summary of Findings in Social Cognition Domain

No	Author	Year	Design	Diagnosis/N/ Age/Sex		Inclusion/ Exclusion Criteria	Intervention		Implemen tation strategies	Cognitive Target Sub- Category	Measures	Results
				Case	Control		Case	Control				
												response to facial emotional stimulation. However, the online CBT was less effective than the offline-CBT at evoking emotions in response to emotional words.
9	Cheung, P. P. P.	2018	Before-After	ASD N=7 Mean age= 12.57 years.		NA	As an initial trial, this study adopted the Friendship Lab program, which was specifically designed to address social-cognitive skills in children with ASD. /10-week social cognitive program		at school	Social Cognition	The Chinese Version Social Skills Improvement System Rating Scales (SSIS-RS-C) Goal Attainment Scaling (GAS) The Friendship Qualities Scale (FQS) The Strange Stories Test The Theory of Mind Inventory – Second Edition (ToMI-2)	The results showed that there is significant increase in goal attainment (GAS) ($p = 0.008$) and ToM (Strange Stories Test) ($p = 0.039$). There were increase in the FQS, SSISRS-C, and ToMI scales at post-test, but the gains were not maintained at follow-up.
41	van der Meer, L.	2014	Single subject	a 10-year-old boy		NA	Augmentative and alternative communication (AAC) (iPad®-based)		using iPad	Social cognition	Vineland Adaptive Behavior Scales, second edition (Vineland-II)	a structured behavioral intervention enabled Ian to learn to use an iPad®-based SGD for specific communicative skills and as he developed an understanding of the meaning and purpose of these communicative interactions, they gradually became spontaneous and generalized to a wider range of communicative functions used within naturally occurring communicative exchanges

Appendix 11 - Summary of Findings in Social Cognition Domain

No	Author	Year	Design	Diagnosis/N/ Age/Sex		Inclusion/ Exclusion Criteria	Intervention		Implemen tation strategies	Cognitive Target	Measures	Results
				Case	Control		Case	Control		Sub- Category		
42	Soorya, L. V.	2015	Random ized Clinical Trial	ASD N=35 30 males 5 females Mean age:10.05 years Mean IQ:94.86	ASD N= 34 27 males 7 females Mean age:9.87 Mean IQ:93.72	Inclusion criteria were as follows: 8- to 11-year-old children with a diagnosis of ASD and a verbal IQ score of > 70. Exclusion criteria were as follows: initiation of new psychiatric medication within 30 days prior to screening, known gross structural abnormalities in the brain, active seizure disorder, and aggression towards others.	NETT—A modular CBI- based social skills curriculum for children with ASD ages 4 to 12 was developed in an outpatient autism treatment program over a five-year period. Open label data was collected on fidelity, outcomes, and therapist satisfaction, which led to modifications of the study protocols and manuals during the development phase. Three developmentally progressive modules targeting autism- specific social cognitive impairments were selected for NETT: nonverbal communication, emotion recognition, and theory of mind.	Facilitated Play—A treatment manual for the control condition was developed to provide a supportive environm ent for children with ASD participati ng in a social group setting. The treatment manual described methods to tailor child- directed play based on the interests and abilities of group members.	Group based	Social Cognition	Social Responsiveness Scale (SRS), Griffith Empathy Measure, and Children’s Communication Checklist-2 (CCC-2). Social Cognition— Direct neuropsychological assessments of social cognition were conducted by blinded, trained raters at baseline, endpoint, and maintenance. Assessments included the Diagnostic Analysis of Nonverbal Accuracy-2 (DANVA2), Strange Stories Task, and the Reading the Mind in the Eyes Test (RMET). Social Validity—A 10-item parent satisfaction measure was developed for the study.	Significant improvements were found on social behavior outcomes such as nonverbal communication, empathic responding, and social relations in the NETT condition relative to the active control at endpoint. Verbal IQ and age moderated the interaction effect on social behavior with higher verbal IQ and older age associated with improvements in the CBI condition. No significant improvements were found on social cognitive outcomes.

Appendix 11 - Summary of Findings in Social Cognition Domain

No	Author	Year	Design	Diagnosis/N/ Age/Sex		Inclusion/ Exclusion Criteria	Intervention		Implemen tation strategies	Cognitive Target	Measures	Results
				Case	Control		Case	Control		Sub- Category		
61	Kandalaf t, M. R.	2013	Before- After	Eight young adults diagnosed with high- functioning autism completed 10 sessions across 5 weeks.		No	The current study investigated the feasibility of an engaging Virtual Reality Social Cognition Training intervention focused on enhancing social skills, social cognition, and social functioning.		Virtual reality	social cognition	The new Advanced Clinical Solutions for WAIS-IV and WMS- IV Social Perception Subtest (ACS-SP). / The Reading the Mind in the Eyes (Eyes). Another ToM measure, Triangles, also known as the Social Perception Task was additionally selected. / the Social Skills Performance Assessment, Version 3.2 (SSPA) was utilized to assess conversational abilities.	Significant increases on social cognitive measures of theory of mind and emotion recognition, as well as in real life social and occupational functioning were found post training. These findings suggest that the virtual reality platform is a promising tool for improving social skills, cognition, and functioning in autism.
50	Ratcliffe , B.	2014	Non- randomi zed clinical trial	ASD N= 111 100 males 11 females Mean age:9.4 years.	ASD N=106 95 males 11 females Mean age:9.57	No	Emotion-Based Social Skills Training (EBSST): EBSST (Wong et al., 2010) aims to teach children with ASD skills in emotional competence. EBSST is divided into three modules, teaching emotional competence skills in understanding own and others' emotions, emotional problem solving and theory of mind, and emotion regulation skills, following a developmental framework.		group school based	Social cognition	SRS (Autism severity) EDQ (Emotional competence) SSIS-RS (Social skill) Emotion-Based Social Skills Training (EBSST) SDQ (Mental health difficulties)	EBSST improved teacher reported emotional competence as measured by the Emotions Development Questionnaire (EDQ). The effect size was large and improvements were sustained at 6 months follow-up. Parent reported emotional competence and more general measures of social skills and mental health were insensitive to change across informants.

Appendix 11 - Summary of Findings in Social Cognition Domain

No	Author	Year	Design	Diagnosis/N/ Age/Sex		Inclusion/ Exclusion Criteria	Intervention		Implemen tation strategies	Cognitive Target Sub- Category	Measures	Results
				Case	Control		Case	Control				
10	Friedrich, E. V.	2015	Before- After	ASD N=13 12 males 1 female Mean age= 11.5 years.			16 NFT-sessions. The NFT was based on a game that encouraged social interactions and provided feedback based on imitation and emotional responsiveness. Bidirectional training of EEG mu suppression and enhancement (8–12 Hz over somatosensory cortex) was compared to the standard method of enhancing mu.		Neurofeedback	Social interaction		Children learned to control mu rhythm with both methods and showed improvements in (1) electrophysiology: increased mu suppression, (2) emotional responsiveness: improved emotion recognition and spontaneous imitation, and (3) behavior: significantly better behavior in every-day life.
24	Liu, M. J.	2018	Random ized Clinical Trial	ASD N=28	ASD N=28	Inclusion criteria: (1) age, 6–18 years; (2) having a diagnosis of ASD according to the DSM-5; (3) full-scale intelligence quotient >80; and (4) having the ability to communicate verbally with others without any difficulty.	The 10-session ToM Performance Training (ToMPT) program was developed for teaching emotion understanding and belief attribution on the basis of suggestions from Howlin et al. The topics in the emotion understanding session included recognizing facial expressions across genders and ages as well as identifying situation-, desire-, and belief-based emotions. The topics in the teaching belief attribution session included understanding the principle of seeing that leads to knowing, first and second-order false belief, nonliteral language, white lies, and sarcasm. In the ToMPT program the instructor also used the situations of bullying as the examples to help awareness of emotion.	The 10-session Social Skills Training (SST) program provided instruction on unwritten social rules for daily life, and the topics included appropriate dressing, eating in an appropriate manner, common social interaction courtesy, and guidelines for making friends.		Tom	The self-reported Chinese version of the School Bullying Experience Questionnaire (C-SBEQ).	The paired t test indicated that in the ToMPT group, the severities of both self-reported and mother reported bullying victimization significantly decreased from the pretraining to post training assessments, whereas in the SST group, only self-reported bullying victimization significantly decreased. The linear mixed-effect model indicated that compared with the SST program, the ToMPT program significantly reduced the severity of mother reported bullying victimization. The present study supports the effects of ToMPT on reducing mother-reported bullying victimization in children and adolescents with high functioning ASD.

Appendix 11 - Summary of Findings in Social Cognition Domain

No	Author	Year	Design	Diagnosis/N/ Age/Sex		Inclusion/ Exclusion Criteria	Intervention		Implemen tation strategies	Cognitive Target Sub- Category	Measures	Results
				Case	Control		Case	Control				
34	Paynter, J.	2013	NON-randomized clinical trial	ASD N=17 Mean age:79.41 months.	ASD N=7 Mean age:94.76 months.	NA	Using two-dimensional cardboard stimuli (e.g., dolls, bubble cut-outs, pictured props, and rooms with door flaps), each child in the experimental group individually received training in how to represent beliefs via cartoon bubbles.		individual training sessions	ToM	The Peabody Picture Vocabulary Test (PPVT) a standardized test of semantic language skill Test for Reception of Grammar (TROG-2) Raven's Progressive Matrices ToM Scale	Statistically significant gains were made by trained children that, furthermore, (a) generalized beyond false-belief to other ToM concepts and (b) were maintained for at least 3 weeks. Control children showed no significant gains of any kind despite their close match to trained children at pretest.
37	de Veld, D. M. J.	2017	Randomized Clinical Trial	AS N=136 90% male Mean age= 9.66 years.		Eligibility criteria of: (1) an ASD according to the DSMIV-TR, based on multiple assessments by psychologists and psychiatrists not involved in this study; (2) a verbal IQ score >70 based on the Peabody Picture Vocabulary Test-III-NL (PPVT).	The "Mini ToM intervention" is a manualized, weekly intervention comprising eight 1-h sessions. All sessions followed the same structure: (1) discussing the homework assignment; (2) games and exercises related to the day's theme; (3) children summarizing the session to their parents; and (4) explanation of next week's homework assignment. Parents were involved in the training through two 1-h parent sessions that explained theory of mind, the ToM-training, and how parents could help their children acquire these new skills and promote generalization.		A manualized, weekly individual clinical based intervention	ToM	Peabody Picture Vocabulary Test-III-NL (PPVT) Proximal Primary Outcome Measure: ToM Test Distal Primary Outcome Measure: ToM Behavior Checklist (ToMbc) Distal secondary Outcome Measure: Social Responsiveness Scale (SRS)	At posttest, children in the treatment condition had more ToM knowledge, showed fewer autistic features, and more ToM-related behavior than children in the control condition. Children who had one or two parents with at least a college degree, and children with parents not diagnosed with/suspected of having ASD themselves benefitted from the training.

Appendix 11 - Summary of Findings in Social Cognition Domain

No	Author	Year	Design	Diagnosis/N/ Age/Sex		Inclusion/ Exclusion Criteria	Intervention		Implemen tation strategies	Cognitive Target	Measures	Results
				Case	Control		Case	Control		Sub- Category		
56	Feng, H.	2008	Single subject	An 11-year-old sixth-grade student with autism.		No	Training was conducted four times a week (i.e., Monday through Thursday), for 40 min each session, in the resource room. Each skill was initially trained one-on-one with Lang.		individual sessions	ToM	Test of Theory-of-Mind (TToM).	The results showed a functional relationship between the intervention and the participant's skill mastery. Specifically, the participant's appropriate social interactions increased substantially across time and settings with similar improvements in the ToM test scores. The participant's teachers, mother, and peers responded positively to the intervention, indicating their acceptance of the training procedures and outcomes.

Appendix 12 - Quality Assessment of Articles in Social Cognition Domain

Are intervention protocols standardized and manualized?	Are randomization procedures clearly detailed and justified?	Design	Sub-Category	Main Category	Year	Author	No
Yes	NA	Single subject	Emotion recognition	Social cognition	2014	Russo-Ponsaran, N. M.	2
NI	NI	Randomized Clinical Trial	Joint attention	Social cognition	2013	Wong, C.	3
Yes	Yes	Randomized Clinical Trial	Social cognition	Social cognition	2016	Chung, U. S.	4
Yes	Yes	Randomized Clinical Trial	Joint attention	Social cognition	2012	Kaale, A.	5
Yes	Yes	Randomized Clinical Trial	Emotion Regulation	Social cognition	2018	Weiss, J. A.	6
Yes	NA	Single subject	Emotion recognition	Social cognition	2010	Lacava, P. G.	8
Yes	No	Before-After	Social Cognition	Social cognition	2018	Cheung, P. P. P.	9
Yes	No	Before-After	Social interaction	Social cognition	2015	Friedrich, E. V.	10
Yes	NA	Before-After	Emotion Regulation	Social cognition	2015	Thomson, K.	14
Yes	Yes	Randomized Clinical Trial	Focused Imitation	Social cognition	2012	Ingersoll, B.	15
No	No	Single subject	Joint attention	Social cognition	2018	Hansen, S. G.	16
Yes	No	Single subject	Emotion recognition	Social cognition	2014	Matsuda, S	17
Yes	Yes	Randomized Clinical Trial	Joint attention	Social cognition	2013	Schertz, H. H.	23
No	Yes	Randomized Clinical Trial	Tom	Social cognition	2018	Liu, M. J.	24
No	NA	Single subject	Joint attention	Social cognition	2014	Rudy, N. A.	25
yes	yes	Randomized Clinical Trial	Emotion Recognition	Social cognition	2016	Russo-Ponsaran, N. M.	26
Yes	No	Non-randomized	Emotion recognition	Social cognition	2010	Golan, O.	28
ni	ni	Randomized Clinical Trial	Emotion Recognition	Social cognition	2001	Silver, M.	30

Appendix 12 - Quality Assessment of Articles in Social Cognition Domain

Are cognitive targets linked to clinical status and functioning?	Are inclusion/exclusion criteria justified?	Are potential predictors/moderators assessed?	Diagnosis confirmation	Are statistical approaches of the art and appropriately matched to the research question and data	Are there plans to monitor fidelity and operationalize the delivery of the experimental and comparison
Yes	Yes	NA	Yes	Yes	No
Yes	No	NI	Yes	NI	NI
Yes	Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes	Yes
Yes	Yes	NI	Yes	Yes	Yes
Yes	NI	NI	Yes	Yes	Yes
Yes	NI	No	Yes	Yes	No
yes	NI	Yes	Yes	Yes	Yes
Yes	Yes	NI	Yes	Yes	Yes
Yes	No	Yes	Yes	Yes	Yes
Yes	NI	No	Yes	No	Yes
Yes	No	No	Yes	Yes	No
Yes	Yes	yes	Yes	Yes	Yes
yes	Yes	Yes	Yes	Yes	Yes
Yes	No	No	Yes	Yes	No
yes	Yes	no	Yes	yes	yes
Yes	NI	No	Yes	Yes	Yes
ni	ni	ni	ni	ni	ni

Appendix 12 - Quality Assessment of Articles in Social Cognition Domain

Are cognitive/function al outcomes distinguishable from practice effects?	Are retention/comple tion rates assessed and reported?	Do assessments provide for the elucidation of intervention mechanisms?	Are potential predictors/moderators of outcomes considered?	Is the hypothesized therapeutic mechanism supported by research and theory?	Do the cognitive training interventions match the perceptual/cognitive/affective processes that characterize the disorder and/or neural circuits implicated?
Yes	Yes	Yes	No	Yes	Yes
Yes	Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes	Yes
NA	Yes	Yes	Yes	Yes	Yes
Yes	NA	No	No	Yes	Yes
No	Yes	No	No	Yes	Yes
yes	yes	yes	no	yes	yes
Yes	Yes	Yes	No	Yes	Yes
Yes	Yes	Yes	Yes	Yes	Yes
NO	NA	No	No	Yes	Yes
No	NA	No	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes	yes
Yes	Yes	NO	Yes	yes	yes
No	Yes	No	Yes	Yes	Yes
yes	yes	yes	no	yes	yes
No	yes	Yes	No	Yes	Yes
ni	ni	ni	ni	ni	ni

Appendix 12 - Quality Assessment of Articles in Social Cognition Domain

Is the comparison condition justified in terms of the research question and stage of intervention development/testing?	Are concomitant treatments held constant across treatment conditions and/or quantified and considered in	How might the proposed concomitant therapies potentiate or interfere with cognitive training	Is cognitive training intended as a monotherapy or as an adjunctive treatment? Are concomitant treatments considered in the assessment and analysis	Does the plan include measures at multiple levels of analysis as appropriate?	Are valid measures of proximal and more distal outcomes included?
NA	NA	NA	monotherapy	No	No
NA	NA	NA	Monotherapy	No	Yes
Yes	NA	NA	monotherapy	Yes	Yes
NA	Yes	Yes	adjunct to school program	No	Yes
NI	NI	NI		Yes	Yes
NA	NA	NA	Monotherapy	No	Yes
NA	NA	NA	monotherapy	No	No
NA	NA	NA	monotherapy	no	yes
NA	NA	NA	Monotherapy	No	Yes
NA	NA	NA	Monotherapy	No	No
NA	NA	NA	Monotherapy	No	No
NA	NA	NA	Monotherapy	No	No
NA	NA	NA	Monotherapy	No	Yes
NA	NA	NA	Monotherapy	No	No
NA	NA	NA	Monotherapy	No	No
Na	na	na	monotherapy	no	no
NA	NA	NA	Monotherapy	No	No
ni	ni	ni	ni	ni	ni

Appendix 12 - Quality Assessment of Articles in Social Cognition Domain

What are the implementation strategies?	Are all relevant stakeholders considered?	Does the comparison condition control for attention, expectations, and potential practice effects associated with training/assessment
	Yes	NA
School Based	NA	NA
online vs offline	No	Yes
school based program	No	NA
	NI	NI
Computer based training game	No	NA
at school	Yes	NA
individual face to face sessions	No	NA
face to face/using Multimedia	Yes	NA
	No	NA
	No	NA
Computer based training	No	NA
parent education	Yes	NA
	yes	NA
Video modeling	No	NA
web based	No	Na
watching a DVD at home	NA	NA
ni	ni	ni

Continuous ...						
Are randomization procedures clearly detailed and justified?	Design	Sub-Category	Main Category	Year	Author	No
No	Case-Control	Emotion recognition	Social cognition	2018	White, S. W.	32
NA	NON-randomized clinical trial	ToM	Social cognition	2013	Paynter, J.	34
yes	Randomized Clinical Trial	Joint attention	Social cognition	2008	Yoder, P.	35
Yes	Randomized Clinical Trial	Joint attention	Social cognition	2012	Nye, C.	36
yes	Randomized Clinical Trial	ToM	Social cognition	2017	de Veld, D. M. J.	37
Yes	Randomized Clinical Trial	Joint attention	Social cognition	2012	Charman, T.	38
NA	Single subject	Social cognition	Social cognition	2014	van der Meer, L.	41
Yes	Randomized Clinical Trial	Social Cognition	Social cognition	2015	Soorya, L. V.	42
yes	Randomized Clinical Trial	Emotion recognition	Social cognition	2015	Rodgers, J. D.	44
No	Single subject	Joint attention	Social cognition	2017	Muzammal, M. S.	47
Yes	Randomized Clinical Trial	Emotion Recognition	Social cognition	2012	Williams, B. T.	49
No	Non-randomized clinical trial	Social emotional	Social cognition	2014	Ratcliffe, B.	50
NA	Single subject	Joint attention	Social cognition	2006	Whalen, C.	51
NA	Single subject	Joint attention	Social cognition	2014	Chiengchan a, N.	52
No	Single subject	ToM	Social cognition	2008	Feng, H.	56
Yes	Randomized Clinical Trial	Joint attention	Social cognition	2014	Gulstrud, A. C.	58
yes	Randomized Clinical Trial	Emotion recognition	Social cognition	2017	Gev, T.	59
NA	Before-After	social cognition	Social cognition	2013	Kandalaft, M. R.	61

Continuous ...					
Are inclusion/exclusion criteria justified?	Are potential predictors/moderators assessed?	Diagnosis confirmation	Are statistical approaches state of the art and appropriately matched to the research question and data	Are there plans to monitor fidelity and operationalize the delivery of the experimental and comparison conditions?	Are intervention protocols standardized and manualized?
Yes	Yes	Yes	Yes	No	No
NI	Yes	Yes	Yes	Yes	Yes
NI	NI	Yes	yes	yes	yes
Yes	NI	Yes	Yes	Yes	Yes
Yes	Yes	Yes	yes	yes	yes
NI	NI	Yes	Yes	Yes	Yes
NI	No	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes	Yes
Yes	yes	Yes	yes	yes	yes
Yes	No	Yes	Yes	No	Yes
Yes	yes	Yes	Yes	Yes	Yes
No	Yes	Yes	Yes	Yes	Yes
NI	No	Yes	Yes	Yes	Yes
No	No	Yes	Yes	No	No
No	No	Yes	No	No	No
NI	NI	Yes	Yes	Yes	Yes
No	Yes	Yes	yes	yes	yes
No	yes	Yes	yes	yes	Yes

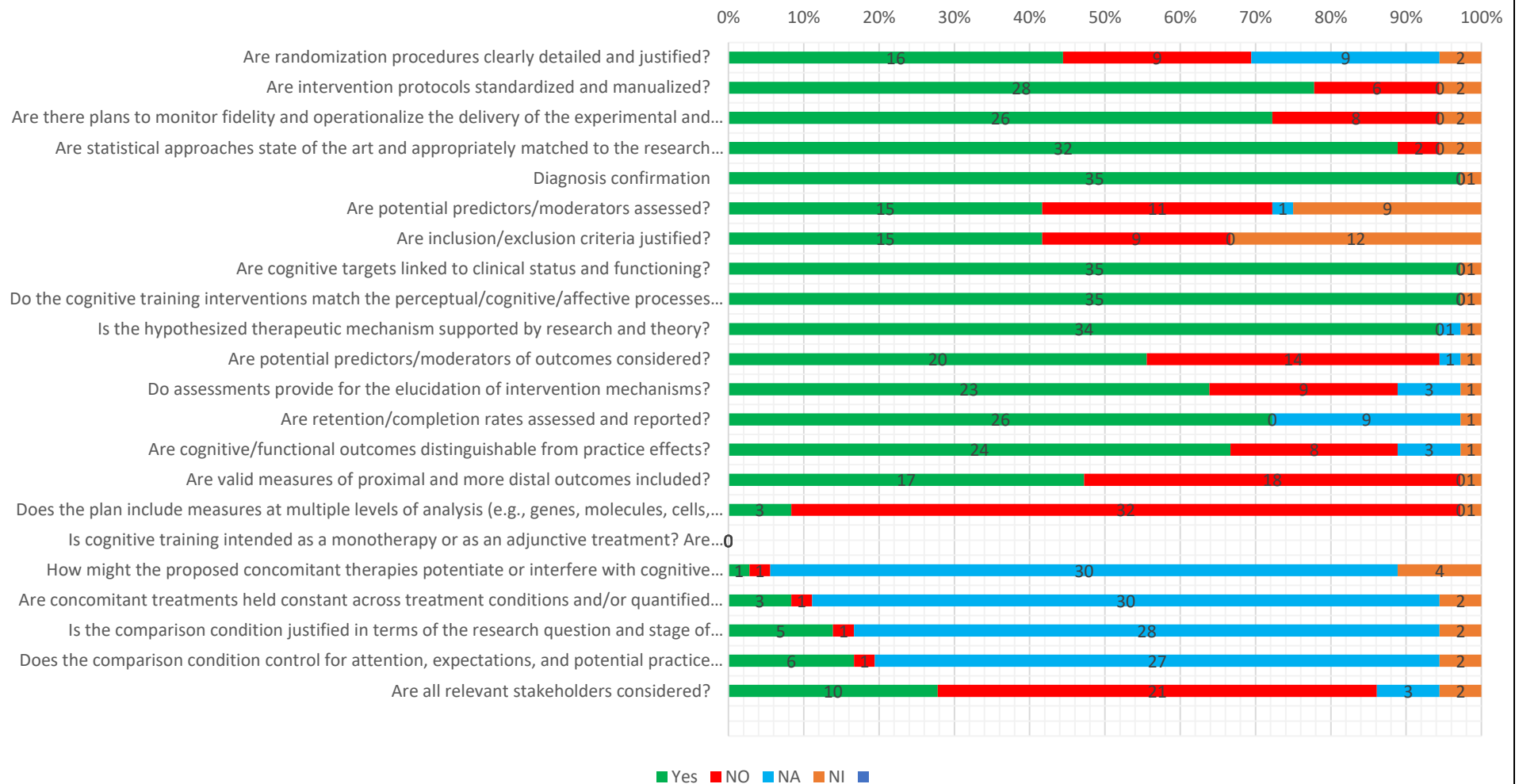
Continuous ...				
Do assessments provide for the elucidation of intervention mechanisms?	Are potential predictors/moderators of outcomes considered?	Is the hypothesized therapeutic mechanism supported by research and theory?	Do the cognitive training interventions match the perceptual/cognitive/affective processes that characterize the disorder and/or neural circuits	Are cognitive targets linked to clinical status and functioning?
NO	Yes	yes	yes	yes
Yes	Yes	Yes	Yes	Yes
yes	yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes
yes	yes	Yes	Yes	Yes
NA	NA	Yes	Yes	Yes
Yes	No	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes
No	Yes	yes	yes	Yes
Yes	No	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes
Yes	No	Yes	Yes	Yes
NA	No	Yes	Yes	Yes
No	No	NA	Yes	Yes
Yes	Yes	Yes	Yes	Yes
yes	no	yes	yes	yes
NA	yes	yes	yes	yes

Continuous ...					
Is cognitive training intended as a monotherapy or as an adjunctive treatment? Are concomitant treatments considered in the assessment and analysis plan?	Does the plan include measures at multiple levels of analysis as appropriate?	Are valid measures of proximal and more distal outcomes included?	Are cognitive/functional outcomes distinguishable from practice effects?	Are retention/compl etion rates assessed and reported?	
Monotherapy	NO	NO	NO	NA	
Monotherapy	Yes	Yes	Yes	Yes	
Monotherapy	No	yes	yes	yes	
Adjunctive	No	Yes	Yes	Yes	
Monotherapy	no	yes	yes	yes	
Monotherapy	No	Yes	Yes	Yes	
Monotherapy	No	No	Yes	NA	
Monotherapy	No	Yes	Yes	Yes	
Monotherapy	no	No	Yes	Yes	
Monotherapy	No	No	Yes	NA	
Monotherapy	No	Yes	Yes	Yes	
Adjunctive to school program	No	Yes	Yes	Yes	
Monotherapy	No	No	Yes	NA	
Monotherapy	No	No	NA	NA	
Monotherapy	No	No	No	NA	
Monotherapy	No	Yes	Yes	Yes	
monotherapy	no	no	no	yes	
Monotherapy	no	no	NA	yes	

Continuous ...				
Does the comparison condition control for attention, expectations, and potential practice effects associated with training/assessment protocols, as	Is the comparison condition justified in terms of the research question and stage of intervention development/testing?	Are concomitant treatments held constant across treatment conditions and/or quantified and considered	How might the proposed concomitant therapies potentiate or interfere with cognitive training effects?	
Yes	NA	NA	NA	
NA	NA	NA	NA	
NA	NA	NA	NA	
Yes	Yes	Yes	NI	
Na	NA	NA	NA	
NA	NA	NA	NA	
NA	NA	NA	NA	
Yes	Yes	NA	NA	
NA	NA	NA	NA	
Na	NA	NA	NA	
Yes	Yes	NA	NA	
Yes	Yes	Yes	NI	
NA	NA	NA	NA	
NA	NA	NA	NA	
NA	NA	NA	NA	
NA	NA	NA	Na	
no	no	no	no	
NA	NA	NA	NA	

Continuous ...	
What are the implementation strategies?	Are all relevant stakeholders considered?
Face to face individual training sessions using PC.	yes
individual training sessions	No
Individual sessions	NA
	No
Individual clinical based	Yes
Individual sessions	No
using iPad	No
Group based	Yes
group based psychosocial intervention	No
Individual Sessions	No
watching a DVD	No
group school based	Yes
	No
individual sessions	No
individual sessions	No
	No
computer based	yes
computer based	No

Social Cognition



Appendix 13 - Quality of Evidence in Social Cognition Domain

Appendix 14 - Description of Included and Excluded Studies

No	First Author	Year	Title	Included/Excluded (reason)
1	Leanne Chukoskie	2018	A Novel Approach to Training Attention and Gaze in ASD: A Feasibility and Efficacy Pilot Study	<i>Included</i>
2	Nicole M. Russo-Ponsaran	2014	A Pilot Study Assessing the Feasibility of a Facial Emotion Training Paradigm for School-Age Children with Autism Spectrum Disorders	<i>Included</i>
3	Connie S Wong	2013	A play and joint attention intervention for teachers of young children with autism: A randomized controlled pilot study	<i>Included</i>
4	Un-sun chung		a prosocial online game for social cognition training in adolescents with high-functioning autism: an fMRI study	<i>Included</i>
5	Anett Kaale	2012	A randomized controlled trial of preschool-based joint attention intervention for children with autism	<i>Included</i>
6	Jonathan A. Weiss	2018	A randomized waitlist-controlled trial of cognitive...	<i>Included</i>
7	Sander M. Weckstein	2017	A Retrospective Chart Analysis with Follow-Up of Cogmed Working Memory Training in Children and Adolescents with Autism Spectrum Disorder	<i>Included</i>
8	Paul G. Lacava	2010	A single case design evaluation of a software and tutor intervention addressing emotion recognition and social interaction in four boys with ASD	<i>Included</i>
9	Phoebe PP Cheung	2017	A social-cognitive intervention program for adolescents with autism: A pilot study	<i>Included</i>
10	Elisabeth V. C. Friedrich	2015	An Effective Neurofeedback Intervention to Improve Social Interactions in Children with Autism Spectrum Disorder	<i>Included</i>
11	Sophie Goldingay	2013	An intervention to improve social participation for adolescents with autism spectrum disorder: Pilot study	<i>Included</i>
12	Kerns, K. A.	2017	Attention and working memory training: A feasibility study in children with neurodevelopmental disorders	<i>Included</i>
13	Spaniol, M. M.	2018	Attention Training in Autism as a Potential Approach to Improving Academic Performance: A School-Based Pilot Study	<i>Included</i>
14	Kendra Thomson	2015	Brief Report of Preliminary Outcomes of an Emotion Regulation Intervention for Children with Autism Spectrum Disorder	<i>Included</i>
15	Brooke Ingersoll	2012	Brief Report: Effect of a focused imitation intervention on social functioning in children with autism	<i>Included</i>
16	Sarah G. Hansen	2018	Caregiver-mediated joint attention intervention	<i>Included</i>
17	Matsuda, S	2014	Computer-based intervention for inferring facial expressions from the socio-emotional context in two children with autism spectrum disorders	<i>Included</i>
18	Songpoom Benyakorn	2018	Computerized Cognitive Training in Children with Autism and Intellectual Disabilities: Feasibility and Satisfaction Study	<i>Included</i>
19	Sara Naderi	2014	Dohsa training and Theory of Mind in High Functioning Autistic Children	<i>Not Cognitive Based Intervention</i>
20	Majid Naeemi	2013	Effectiveness of Audiovisual Stimulation on Executive function in Children with High-functioning Autism	<i>Included</i>
21	Sun, I.	2017	Effects of executive function stimulation in the language improvement of children with ASD	<i>Included</i>
22	Claudia List Hilton	2014	Effects of Exergaming on Executive Function and Motor Skills in Children With Autism Spectrum Disorder: A Pilot Study	<i>Included</i>
23	Hannah H. Schertz	2013	Effects of Joint Attention Mediated Learning for toddlers with autism spectrum disorders: An initial randomized controlled study	<i>Included</i>
24	Meng-Jung Liu	2018	Effects of theory of mind performance	<i>Included</i>
25	Nikki A. Rudy	2014	Effects of Video Modeling on Teaching Bids for Joint Attention to Children with Autism	<i>Included</i>
26	Nicole M. Russo-Ponsaran	2016	Efficacy of a Facial Emotion Training Program for Children and Adolescents with Autism Spectrum Disorders	<i>Included</i>
27	Estate M. Sokhadze	2016	Electrophysiological and Behavioral Outcomes of Berard Auditory Integration Training (AIT) in Children with Autism Spectrum Disorder	<i>Included</i>

Appendix 14 - Description of Included and Excluded Studies

No	First Author	Year	Title	Included/Excluded (reason)
28	Ofer Golan	2010	Enhancing Emotion Recognition in Children with Autism Spectrum Conditions: An Intervention Using Animated Vehicles with Real Emotional Faces	<i>Included</i>
29	Hesham Kozou	2018	Evaluation and remediation of central auditory processing disorders	<i>Included</i>
30	MIRIAM SILVER	2001	Evaluation of a new computer intervention to teach people with autism or Asperger syndrome to recognize and predict emotions in others	<i>Included</i>
31	de Vries, M.	2018	Exploring possible predictors and moderators of an executive function training for children with an autism spectrum disorder	<i>Included</i>
32	Susan W. White	2018	feasibility of automated...	<i>Included</i>
33	Georgina Powell	2016	First evidence of the feasibility of gaze-contingent attention training for school children with autism	<i>Included</i>
34	Jessica Paynter	2013	Further evidence of benefits of thought-bubble training for theory of mind development in children with autism spectrum disorders	<i>Included</i>
35	Paul Yoder	2008	Initiating joint-attention treatment facilitates later expressive language development, particularly in initially low-verbal children with autism spectrum disorder	<i>Included</i>
36	Chad Nye	2012	Joint attention training shows significant improvement for children with autism	<i>Included</i>
37	Danielle M. J. de Veld	2017	Moderating Effects of Parental Characteristics on the Effectiveness of a Theory of Mind Training for Children with Autism	<i>Included</i>
38	Tony Charman	2012	Modest size RCT indicates that short- term joint attention and symbolic play intervention improves shared positive affect in social interactions for preschool children with autism	<i>Included</i>
39	Mirjam E.J. Kouijzer	2009	Neurofeedback treatment in autism. Preliminary findings in behavioral, cognitive, and neurophysiological functioning	<i>Included</i>
40	Hajri, M.	2017	Place of cognitive remediation therapy in the management of autism spectrum disorder	<i>Included</i>
41	Larah van der Meer	2014	Preference-Enhanced Communication Intervention and Development of Social Communicative Functions in a Child with Autism Spectrum Disorder	<i>Included</i>
42	Latha V. Soorya	2015	Randomized Comparative Trial of a Social Cognitive Skills Group for Children With Autism Spectrum Disorder	<i>Included</i>
43	Lauren Kenworthy	2014	Randomized controlled effectiveness trial of executive function intervention for children on the autism spectrum	<i>Included</i>
44	Jonathan D. Rodgers	2014	RCT of a Psychosocial Treatment for Children with High-Functioning ASD: Supplemental Analyses of Treatment Effects on Facial Emotion Encoding	<i>Included</i>
45	oshiyuki T achibana	2013	Reading aloud improves executive function of children with autism spectrum disorder: a pilot randomized controlled trial	<i>Not Cognitive Based Intervention</i>
46	María Vélez-Coto	2017	SIGUEME: Technology-based intervention for low-functioning autism to train skills to work with visual signifiers and concepts	<i>Included</i>
47	Muzammal, M. S.	2017	Social-Communication Intervention for Toddlers with Autism Spectrum Disorder: Effects on Initiating Joint Attention and Interactions with Mother	<i>Included</i>
48	Ingrid Ya I. Sun	2017	Stimulation of Executive Functions as Part of the Language Intervention Process in Children with Autism Spectrum Disorder	<i>Included</i>
49	Beth T. Williams	2012	Teaching emotion recognition skills to young children with autism: a randomised controlled trial of an emotion training programme	<i>Included</i>
50	Ratcliffe, B	2014	Teaching social-emotional skills to school-aged children with Autism Spectrum Disorder: A treatment versus control trial in 41 mainstream schools	<i>Included</i>
51	Christina Whalen	2006	The Collateral Effects of Joint Attention Training on Social Initiations, Positive Affect, Imitation, and Spontaneous Speech for Young Children with Autism	<i>Included</i>
52	Natee Chiengchana	2014	The effect of Kodály-based music experiences on joint attention in children with autism spectrum disorder	<i>Included</i>
53	Varvara Pasiali	2014	The Effect of Musical Attention Control Training (MACT) on Attention Skills of Adolescents with Neurodevelopmental Delays: A Pilot Study	<i>Included</i>

Appendix 14 - Description of Included and Excluded Studies

No	First Author	Year	Title	Included/Excluded (reason)
54	Javad Afshari	2012	The effect of perceptual-motor training on attention in the children with autism spectrum disorders	<i>Included</i>
55	Bryan Gee	2014	The effectiveness of auditory stimulation in children with autism spectrum disorders: A case–control study	<i>Included</i>
57	Acero-Ferrero, M.	2017	Transferring learning to everyday life in autism spectrum disorder through an Executive Functions training programme	<i>Included</i>
58	Amanda C. Gulsrud	2014	Two to ten years: Developmental trajectories of joint attention in children with ASD who received targeted social communication interventions	<i>Included</i>
59	Tali Gev	2017	Unique effects of The Transporters animated series and of parental support on emotion recognition skills of children with ASD	<i>Included</i>
60	Michelle Wang	2013	Using the Virtual Reality-Cognitive Rehabilitation Approach to Improve Contextual Processing in Children with Autism	<i>Included</i>
61	Michelle R. Kandalaf	2012	Virtual Reality Social Cognition Training for Young Adults with High-Functioning Autism	<i>Included</i>
62	Marieke de Vries	2014	Working memory and cognitive flexibility-training for children with an autism spectrum disorder: A randomized controlled trial	<i>Included</i>
63	Catherine Y. Wan	2011	Auditory-Motor Mapping Training as an Intervention to Facilitate Speech Output in Non-Verbal Children with Autism: A Proof of Concept Study	<i>Non interventional</i>
64	Zheng, Z.	2017	Design of an Autonomous Social Orienting Training System (ASOTS) for Young Children with Autism	<i>Non interventional</i>
65	CONNIE KASARI,	2001	Early Intervention in Autism: Joint Attention and Symbolic Play	<i>Non interventional</i>
66	W. X. Chmielewski	2016	Effects of multisensory integration processes on response inhibition in adolescent autism spectrum disorder	<i>Non interventional</i>
67	Winoto, P.	2016	I will Help You Pass the Puzzle Piece to Your Partner if This is What You Want Me to: The Design of Collaborative Puzzle Games to Train Chinese Children with Autism Spectrum Disorder Joint Attention Skills	<i>Non interventional</i>
68	<u>Elske Hoddenbach</u>	2012	Individual differences in the efficacy of a short theory of mind intervention for children with autism spectrum disorder: a randomized controlled trial	<i>Non interventional</i>
69	Anonymous	2017	Technology-based interventions	<i>Non interventional</i>
70	Fatima A. Boujarwah	2010	Training Social Problem Solving Skills in Adolescents with High-Functioning Autism	<i>Non interventional</i>
71	Matsumoto, S.	2016	Visual Effect on the Odor Identification Ability of Children with Autism Spectrum Disorder	<i>Non interventional</i>
72	Carlos Duarte	2014	Welcoming Gesture Recognition into Autism Therapy	<i>Non interventional</i>
73	LINDSAY M. LUTON	2011	A pilot study evaluating an abbreviated version of the cognitive remediation programme for youth with neurocognitive deficit	<i>Not ASD cases</i>
74	Richard, E.	2007	Augmented reality for rehabilitation of cognitive disabled children: A preliminary study	<i>Not ASD cases</i>
75	Heather L. Dankert,	2003	Occupational Therapy Effects on Visual-Motor Skills in Preschool Children	<i>Not ASD cases</i>
76	Susan R. McGurk	2008	Response to Cognitive Rehabilitation in Older Versus Younger Persons with Severe Mental Illness	<i>Not ASD cases</i>
77	Tia R. Schultz	2012	Social Competence Intervention for Parents (SCI-P): Comparing Outcomes for a Parent Education Program Targeting Adolescents with ASD	<i>Not ASD cases</i>
78	Yi-Nan Chen	2013	The effectiveness of multimedia visual perceptual training groups for the preschool children with developmental delay	<i>Not ASD cases</i>
79	Agnes S. Chan	2012	A Chan Dietary Intervention Enhances Executive Functions and Anterior Cingulate Activity in Autism Spectrum Disorders: A Randomized Controlled Trial	<i>Not Cognitive Based Intervention</i>
80	Neri L. Romero	2017	A Pilot Study Examining a Computer-Based Intervention to Improve Recognition and Understanding of Emotions in Young Children with Communication and Social Deficits	<i>Not Cognitive Based Intervention</i>
81	Naomi Fisher	2005	A Training Study of Theory of Mind and Executive Function in Children with Autistic Spectrum Disorders	<i>Not Cognitive Based Intervention</i>
82	Anonymous	2015	An Intervention for Sensory Processing Difficulties in Children with Autism	<i>Not Cognitive Based Intervention</i>
83	Karen V. Chenausky	2017	Auditory-Motor Mapping Training in a More Verbal Child with Autism	<i>Not Cognitive Based Intervention</i>

Appendix 14 - Description of Included and Excluded Studies

No	First Author	Year	Title	Included/Excluded (reason)
84	Crooke, P. J.	2008	Brief Report: measuring the effectiveness of teaching social thinking to children with Asperger syndrome (AS) and High Functioning Autism (HFA)	<i>Not Cognitive Based Intervention</i>
85	Cristina de Andrade Varanda	2017	Cognitive flexibility training intervention among children with autism: a longitudinal study	<i>Not Cognitive Based Intervention</i>
86	Frank H Duffy	2014	Corticosteroid therapy in regressive autism: a retrospective study of effects on the Frequency Modulated Auditory Evoked Response (FMAER), language, and behavior	<i>Not Cognitive Based Intervention</i>
87	Agnes S. Chan	2011	Dejian Mind-Body Intervention Improves the Cognitive Functions of a Child with Autism	<i>Not Cognitive Based Intervention</i>
88	Bebko, J. M.	(study1)2017	Effectiveness and Retention of Teaching Memory Strategy Use to Children With Autism Spectrum Disorder	<i>Not Cognitive Based Intervention</i>
89	MARIE L. ROCHA	2007	Effectiveness of Training Parents to Teach Joint Attention in Children With Autism	<i>Not Cognitive Based Intervention</i>
90	Deriso, D.	2012	Emotion mirror: A novel intervention for autism based on real-time expression recognition	<i>Not Cognitive Based Intervention</i>
91	Shadan Golestan	2017	Feasibility of Using Sphero in Rehabilitation of Children with Autism in Social and Communication Skills	<i>Not Cognitive Based Intervention</i>
92	Nozomi Naoi	2008	Functional training for initiating joint attention in children with autism	<i>Not Cognitive Based Intervention</i>
93	hannah Schertz	2006	Interventions for Toddlers With Autism: Building on the Parent-Child Relationship to Promote Joint Attention	<i>Not Cognitive Based Intervention</i>
94	Rao, V. S.	2014	Joint attention routines in intervention for children with autism spectrum disorders	<i>Not Cognitive Based Intervention</i>
95	Christina Whalen	2003	Joint attention training for children with autism using behavior modification procedures	<i>Not Cognitive Based Intervention</i>
96	Whalen, C.	2003	Joint attention training for children with autism using behavior modification procedures	<i>Not Cognitive Based Intervention</i>
97	Connie Kasari	2008	Language Outcome in Autism: Randomized Comparison of Joint Attention and Play Interventions	<i>Not Cognitive Based Intervention</i>
98	Connie Kasari	2012	Longitudinal Follow Up of Children with Autism Receiving Targeted Interventions on Joint Attention and Play RH = Targeted Interventions on Joint Attention and Play	<i>Not Cognitive Based Intervention</i>
99	Sokhadze, G.	2013	Modulatory Effects of Ambient Prism Lenses on Spatial Attention in Autism	<i>Not Cognitive Based Intervention</i>
100	Eduardo Quintana	2012	Object and gesture recognition to assist children with autism during the discrimination training	<i>Not Cognitive Based Intervention</i>
101	Tony Gentry	2010	Personal digital assistants as cognitive aids for high school students with autism: Results of a community-based trial	<i>Not Cognitive Based Intervention</i>
102	Parvaneh haddadi	2011	Rehabilitation in Autism Spectrum Disorder (ASD): a mixture of neurofeedback training and Auditory Integration Training (AIT)	<i>Not Cognitive Based Intervention</i>
103	Gundersen, K. K.	2016	Social perception training as a strategy for achieving better social understanding in young children with autism	<i>Not Cognitive Based Intervention</i>
104	Krstovska-Guerrero, I.	2016	Social-Communication Intervention for Toddlers with Autism Spectrum Disorder: Eye Gaze in the Context of Requesting and Joint Attention	<i>Not Cognitive Based Intervention</i>
105	Lawton, K	2012	Teacher-Implemented Joint Attention Intervention: Pilot Randomized Controlled Study for Preschoolers with Autism	<i>Not Cognitive Based Intervention</i>

Appendix 14 - Description of Included and Excluded Studies

No	First Author	Year	Title	Included/Excluded (reason)
106	Supawadee Cindy Lee	2013	The Effect of Computer-Based Intervention on Enhancing Visual Perception of Preschool Children with Autism: A Single-Subject Design Study	<i>Not Cognitive Based Intervention</i>
107	Lauren A. Kryzak	2015	The Effect of Prompts within Embedded Circumscribed Interests to Teach Initiating Joint Attention in Children with Autism Spectrum Disorders	<i>Not Cognitive Based Intervention</i>
108	Zeinab Shams Aliee	2013	The Effectiveness of Managing Split Attention Among Autistic Children using Computer Based Intervention	<i>Not Cognitive Based Intervention</i>
109	Sokhadze, E. M	2014	The Effects of Auditory Integration Training (AIT) on Mismatch Negativity in Children with Autism	<i>Not Cognitive Based Intervention</i>
110	Monireh JALILI MA	2014	The Effects of Imitative Vs. Cognitive Methods on The Speech Development of Children with Autism	<i>Not Cognitive Based Intervention</i>
111	Begeer, S.	2011	Theory of Mind Training in Children with Autism: A Randomized Controlled Trial	<i>Not Cognitive Based Intervention</i>
112	Zhang, X. M	2013	Theory of Mind Training Method Applied to Autism	<i>Not Cognitive Based Intervention</i>
113	Stieben, J.	2012	TREATMENT RELATED CHANGES IN CORTICAL CONNECTIVITY IN FACE/EMOTION PROCESSING WITH PRESCHOOL AGE CHILDREN WITH AUTISM	<i>Not Cognitive Based Intervention</i>
114	Mourning, R.	2016	Virtual Reality Social Training for Adolescents with High-Functioning Autism	<i>Not Cognitive Based Intervention</i>
115	Kirst, S.	2015	Zirkus Empathico: A mobile application for the training of socio-emotional competencies in children with autism spectrum disorder	<i>Not Cognitive Based Intervention</i>
116	Danielle L. LaFrance	2015	A CASE STUDY ON THE USE OF AUDITORY INTEGRATION TRAINING AS A TREATMENT FOR STEREOTYPY	<i>Not Cognitive Domain</i>
117	oliver c.mudford	2000	Auditory integration training for children with autism: no behavioral benefits detected	<i>Not Cognitive Domain</i>
118	Mudford, O. C.	2000	Auditory integration training for children with autism: No behavioral benefits detected	<i>Not Cognitive Domain</i>
119	Edelson, S. M	1999	Auditory integration training: A double-blind study of behavioral and electrophysiological effects in people with autism	<i>Not Cognitive Domain</i>
120	Nicole M Russo	2010	Biological changes in auditory function following training in children with autism spectrum disorders	<i>Not Cognitive Domain</i>
121	Van der Paelt, S.	2016	Effect of community interventions on social-communicative abilities of preschoolers with autism spectrum disorder	<i>Not Cognitive Domain</i>
122	Hajri, M.	2015	Effects of cognitive remediation therapy on school results in children with autism spectrum disorder	<i>Not Cognitive Domain</i>
123	Bryan M. Gee	2013	Efficacy of a Sound-based Intervention with a Child with an Autism Spectrum Disorder and Auditory Sensory Over-responsivity	<i>Not Cognitive Domain</i>
124	Shanon Phelan	2009	Exploring a cognitive intervention for children with pervasive developmental disorder	<i>Not Cognitive Domain</i>
125	Heidi J. Eilers	2015	Exposure and response prevention therapy with cognitive diffusion exercises to reduce repetitive and restrictive behaviors displayed by children with autism spectrum	<i>Not Cognitive Domain</i>
126	Heather L. Dankert	2003	Occupational Therapy Effects on Visual-Motor Skills in Preschool Children	<i>Not Cognitive Domain</i>
127	PAIGE M. WEINGER	2011	Remediation of Deficits in Recognition of Facial Emotions in Children with Autism Spectrum Disorders	<i>Not Cognitive Domain</i>
128	Hsiao Yun Chin	2000	Teaching Conversational Skills to Children with Autism: Effect on the Development of a Theory of Mind	<i>Not Cognitive Domain</i>
129	Hsiao Yun Chin	2000	Teaching Conversational Skills to Children with Autism: Effect on the Development of a Theory of Mind	<i>Not Cognitive Domain</i>
130	Edgington, L.	2016	The design and implementation of a CBT-based intervention for sensory processing difficulties in adolescents on the autism spectrum	<i>Not Cognitive Domain</i>
131	Donald E. P. Smith	1981	The Effects of Improved Auditory Feedback on the Verbalizations of an Autistic Child	<i>Not Cognitive Domain</i>

Appendix 14 - Description of Included and Excluded Studies

No	First Author	Year	Title	Included/Excluded (reason)
132	Villanueva-Bonilla, C.	2016	Effects of a 'theory of mind' cognitive development pilot programme in three children with autism: emotional component	<i>Not English</i>
133	María-Ángeles Bravo-Álvarez	2016	Entrenamiento para la mejora de disfunciones atencionales en niños y adolescentes con Síndrome de Asperger a través de estimulación cognitiva directa	<i>Not English</i>
134	Zoerner, D.	2017	IT-aided training of socio-emotional cognition for people with autism	<i>Not Found</i>
135	Gunji, A.	2006	Auditory feedback in children with autism: A reduced Lombard effect	<i>Not Cognitive Domain</i>
136	Bernard Rimland	1995	Brief Report: A Pilot Study of Auditory Integration Training in Autism	<i>Not Cognitive Domain</i>
137	Gevers, C.	2006	Brief report: A theory-of-mind-based social-cognition training program for school-aged children with pervasive developmental disorders: An open study of its effectiveness	<i>Not Found</i>
138	Banerjee, M.	2016	Can the Theory of Mind of Children with High Functioning Autism be Improved by Intervention? : An Experimental Approach	<i>Not Found</i>
139	Xu, Y	2013	Case Study on Training of Theory of Mind of Autistic Children	<i>Not Found</i>
140	Rua, M. O.	2017	Development of semantic memory ability through the training of related networks in students with autism spectrum disorder	<i>Not Cognitive Based Intervention</i>
141	Banerjee, M.	2008	Effect of affective stimulation on cognitive-affective impairments of autism	<i>Not Cognitive Domain</i>
142	Nagai, Y.	2016	Effect of Intervention on Joint Attention Strategies used by Mothers of Preschoolers with Autism Spectrum Disorders	<i>Not Cognitive Based Intervention</i>
143	Donald E. P.	1985	Effect of Using an Auditory Trainer on the Attentional, Language, and Social Behaviors of Autistic Children	<i>Not Cognitive Based Intervention</i>
144	Baltruschat, L.	2011	Further analysis of the effects of positive reinforcement on working memory in children with autism	<i>Not Cognitive Based Intervention</i>
145	Moutier, S.	2015	Improving executive function skills in children with autism spectrum disorder: The example of a new executive training protocol based on Learn Enjoy digital apps	<i>Not Found</i>
146	Cheng, Y.	2010	Improving social understanding of individuals of intellectual and developmental disabilities through a 3D-facail expression intervention program	<i>Not Found</i>
147	Beglinger, L. B.	2001	Information processing ability in children with autism receiving behavioral treatment	<i>Not Cognitive Based Intervention</i>
148	Wang, Y.	2016	Intervention of emotion recognition for children with high-functioning autism: A case study	<i>Not Found</i>
149	Charman, T.	2007	Interventions targeting joint attention and symbolic play can improve aspects of these skills in young children with autism	<i>Not Found</i>
150	MacSween, J.	2015	Investigating the efficacy of computerized cognitive intervention for children with FASD and ASD	<i>Not Found</i>
151	Johnston, S. S.	2007	Joint attention intervention shows promising positive outcomes for young children with autism	<i>Not Found</i>
152	Li, C. S.	2016	Metaphor processing defects and intervention in High-functioning autism	<i>Not Found</i>
153	Wagle, S.	2018	Mobile-based working memory training as a potential therapy for Autism Spectrum Disorder	<i>Not Found</i>
154	Jones, E. A.	2006	Multiple Effects of Joint Attention Intervention for Children with Autism	<i>Not Found</i>
155	Long, R.	2008	Rob Long's intervention toolbox: For social, emotional and behavioural difficulties	<i>Not Found</i>
156	Myung, J.	2016	The Effects of Neurofeedback Training on Social Communication in the Child with Autism Spectrum Disorder: A Case Study	<i>Not Cognitive Domain</i>
157	Jane A. Summers	1994	The Effects of Subject-Performed Tasks on the Memory Performance of Verbal Autistic Children	<i>Not Cognitive Based Intervention</i>
158	Hua Feng	2008	The Effects of Theory-of-Mind and Social Skill Training on the Social Competence of a Sixth-Grade Student with Autism	<i>Not Found</i>

Appendix 14 - Description of Included and Excluded Studies

No	First Author	Year	Title	Included/Excluded (reason)
159	Leew, S. V.	2010	Weighted vests' effect on social attention for toddlers with Autism Spectrum Disorders	<i>Not Cognitive Based Intervention</i>
160	Kiser, R. M. B.	2013	Implications of Auditory ERP Outcomes for Auditory Integration Training in Autism	<i>Not Cognitive Based Intervention</i>
161	Iakimova, G.	2013	Can a Training with Video Game of Social Cognition Enhance Neurocognitive Processes of Emotional Perception in Autism Spectrum? Insights of Event-Related Potentials	<i>Not Cognitive Based Intervention</i>
162	Hetzroni, O.	2013	Effectiveness of computer-based simulations on learning of social and communication skills by children with ASD	<i>Not Cognitive Based Intervention</i>
163	Glod, M	2013	Teaching emotion recognition skills to young children with autism: A randomised controlled trial of an emotion training programme	<i>Not Cognitive Based Intervention</i>
164	Galitsky, B	2013	A computational simulation tool for training autistic reasoning about mental attitudes	<i>Not Cognitive Based Intervention</i>
165	Anton Ashcroft	1999	A theory of mind and people with learning disabilities	<i>On adult sample</i>
166	Sven Bo"lte	2006	Facial Affect Recognition Training in Autism: Can We Animate the Fusiform Gyrus?	<i>On adult sample</i>
56	Maki Miyajima	2016	The effects of cognitive remediation therapy using the frontal/ executive program for autism spectrum disorder	<i>On adult sample</i>
167	Naomi Fisher	2005	A Training Study of Theory of Mind and Executive Function in Children with Autistic Spectrum Disorders	<i>Repetitive</i>
168	Amanda C. Gulsrud	2007	Children with autism's response to novel stimuli while participating in interventions targeting joint attention or symbolic play skills	<i>Repetitive</i>
169	Nikki A. Rudy	2014	Effects of Video Modeling on Teaching Bids for Joint Attention to Children with Autism	<i>Repetitive</i>
170	Kasari, C.	2007	Joint attention and symbolic play in young children with autism: a randomized controlled intervention study	<i>Repetitive</i>
171	Christina Whalen	2003	Joint attention training for children with autism using behavior modification procedures	<i>Repetitive</i>
172	Hua Feng	2008	The Effects of Theory-of-Mind and Social Skill Training on the Social Competence of a Sixth-Grade Student with Autism	<i>Repetitive</i>
173	Bebko, J. M.	(study2)		<i>Repetitive</i>
174	Chia-Jung Hsu MA OT	2013	Assessment and Intervention Protocol for Improving Figure-Copying Competence of Children with Autism Spectrum Disorder with Weak Central Coherence	<i>Review article</i>
175	American Academy of Pediatrics	1998	Auditory Integration Training and Facilitated Communication for Autism	<i>Review article</i>
176	Anna Robinson	2018	Emotion-Focused Therapy for Autism Spectrum Disorder	<i>Review article</i>
177	Anna Robinson	2017	Emotion-Focused Therapy for Clients with Autistic Process	<i>Review article</i>
178	Vidya Bhagat	2017	Emotional Regulation in Autism Spectrum Disorders: A New Proposed Model for Regulating Emotions through Parent Education	<i>Review article</i>
179	Reichle, J.	2018	Explicit joint attention interventions for young children with autism spectrum disorders are successful: But determining a specific strategy requires further evidence	<i>Review article</i>
180	Elizabeth Hurt	2014	Quantitative EEG Neurofeedback for the Treatment of Pediatric Attention Deficit/Hyperactivity Disorder, Autism Spectrum Disorders, Learning Disorders, and Epilepsy	<i>Review article</i>
181	Sander Begeer	2015	Theory of mind interventions can be effective in treating autism, although long-term success remains unproven	<i>Review article</i>
182	Carlos Duarte	2014	Welcoming Gesture Recognition into Autism Therapy	<i>Review article</i>
183	Catherine Marraffa		Social communication in autism spectrum disorder not improved by Theory of Mind interventions	<i>Review article</i>

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