ARCHIVOS DE NEUROCIENCIAS | Evidence synthesis

received 12 January 2022 | accepted 11 April 2022 | published 26 May 2022

Doi: 10.31157/an.v27i3.337

Study on the use of reference frameworks in autism spectrum disorder: a systematic review

Pérez-Estrada Katy Arlette[1] | Ronzón-González Eliane [2] | Fernández-Ruíz Juan [2]

1. Veracruzana University, Mexico
2. National Autonomous University of Mexico, Mexico

Correspondence

Juan Fernández Ruíz. National Autonomous University of Mexico. Av. Universidad 3004, Copilco Universidad, Coyoacán, 04510, Mexico City, Mexico.

jfr@unam.mx

Abstract

Reference frameworks enable the positioning of objects and individuals within a given space, influencing both spatial and social aspects. The egocentric reference framework (ERF) allows individuals to perceive their surroundings from their perspective, while the allocentric reference framework (ARF) facilitates the establishment of relationships between objects without considering such perspective. Previous research on Autism Spectrum Disorder (ASD) has identified potential alterations in reference frameworks. The objective of this study was to evaluate, through an analysis of original articles, whether individuals with ASD demonstrate impairments in ERF, ARF, or both. The PRISMA-2020 methodology was utilized, and the study protocol was registered with PROSPERO under the number CRD42021253755. Data were collected from PubMed, ScienceDirect, and SpringerLink, using the following search terms: egocentrism, allocentric, spatial, cognition, visuospatial perspective taking, and ASD. Articles meeting the following inclusion criteria were selected: published in English between 1980 and 2021, assessing ERF and ARF in children, adolescents, and adults diagnosed with autism, Asperger's syndrome, or ASD according to current diagnostic criteria, compared to neurotypical individuals, in tasks involving spatial navigation, mental rotation, and visuospatial perspective taking. The exclusion criteria encompassed theoretical works, studies evaluating reference frameworks with tasks not included in the specified domains, and those outside the fields of psychology, psychopathology, or neuroscience. A total of 964 articles were identified, with 15 meeting the predetermined criteria. The risk of bias was assessed using the Quality Assessment Tool for Quantitative Studies. The results are presented based on task types: three studies reported alterations in ERF, while seven indicated normal functioning; eight demonstrated alterations in ARF, while six displayed average functioning. The evidence suggests that individuals with ASD exhibit impairments in ARF, but not in ERF. However, these findings are not definitive due to potential biases in the studies, heterogeneity in task selection and participant ages, small sample sizes, and variations in study designs and procedures. In conclusion, the evidence remains inconclusive regarding the impairment of reference framework utilization in individuals with ASD.

Keywords: *PRISMA, egocentric reference framework, allocentric reference framework, autism spectrum disorder*

Introduction

Reference frameworks constitute coordinate systems for representing places, objects, or entities from individual or multiple points, allowing for the encoding of spatial information and situating objects and individuals within a context.[1] They have an impact on the interpretation of the spatial and social world.[2,3] There are two modalities of reference frameworks: egocentric reference framework (ERF) and allocentric reference framework (ARF).

In the ERF, individuals take themselves as the point of reference and interpret spatial relationships based on what they see, perceive, and think in relation to objects or subjects, without considering the perspective of others, establishing a "me-you" relationship.[4] A visuospatial example would be "the pencil is next to me," and according to social cognition, "She is my sister."

In the ARF, individuals establish relationships between objects or individuals independently of themselves. This framework allows them to put themselves in the place of others to interpret the surrounding world, establishing a "you-he/she-they" relationship.[4] A visuospatial example would be "the pencil is next to the printer," and according to social cognition, "she is Juan's daughter."

Both reference frameworks are of great importance for cognitive processes such as perception, spatial memory, and motor actions,[5] which are necessary for navigating within the physical context and in social cognition processes.[5,6] Regarding social cognition, theory of mind (ToM) is fundamental as it allows for the understanding that individuals have independent minds and also utilize egocentric and allocentric positions, similar to visual perception. In this way, the mind of others can be interpreted from one's mind or as independent.[4]

Some conditions affect the utilization of reference frameworks, such as Alzheimer's disease,[7] attention deficit hyperactivity disorder,[8] and Autism Spectrum Disorder (ASD).[4]

ASD can be defined as a clinical neurodevelopmental entity characterized by the presence of restricted and repetitive behavior patterns, such as motor stereotypies, as well as insistence on sameness and atypical interests due to their intensity and scope. It also presents deficiencies in social communication, including alterations in social relationships, non-verbal language, socio-emotional reciprocity,[9] and language pragmatics.[4]

The prevalence of ASD in Mexico is estimated at 87 cases per 10,000 individuals,[10] with a male-to-female ratio of 3:1.[11] In 75% of cases, the causes are multifactorial and unknown, while the remaining 25% is associated with syndromic situations, chromosomal alterations, variations in the number of copies of genome parts, and other rare genetic variations.[12]

Individuals with ASD exhibit particular characteristics in their cognitive processes, including memory, attention, language, executive functions, and perception. In the domain of perception, they tend to focus on details and have difficulties establishing interactions between environmental elements (objects, people, and situations), instead focusing on a one-to-one relationship with these elements. This limited understanding stems from their partial interpretation. Conversely, neurotypical individuals (NT), those with typical development, perceive and comprehend all contextual information holistically rather than treating each part independently.[13]

The preferential use of ERF can be related to the typical social behaviors observed in ASD, such as difficulties in initiating or maintaining social interactions, following or initiating joint attention, understanding and using gestures, as well as emotional reciprocity.[4]

Previous research has found that individuals with ASD exhibit alterations in spatial and temporal representations,[14] with significant difficulties in both egocentric and allocentric reference frameworks. These have been assessed through cognitive tasks[15,16] as well as neuroimaging studies.[17,18] However, the presented results are ambiguous. For example, Turi et al.[19] found differences only in the allocentric reference framework, while other studies have shown alterations in both frameworks.[20,21]

In the literature search, a previous systematic review related to the topic of reference frameworks in ASD was identified.[2] However, it only addressed aspects of visuospatial perspective-taking and did not differentiate between ERF and ARF. Moreover, it did not include studies evaluating reference frameworks in spatial navigation. It is worth noting that separately identifying the use of reference frameworks allows for a broader understanding of their utilization in individuals with ASD and their potential relationship with the social impairments present in the autism spectrum.

The overall objective of this review was to evaluate, through the analysis of empirical (original) articles, whether individuals with ASD exhibit alterations in the egocentric reference framework, the allocentric reference framework, or both,

in tasks involving spatial navigation, mental rotation, and visuospatial perspective taking.

One area of deficit in ASD is social communication, which could be linked to the reference frameworks, as they enable the interpretation of both spatial and social aspects. Gaining clarity on their functioning will contribute to understanding the cognitive profile of this population and designing intervention programs.

Method

This study constitutes a systematic review based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses 2020 (PRISMA-2020) statement.[22] The protocol for this review was registered on the PROSPERO platform with the registration number CRD42021253755 (https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42021253755). The entire procedure was conducted by two independent researchers, and disagreements were resolved through a third reviewer.

Procedure

The search was conducted in the months of July and August 2021, using the databases PubMed, ScienceDirect, and SpringerLink, with the following keyword combination:

- (((EGOCENTRISM) AND (ALLOCENTRIC)) AND (SPATIAL COGNITION)) AND (ASD)
- ((AUTISM SPECTRUM DISORDER) AND (ALLOCENTRIC)) AND (EGOCENTRIC)
- ("ASD") OR ("ASPERGER") OR ("AUTISM") AND ("ALLOCENTRIC" OR "EGOCENTRIC" OR "SPATIAL COGNITION")
- (((ASD) OR (ASPERGER)) OR (AUTISM)) AND (VISUOSPATIAL PERSPECTIVE TAKING)

» Inclusion criteria: articles published between 1980 and 2021, written in English, that evaluated the egocentric and allocentric reference frameworks in children, adolescents, and adults diagnosed with autism, Asperger's syndrome, or ASD according to the diagnostic criteria in effect at the time of publication (DSM-III, DSM-III-R, DSM-IV, DSM-IV-TR, DSM-5, ICD-9, or ICD-10), compared to neurotypical individuals, in tasks involving spatial navigation, mental rotation, and visuospatial perspective taking. Only articles in the English language and published after 1980 were included due to preliminary exploration indicating that relevant documents were primarily in English and dated from that decade. The end date was set as 2021, the time of protocol development, to avoid excluding recent studies.

» Exclusion criteria: theoretical works, studies that evaluated reference frameworks with tasks not included in the inclusion criteria, and those not belonging to the fields of psychology, psychopathology, and neuroscience. The thematic area was identified in the background and methods sections of the articles.

Selection

In the initial search, 964 articles were found, and each of them was recorded in a spreadsheet. They were sorted alphabetically, and six duplicate documents were manually removed. By reading the title, abstract, and keywords, 927 articles unrelated to ASD and reference frameworks, as well as tasks involving visuospatial perspective taking, spatial navigation, and/or mental rotation, were excluded. Systematic reviews and theoretical works were also manually removed, resulting in a total of 31 articles.

The 31 selected articles were read in their entirety, and 20 of them were eliminated for not providing specific information about ERF or ARF or because their comparison group was not neurotypical, leaving a total of 11 articles. During the reading, nine citations were found that did not appear in the general database search. These articles were obtained through Google Scholar, and two of them were discarded for not having a control group, while three others were excluded for not providing separate results for the reference frameworks. As a result, five articles were excluded, and four were included in the sample (screening available at [https://www.dropbox.com/s/pqvhcbomlwf8ii1/Material%20en%20l%C3%ADnea.%20RS_Estudio%20del%20uso%20de%20marcos%20de%20referencia%20en%20el%20TEA.zip?dl=0]). In total, 15 articles were included in the final sample, which met the inclusion/exclusion criteria and the objective of this review (Chart 1).

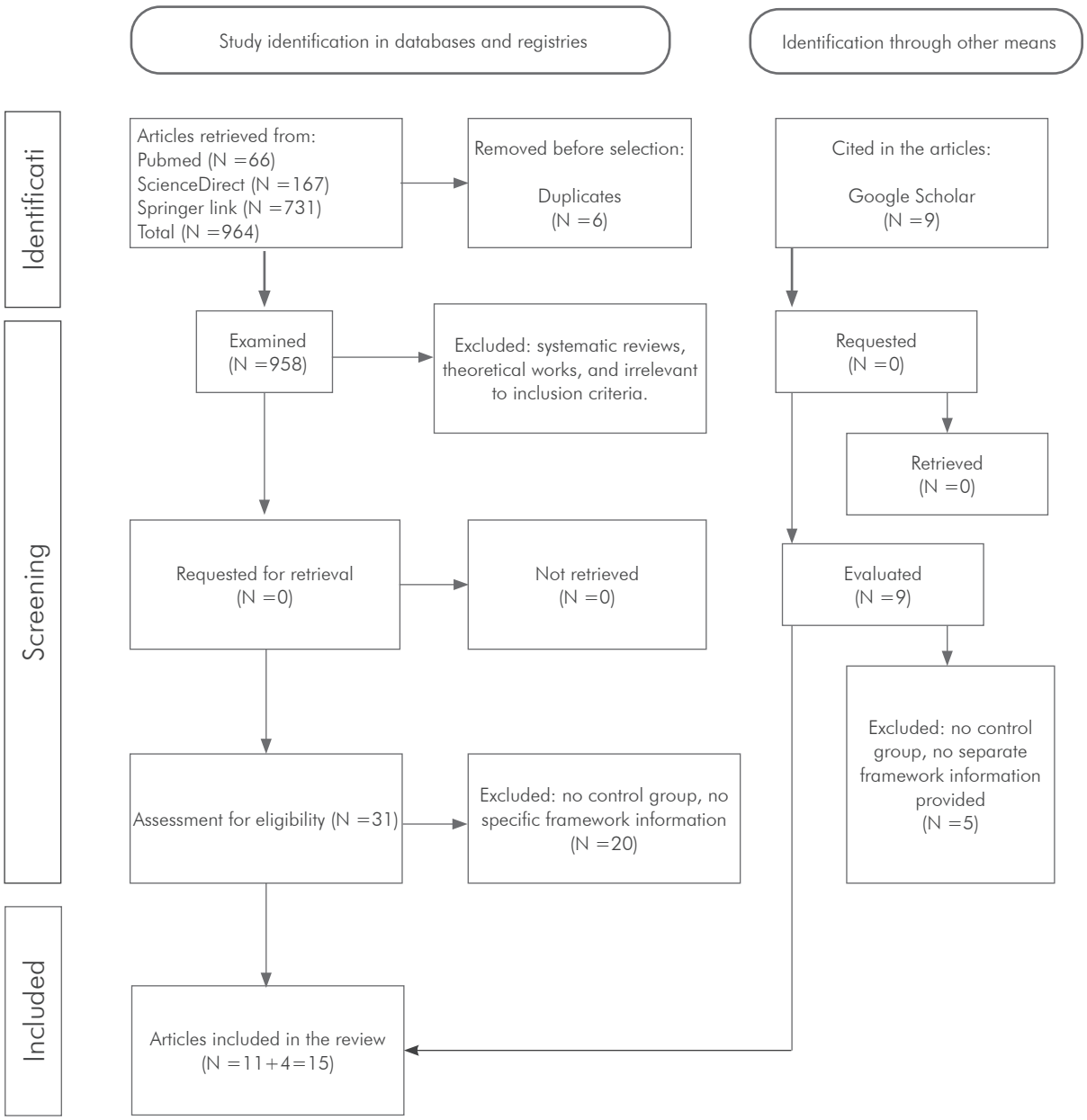
Data extraction and analysis

The following data were recorded in an Excel spreadsheet: author, date, number of participants, study group and control group, gender, age, country, design, objective, inclusion/exclusion criteria, task, procedure, study results, and contributions. Subsequently, those with similar results were selected for presentation in the synthesis.

Risk of bias assessment

The risk of bias in each of the 15 included articles was evaluated using the Quality Assessment Tool for Quantitative Studies,[23] developed by the Effective Public Health Practice Project (https://www.nccmt.ca/knowledge-repositories/search/14).

Chart 1. PRISMA Flow Diagram



This tool consists of eight sections: selection, design, confounders, blinding, data collection methods, withdrawals and dropouts, intervention integrity, and analysis. The tool provides an overall methodological rating of strong (low risk), moderate (moderate risk), or weak (high risk).

For this review, a modification was made to the tool in the confounders section. The variables of race, marital status, and pre-intervention were eliminated as they were not relevant to the evaluated studies. In the education variable, intellectual quotient, verbal quotient, and mental age were used as they are important variables to control when comparing neurotypical individuals and individuals with ASD.

Data synthesis

The p-value was used as a measure to identify the presence or absence of alterations in the reference frameworks. In articles that reported additional information, only relevant data for this study were extracted.

Results

Risk of Bias

The 15 articles included in this review were evaluated for risk of bias. The results showed that four studies had an overall low risk of bias, six had a moderate risk, and five had a high risk (Figure 1). The two sections with the highest bias were withdrawals and dropouts and confounding variables (Table 1).

Figure 1. Risk of Bias

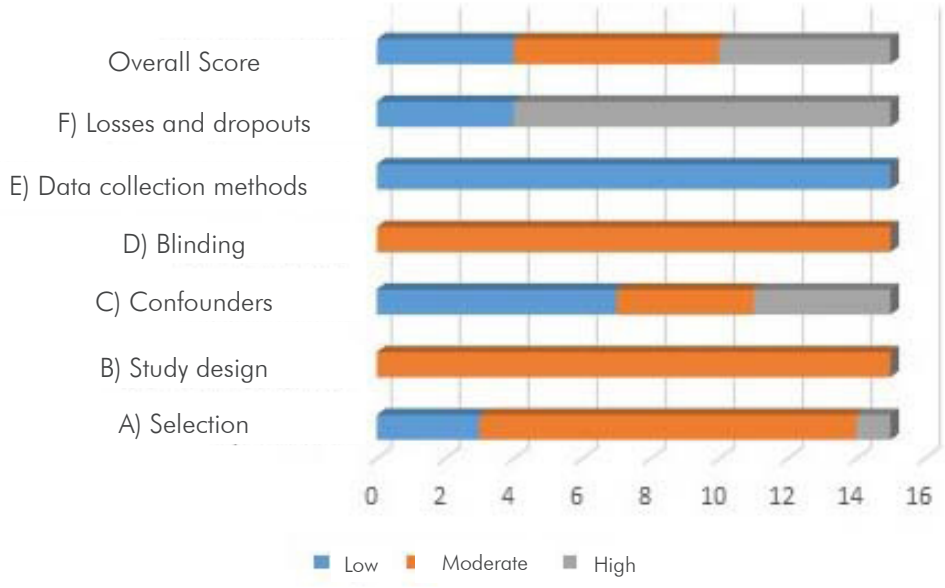


Table 1. Risk of Bias

Author	Selection	Design Blinding	Confounders	Cegamiento	Collection Method	Losses and Dropouts	Overall
Tan y Harris[47]	M	M	M	M	L	H	M
Pearson et al.[33]	M	M	H	M	L	H	H
Reed y peterson[44]	M	M	H	M	L	H	H
Yirmiya et al.[39]	M	M	L	M	L	L	L
Cardillo et al.[42]	M	M	L	M	L	H	M
Gauthier et al.[21]	M	M	M	M	L	H	M
Zwickel et al.[43]	M	M	H	M	L	H	H
David et al.[35]	M	M	M	M	L	H	M
Schwarzkopf et al.[24]	M	M	L	M	L	H	M
Pearson et al.[37]	L	M	L	M	L	H	M
Conson et al.[20]	L	M	L	M	L	L	L
Turi et al.[19]	H	M	M	M	L	H	H
Ring et al.[14]	L	M	L	M	L	L	L
Umesawa et al.[28]	M	M	H	M	L	H	H
Doi et al.[25]	M	M	L	M	L	L	L

Risk of Bias A= high M= moderate L= low

The included articles are presented grouped according to the evaluated reference framework and the presence or absence of alterations (Table 2). The main findings are described below.

Table 2. Characteristics of the included studies

Author	Country	ASD	Controls	Task	Reference Frame	Results
Tan y Harris[47]	UK	N=20 A=7.3-19.1 (M=12.8)	N=20 A=5.1-7.1 (M=6.11)	Verbal Semiecological Objects in various positions What can John and Mari see?	Allocentric	No significant differences found
Pearson et al. [33]	UK	N=30 G=27M 3F A=5.1-13.6 (M=9.3)	N=30 G=18M 12F A=4.7-11.3 (M=6.83)	Non-verbal semiecological Rotating disc: What image will you see when the container is lifted? What image will Jim see when he lifts the container?	Egocentric Allocentric	No significant differences were observed in ERF and ARF
Reed y peterson[44]	Australia	N=13 11M 2F A=4.3-29.11 (M=12)	N=13 A=3-15.9 (M=7.1)	Non-verbal semiecological "Make Joe hide from Sam" "Rotate the disc so that I can see..."	Allocentric	No significant differences detected
Yirmiya et al.[39]	United States	N=18 G= 17M 1F A=9.3-16.10	N=14 G= 13M 1F A=9.3-14.6	Non-verbal semiecological "Rotate the disc so that I can see the same as you"	Allocentric	Significant differences detected
Cardillo et al.[42]	Italy	N=36 G=34M 2F A=8.0-16.10 (M=10.10)	N=39 G=36M 2F A=8.0-16.8 (M=11.3)	Pen and paper, non-verbal "Imagine that you are... and point"	Allocentric	Significant differences were observed between 0° and 60° No significant differences were observed between 60°-120°
Gauthier et al.[21]	France	N=26 21M 5F A= 6-19 (12.65)	N=38 23H 15M E= 6-19 (M=12.03)	Non-verbal 3D ecological Imitate the left-right tilt movement of the tightrope walker from the front and back	Egocentric Allocentric	Significant differences in ERF No significant differences in ARF
Zwickel et al.[43]	Germany	N=19 A= (M= 37)	N=18 A= (M= 39)	Computer-based Right-left decision of a point relative to a triangle	Allocentric	Significant differences detected
David et al.[35]	Germany	N=19 G=11M 8F A=23-50 (M=36)	N=15 G=4M 11F A=21-43 (M=31.2)	Computer-based, non-verbal Left-right decision of a raised object from one's own/other perspective	Egocentric Allocentric	No significant differences were detected in ERF and ARF
Schwarzkopf et al.[24]	Germany	N=16 G=9M 7F A=29-54 (M=44)	N=15 G=4M 11F A=29-53 (M= 42.9)	Computer-based Verification of the number of disks from one's own/other perspective	Egocentric Allocentric	No differences were observed in ERF Significant differences observed in ARF
Pearson et al.[37]	UK	N=18 G=17M 1F A=16-32 (M=19.7)	N=18 G=17M 1F A=16-29 (M=18.5)	Computer-based "Same/Different" Left-right decision of arm/door	Egocentric	Significant differences detected
Conson et al.[20]	Italy	N=22 G=20M 2F A=(M=13.3)	N=22 G=20M 2F A= (M=13.5)	Computer-based Right-left decision of a bottle from one's own/other perspective	Egocentric Allocentric	Without visual cues/ grasping: Significant differences observed in ERF No significant differences were observed in ARF
Turi et al. [19]	Italy	N=19 G= 16M 3F A=8-16.5 (M=11.5)	N=18 G= 14M 4F A=8-17 (M=11.9)	Computer-based "Bodily points simulation of pressing"	Egocentric Allocentric	No significant differences were observed in ERF Significant differences observed in ARF
Ring et al.[14]	UK	N=26 G=23M 13F A=24-63 (M=38.81)	N=26 G=18M 8F A=22-61 (M=42.12	Computer-based, virtual spatial navigation, non-verbal Shortest route Left-right decision of a circle	Egocentric Allocentric	No differences were observed in ERF Significant differences observed in ARF
Umesawa et al.[28]	Japan	N=17 G=14M 3F MA=20.9	N=17 G=10M 7F MA=19.5	Computer-based Touch the screen where a stimulus appeared, taking into account or disregarding the screen frame	Egocentric Allocentric	No significant differences were observed in ERF Significant differences observed in ARF
Doi et al.[25]	Japan	N=20 G=20M MA=31.9	N=18 G=18M MA=32.2	Computer-based Verify the number of disks from one's own/other perspective	Egocentric Allocentric	No significant differences were observed in ERF Significant differences observed in ARF

Studies that evaluated both reference frameworks

Nine studies evaluated both reference frameworks simultaneously, and five found alterations in the ARF but not in the ERF. Schwarzkopf et al.[24] and Doi et al.[25] used the dot perspective paradigm.[26] The results of Schwarzkopf et al.[24] showed slower reaction times in the ASD group compared to the NT group when responding to the avatar's perspective (allocentric) vs. their own perspective (egocentric) ($p < .005$). The results of Doi et al.[25] were similar, as they found significant differences in the ARF ($p = .049$) but not in the ERF ($p > .16$).

Ring et al.[14] used a virtual spatial navigation task adapted from Feigenbaum and Morris.[27] They did not find differences in the ERF between groups ($p = .82$), but individuals with ASD spent less time in the allocentric quadrant ($p < .05$). Umesawa et al.[28] employed the paradigm by Uchimura et al. [29] Errors influenced by the ARF ($p = .001$) were greater than errors influenced by the ERF ($p = .55$). Turi et al.[19] used a procedure similar to that of Tinelli et al.[30] In the egocentric condition, there were no significant differences ($p = .22$); however, individuals with ASD showed lower allocentric sensitivity ($p = .0001$) than NT individuals. On the other hand, two studies found alterations in the ERF ERF and absence of alterations in the ARF. Conson et al.[20] used the task by Mazzarella et al.[31] The results showed significant differences in the ERF ($p < .006$) but not in the ARF ($p > .05$) when individuals did not provide any visual cues or object support. Gauthier et al.[21] applied an ecological 3D task, with an adaptation of the tightrope walker paradigm.[32] Individuals with ASD showed lower performance in the ERF ($p = .017$) and similar performance in the ARF ($p = .19$).

Two other studies did not find alterations in either the ERF or the ARF. Pearson et al.[33] used a task based on Hamilton et al.[34] designed to evaluate both reference frameworks. The results did not show significant differences in the task-by-group interaction: visuospatial perspective taking of self and others was similar in ASD and NT individuals ($p = .684$). David et al.[35] employed the task by Bewernick et al.[36] There were no significant differences in visuospatial perspective taking of self ($p > .05$) or visuospatial perspective taking of others ($p > .05$).

Studies that evaluated only one reference framework

This section includes one study that assessed the ERF and five studies that evaluated the ARF.

Pearson et al.[37] used a paradigm similar to Zacks et al.,[38] which is solved from an ERF. Their results showed that individuals with ASD had lower accuracy in the ERF than NT individuals ($p = .038$) and were slower ($p = .001$).

Furthermore, the results of Yirmiya et al.[39] showed that individuals with ASD experienced greater difficulties than NT individuals in perspective taking from the ARF ($p < .05$). Similar results were obtained by Zwickel et al.,[40] who modified and used the Frith-Happé animation task,[41] where the ASD group had a higher number of incorrect responses than NT individuals in visuospatial perspective taking from the ARF ($p < .05$).

Cardillo et al.[42] employed a paper-and-pencil task adapted from Kozhevnikov and Hegarty.[43] The results showed that individuals with ASD were less accurate than NT individuals in the visuospatial perspective-taking task from the ARF when stimuli were between 0°-60° ($p = .04$). However, between 60°-120° and 120°-180°, the responses of both groups were comparable, and no significant differences existed ($p = .77$, $p = .11$).

Reed and Peterson[44] used two tasks, one based on Huges and Donaldson[45] and the other on Fishbein et al.,[46] where no significant differences were found between groups in visuospatial perspective taking from the ARF ($p > .20$). These same findings were obtained by Tan and Harris,[47] who employed two semi-ecological verbal tasks to assess the ARF, and the results did not show significant differences (p = n.s.).
In summary, the analysis of the tasks used in the included studies shows that three of them demonstrated differences in the use of the ERF,[21,22,20] while seven reported similar performance in both groups.[25,36,38,19,14,45,47] In the ARF, eight tasks showed differences,[30,31,32,38,19,14,45,47] while six reported unaltered performance.[27,24,36,25,21,20]

Upon analyzing the results, no specific pattern was found where the type of task (verbal, semi-ecological, or computer-based) influenced the observed heterogeneity. However, the task design, differences in cognitive demand, and disparities in the samples, both in chronological age and sex, could be the determining factors of the variability in results. These discrepancies will be discussed in the following section.

Discussion

This review aimed to identify whether individuals with ASD have difficulties in the ERF, ARF, or both reference frameworks, which are necessary for visuospatial perspective-taking to the theory of mind.[2]

The evidence leans, but is not conclusive, towards individuals with ASD not having difficulties in the ARF,[33,35,24,19,15,28] although a minority of studies did detect alterations.[21,37,20] This could be explained by differences in the tasks. For example, in Pearson et al.,[33] the avatar rotated at angles, and at 140° and 180°, the task required mental rotation to be solved, while in David et al.,[35] the avatar remained in the same position, eliminating the need for mental rotation. In Gautier et al.,[21] the back-facing task requires not only the use of the ERF but also immediate imitation, in which individuals with ASD have limitations.[48,49] Therefore, it cannot be determined that the ERF functions the same way in individuals with ASD as in NT individuals.

On the other hand, the majority of evidence suggests that individuals with ASD have difficulties in tasks that require the use of the ARF,[39,42,40,24,19,15,28,27] although other studies did not find alterations.[47,33,44,21,35,20] It is important to note that young children are capable of using the ARF, but it is not until around the age of 10 that it is used more efficiently. Age plays an important role during childhood and adolescence, with greater efficiency as individuals get older.[50] Therefore, the higher chronological age of the ASD sample and the lower age of the NT group[23,34] could explain the absence of differences in the ARF.

In addition to age, another uncontrolled variable in the samples of the evaluated studies was sex. The scientific literature acknowledges that activation in the brains of males and females differs in the use of reference frameworks in visuospatial tasks, with males outperforming females.[51,52] This variable may have influenced the results of the studies, as in David et al.[35], the NT sample consisted of three times more females than males, while the ASD sample had more males than females. Similarly, in Pearson et al.,[33] the NT female sample was four times larger than the ASD female sample.

In the assessment of bias, a large number of publications were identified with moderate[47,21,35,19] and high[33,44,43,28] risk in the confounding variables section, particularly in controlling for verbal age, where studies that reported this measure only assessed vocabulary. It should be noted that individuals with ASD can have vocabulary at or above their chronological age but may have impairments in comprehension and expression.[12,13] The need for greater comprehension capacity in the provided instructions and/or in generating responses could be related to the heterogeneity of results. Properly matching ASD and NT samples and using tasks with lower language demands would provide greater certainty in the results.

Some authors mention that individuals with ASD have a preference for using the ERF over the ARF.[15,16] However, the evidence is not strong enough to support it as an undeniable fact. The difficulty in interpreting gestures and facial expressions, the tendency to only talk about their interests, the challenges in respecting turns, and their tendency to speak their mind and present facts without the subtleties of NT individuals[4,9,13] are clear examples of interpreting the world based on the ERF.

In this review, the paradigm that appears to have greater reliability for assessing reference frameworks is the one by Samson et al.,[26] used by Schwarzkopf et al.[24] and Doi et al.[27] These studies had a moderate and low risk of bias, were conducted on a computer (virtually), and required lower cognitive and language demand.

On the other hand, not all authors consider that there are inherent alterations in the ERF or ARF. The hypothesis they propose is that the difficulty lies primarily in the transition between frameworks,[4] as both spatial and social cognition depend on the situation and require constant switching between the ERF and ARF to adapt to the context and achieve appropriate interpretation and response.

Studies on grasp spatial ability support the hypothesis that each reference framework provides important information for action but constantly switching between them and synergistic work are necessary. Failure to do so can lead to errors in spatial skills.[53]

Among the limitations found in this systematic review are the use of three databases for article search and the lack of Spanish studies in those databases, which resulted in the inclusion of only English articles and the exclusion of potentially representative studies from the Spanish-speaking population. Another limitation was the heterogeneity of samples in terms of age, intelligence, language level, and task design (e.g., verbal or non-verbal, higher or lower cognitive demand).

Conclusion

The main objective of this study was to conduct a systematic literature review spanning the past 21 years on the utilization of frames of reference in individuals with Autism Spectrum Disorder (ASD). The evidence indicates that the ERF demonstrates functioning comparable to that of NT, while the ARF exhibits altered functioning. However, caution is warranted when

interpreting these findings due to certain inconsistencies in the control of variables within the analyzed investigations. Notably, the sample sizes were relatively small (M = 20), resulting in an underrepresentation of females with ASD, and in some cases, an imbalance of female participants in the neurotypical samples. Moreover, the age ranges of the study participants encompassed children, adolescents, and adults, with varying criteria for sample matching, including verbal age and chronological age. The employed tasks exhibited heterogeneity, incorporating verbal, non-verbal, and computer-based approaches, each with distinct designs and procedures, complicating the identification of potential factors influencing task outcomes. Additionally, the majority of the included studies exhibited a moderate to high risk of bias.

Given the available evidence, it is not feasible to provide clinical recommendations, as the alteration of either the ERF or ARF in individuals with ASD cannot be confirmed. Consequently, further research is necessary, employing replicated designs, randomized methodologies, and age-matched samples. Moreover, studies should encompass samples representing different levels of functioning according to the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-5) to enable comparisons within the ASD population.

In addition, it is crucial to employ non-verbal computer-based tasks to mitigate the potential impact of language impairments, which are prevalent in individuals with ASD, on task performance. Furthermore, it is recommended to utilize tasks that separately assess the ERF and ARF, along with an additional task evaluating the capacity to switch between frames of reference.

The authors declare no conflicts of interest

This research was funded by the National Council of Science and Technology (CONACYT).

References

1. Klatzky RL. Allocentric and egocentric spatial representations: Definitions, distinctions, and interconnections. In: Freksa C, Habel C, Wender KF, editors. Spatial cognition. Lecture notes in computer science. Vol 1404. Heidelberg: Springer; 1998. doi: 10.1007/3-540-69342-4_1
2. Pearson A, Ropar D, Hamilton AF. A review of visual perspective taking in autism spectrum disorder. Front Hum Neurosci. 2013; 7(652). doi: 10.3389/fnhum.2013.00652
3. Caballero-García A. Desarrollo de la representación espacial. EduPsykhé: Revista de psicología y psicopedagogía. 2002; 1(1): 41-68.
4. Frith U, de Vignemont F. Egocentrism, allocentrism, and Asperger syndrome. Conscious Cogn. 2005; 14(4): 719-38.
5. Moraresku S, Vlcek K. The use of egocentric and allocentric reference frames in static and dynamic conditions in humans. Physiol Res. 2020; 69: 787-801. doi: 10.33549/physiolres.934528
6. Proulx MJ, Todorov OS, Taylor-Aiken A, de Sousa AA. Where I am? Who I am? The relation between spatial cognition, social cognition and individual differences in the built environment. Front Psychol. 2016; 7:64. doi: 10.3389/fpsyg.2016.00064
7. Serino S, Cipresso P, Morganti F, Riva G. The role of egocentric and allocentric abilities in Alzheimer's disease: a systematic review. Ageing Res Rev. 2014; 16:32-44. doi: 10.1016/j.arr.2014.04.004.
8. Brown FC, Roth RM, Katz LJ. Allocentric but not egocentric visual memory difficulties in adults with ADHD may represent cognitive inefficiency. Psychiatry Res. 2015; 228(3): 649-58. doi: 10.1016/j.psychres.2015.04.051
9. Asociación Americana de Psiquiatría, editor. Manual Diagnóstico y Estadístico de los Trastornos Mentales. 5° ed. Arlington: Panamericana; 2014.
10. Fombonne E, Marcin C, Manero AC, Bruno R, Diaz C, Villalobos M, Ramsay K, Nealy B. Prevalence of autism spectrum disorders in Guanajuato, Mexico: The Leon survey. J Autism Dev Disord. 2016; 46(5): 1669-85. doi: 10.1007/s10803-016-2696-6

11. Loomes R, Hull L, Polmear W, Mandy L. What is the male-to-female ratio in autism spectrum disorder? A systematic review and meta-analysis. J Am Acad Adolesc Psychiatry. 2017; 56(6): 466-474. doi: 10.1016/j.jaac.2017.03.013
12. Hervás-Zuñiga A, Balmaña N, Salgado M. Los trastornos del espectro autista. Pediatr Integral [Internet]. 2017 [consultado 22 sept 2021]; XXI(2): 92-108. https://www.pediatriaintegral.es/publicacion-2017-03/los-trastornos-del-espectro-autista-tea/
13. Frith U. Autism. Explaining the enigma. Oxford: Basil Blackwell. [Trad. cast. de Rivière Á, Núnez M. Autismo: Hacia una explicación del enigma. Madrid: Alianza; 1991.]
14. Ring M, Gaigg SB, Bowler DM. Object-location memory in adults with autism spectrum disorder: Explicit vs implicit relational memory in ASD. Autism Res. 2015; 8(5): 609-19. doi: 10.1002/aur.1478
15. Ring M, Gaigg SB, Altgassen M, Barr P, Bowler, DM. Allocentric versus egocentric spatial memory in adults with autism spectrum disorder. J Autism Dev Disord. 2018; 48(6): 2101-11. doi: 10.1007/s10803-018-3465-5
16. Zurita C, Cruz F, Cárdenas J, Orozco G. Cognición espacial: Posiciones egocéntrica y alocéntrica en un grupo con síndrome de Asperger. Rev Chil Neuropsicol. 2013; 8(2): 40-5. doi: 10.5839/rcnp.2013.0802.04
17. Lombardo MV, Chakrabarti B, Bullmore ET, Sadek SA, Pasco G, Wheelwright SJ, et al. Atypical neural self-representation in autism. Brain. 2010; 133(2): 611-24. doi: 10.1093/brain/awp306
18. Li H, Liu N, Li Y, Weidner R, Fink GR, Chen Q. The Simon effect based on allocentric and egocentric reference frame: Common and specific neural correlates. Sci Rep. 2019; 9(1): 13727. doi: 10.1038/s41598-019-49990-5
19. Turi M, Muratori F, Tinelli F, Morrone M C, Burr D C. Autism is associated with reduced ability to interpret grasping actions of others. Sci Rep. 2017; 7(1): 12687. doi: 10.1038/s41598-017-12995-z
20. Conson M, Mazzarella E, Esposito D, Grossi D, Marino N, Massagli A. et al. "Put myself into your place": Embodied simulation and perspective taking in autism spectrum disorders. Autism Res. 2015; 8(4): 454-66. doi: 10.1002/aur.1460
21. Gauthier S, Anzalone SM, Cohen D, Zaoui M, Chetouani M, Villa F, et al. Behavioral own-body-transformations in children and adolescents with typical development, autism spectrum disorder, and developmental coordination disorder. Front Psychol. 2018; 9: 676. doi: 10.3389/fpsyg.2018.00676
22. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffman TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021; 372: (n71). doi: 10.1136/bmj.n71
23. Armijo-Olivo S, Stiles CR, Hagen NA, Biondo PD, Cummings GG. Assessment of study quality for systematic reviews: a comparison of the Cochrane Collaboration Risk of Bias Tool and the Effective Public Health Practice Project Quality Assessment tool: methodological research. J Eval Clin Pract. 2012; 18(1): 12-8. doi: 10.1111/j.1365-2753.2010.01516.x.
24. Schwarzkopf S, Schilbach L, Vogeley K, Timmermans B. "Making it explicit" makes a difference: Evidence for a dissociation of spontaneous and intentional level 1 perspective taking in high-functioning autism. Cognition. 2014; 131(3): 345-54. doi: 10.1016/j.cognition.2014.02.003
25. Doi H, Kanai C, Tsumura N, Shinohara K, Kato N. Lack of implicit visual perspective taking in adult males with autism spectrum disorders. Res Dev Disabil. 2020; 99: 103593. doi: 10.1016/j.

Artículo sin conflicto de interés