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Use of eye-tracking in instrument construction and validity studies: A Scoping Review

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Abstract

Psychometric tests are commonly used to assess cognitive and psychological aspects. The development of research instruments, like questionnaires, relies on identifying specific causal relationships. Eye-tracking adds value by offering objective data on visual behavior and revealing cognitive processes not captured by other methods. Aims to map the evidence on the use of eye-tracking in studies on instruments' construction and validity. This scoping review follows the Joanna Briggs Institute methodology and has its protocol registered in the Open Science Framework. Searches were carried out in Embase, SCOPUS, Web of Science, MEDLINE/PubMed, CINAHL, LILACS, PsycINFO, and gray literature. The eligibility criteria included studies without restrictions on publication date or language that used eye-tracking in the development of instruments and in the generation of validity evidence. Studies that were ongoing, letters to the editor, and abstracts were excluded. A total of 26 studies were included in the final sample. Eye-tracking has been employed in various ways to support the construction and validation of instruments, particularly in experimental studies involving multiple-choice questionnaires. Its applications include analyzing the item reading process, verifying the order and format of response options, and evaluating both complex questions and revised versions of instruments. Additionally, eye-tracking has been used to explore response processes, learning styles, asthenopia, cognitive capacity and impairment, discrete choice modeling, instrument reliability, and facial emotion recognition. The main metrics collected were fixation rates and duration, areas of interest, dwell time, GazePlot, Heatmap, saccades, and refixation rates. Eye-tracking has been used in studies aimed at evaluating the validity of multiple-choice questionnaires, enabling the analysis of elements such as the layout and format of answer choices, the clarity and coherence of item wording, response patterns adopted by participants, and the underlying cognitive processes involved in answering the questions.

Keywords: Eye-tracking technology, Eye Movements, Validation Study, Surveys and Questionnaires

Introduction

Psychometric tests are widely used in various contexts to analyze cognitive and psychological aspects. They are employed in forensic procedures, educational assessments, driver's license acquisition, medical diagnostics, and procedures. Moreover, these tests play a role in clinical evaluations within nursing, continuing and permanent education, and care management, allowing for the measurement of both objective and subjective phenomena through validated measurement instruments (Ferretti-Rebustini, 2023; Reppold *et al*., 2019).

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In this context, the development and validation of research instruments, such as questionnaires, are based on the observation of specific causal relationships. Researchers aim to understand concrete problems and the interrelation of phenomena of interest in cultural, social, and belief-related processes. Consequently, these instruments are designed to provide answers to questionnaires conceived throughout the investigation (Maia *et al.,* 2023).

Eye-tracking emerges as a promising technology in this scenario, relying on non-invasive devices such as wearable glasses and screen-based eye trackers used to monitor participants' eye movements while performing specific tasks. This technology enables the analysis of information processing through gaze fixations and rapid eye movements, providing metrics for analyzing and interpreting cognitive processes (Monteiro *et al.,* 2020).

Studies such as those by Obadă (2021) and Tontini (2021) have investigated, respectively, the use of eye-tracking in pre-testing questionnaire flow design and the effectiveness of combining this technology with cognitive interviews in research pre-tests. Both studies indicate that eye-tracking, when integrated, offers an innovative approach to pre-testing and the applicability of choice-based questionnaires. Furthermore, its combination with cognitive interviews proves to be a promising tool for improving the quality and accuracy of collected data.

Eye-tracking has various applications, including research on consumer behavior toward packaging, reading patterns, studies on inclusive education, eye movements in associative memory tasks for early Alzheimer's diagnosis, clinical nursing simulations, and other contexts (Batista *et al*., 2023; Caloca-Amber *et al*., 2024; Camargo, 2022; Gallina *et al*., 2022; Kim *et al.,* 2023; Requena, 2022).

Eye-tracking not only provides objective metrics on visual behavior but also offers valuable insights into underlying cognitive processes that cannot be captured through other behavioral measures. These metrics allow for the investigation of mechanisms and the temporal course of cognitive processing, which may influence the interpretation of tests related to attention, memory, and response speed. Eye movement data can contribute to enhancing the accuracy of psychometric assessments and obtaining validity evidence regarding the response process of an instrument (Padilla & Benítez, 2014; Rodrigues, 2021; Beesley, Pearson & Pelley, 2019).

The primary eye-tracking metrics include fixation rates, which indicate the time the eyes remain on a specific object or area while assimilating or decoding it; areas of interest (AOI), which analyze dwell time, number, and average duration of fixations on a given item or area; saccades, characterized by rapid eye movements over a short period (30 to 120 ms); GazePlot, which represents the sequence of fixations on an interface and indicates where the participant directed their attention at each moment of an instrument's application; and Heat Maps, which visually display the aggregated distribution of visual attention in a static or dynamic manner, highlighting areas with longer and shorter fixation durations among participants, among other metrics (Balam & Osório, 2018; Barreto, 2012; Gobbi et al., 2017; Pauszek, 2022).

Although eye-tracking has shown significant results in various fields, its application in psychometric instrument validation remains incipient. The lack of systematic review processes and studies consolidating this technology to enhance psychometric instrument validity highlights the need for further investigation, particularly given the increasing use of psychometric assessments in clinical and educational contexts. Additionally, the absence of ongoing scoping or systematic review protocols underscores the importance of deepening research on this topic. This study aims to map the available evidence on the use of eye-tracking in research related to the development and validation of instruments.

Method

Type of Study

This is a scoping review, based on the Johnna Briggs Institute (JBI) Manual for Evidence Synthesis, and it followed the recommendations of the Preferred Reporting Items for Systematic reviews and Meta-

Analyses extension for Scoping Reviews (PRISMA-ScR) (Arksey & O'Malley, 2005; Peters et al., 2020).

In addition, the review followed the following steps: 1) research question title identification; 2) definition of the inclusion criteria according to the PCC strategy; 3) selection of the evidence sources; 4) definition of the search strategy; 5) screening and selection of the evidence; 6) data extraction; 7) data analysis and synthesis; 8) results presentation (Peters et al., 2020). In order to ensure methodological rigor and transparency, the protocol is registered in the Open Science Framework (OSF) via the link: DOI 10.17605/OSF.IO/THM56 (https://osf.io/thm56/)

Research Questions

The search strategy was based on the acronym PCC (Population, Concept and Context). In relation to the population (P): Surveys and questionnaires, the concept (C): Eye-tracking Technology and the context (C): was not defined. The following guiding question was therefore drawn up: "How is eye-tracking being used in instrument construction and/or validity studies?"

Eligibility Criteria

The eligibility criteria included studies with no time or language restrictions that used eye-tracking in the construction and/or validation of instruments. Studies were excluded if they were in the execution phase, consisted of letters to the editor or abstracts, or did not employ eye-tracking in the process of instrument development and validation.

Search Strategy

The electronic search took place in January 2024. Searches were carried out in Embase (Elsevier); SCOPUS (Elsevier); Web of Science (Clarivate Analytics); MEDLINE/PubMed via National Library of Medicine; Cumulative Index to Nursing and Allied Health Literature (CINAHL); Latin American and Caribbean Health Sciences Literature (LILACS) via the Virtual Health Library (VHL), PsycINFO and gray literature.

In addition, grey literature such as theses, dissertations, manuals, technical reports and other productions were analyzed through Google Scholar, the Brazilian Digital Library of Theses and Dissertations (BDTD) and the Catalogue of Theses and Dissertations (CTD). In this way, access took place through the Portal of Periodicals of the Coordination for the Improvement of Higher Education Personnel (CAPES Portal, Brazilian government), through the Federated Academic Community (CAFe), according to the specifics of each database chosen.

The search strategy used controlled vocabularies in the area of health through Health Science Descriptors (DeCS), Medical Subject Headings (MeSH), CINAHL Thesaurus, APA Thesaurus for PsycINFO and Embase Subject Headings (EMTREE) for Embase. In addition, the keywords and descriptors were cross-referenced using the Boolean operators "AND" and "OR". Furthermore, the model (ECUs) was adapted and used: Extraction, Conversion, Combination, Construction and Use (Araújo, 2020). Table 1 shows the search terms for the MEDLINE/PubMed database; the terms for the other databases were drawn up according to their specific characteristics and are described in the review protocol [removed to ensure blind review].

Table 1

MEDLINE/PubMed search strategy. Adapted from Araújo (2020).

	EXTRACTION	
Description	**Acronym**	**Terms**
Population	P	"Surveys and Questionnaires"
Concept	C	"Eye Tracking Technology"
Context	C	------
	CONVERSION AND COMBINATION	
DATABASES RECORDS	**FINAL SEARCH EXPRESSION RECORDS**	
MEDLINE/PubMed 929	((((((((((((("surveys and questionnaires"[MeSH Terms]) OR ("Questionnaires and Surveys")) OR (Surveys)) OR (Survey)) OR ("Questionnaire Design")) OR ("Design, Questionnaire")) OR ("Designs, Questionnaire")) OR ("Questionnaire Designs")) OR (Respondent)) OR ("Randomized Response Technique")) OR ("Randomized Response Techniques")) OR ("Techniques, Randomized Response")) OR (Questionnaires)) OR (Questionnaire)) AND ((((((((((((((((((((("Eye Tracking technology"[MeSH Terms]) OR ("Eye Tracking Technology")) OR ("Eye-Tracking Technologies")) OR ("Technology, Eye-Tracking")) OR ("Eyetracking Technology")) OR ("Eyetracking Technologies")) OR ("Gaze-Tracking Technology")) OR ("Gaze Tracking Technology")) OR ("Gaze-Tracking Technologies")) OR ("Eye-Tracking System")) OR ("Eye Tracking System")) OR ("Eye-Tracking Systems")) OR ("Eyetracking System")) OR ("Eyetracking Systems")) OR ("Eye Movement Data Analysis")) OR ("Gaze-Tracking")) OR ("Gaze Tracking")) OR ("Gaze-Tracking System")) OR ("Gaze Tracking System")) OR ("Gaze-Tracking Systems")) OR ("Eye-Tracking")) OR ("Eye Tracking") AND (fha[Filter]))	

Selection of Studies

The studies were selected from the previously selected databases and the screening process conducted by two reviewers. The EndNote® software was then used to exclude duplicate studies from the databases. After this process, the study files were downloaded in Information Systems Research (ISR) format and transferred to Rayyan® software for selection by reading the title and abstract, for subsequent analysis of the studies by the inclusion and exclusion criteria.

Data Mapping and Analysis

In order to extract the data and characterize the studies, they were summarized using a detailed table with the following bibliographic information: author, year, database, type of study, study location, context and target audience, hardware and software used, eye-tracking metrics, instrument used and the main results. In addition, a co-occurrence analysis of the keywords was carried out in the VOSviewer® software, based on the articles in the final sample (see figure 02). As these studies have already been published in databases and are widely accessible in the scientific literature, there was no need for them to be submitted to a Research Ethics Committee. However, the authors reaffirm their ethical commitment to the use of the studies and to the ethical principles that guide scientific research. Furthermore, the methodological quality assessment was not conducted, as according to Trico et al., (2018), it is not a mandatory item but optional for a scoping review.

Results

Through the database searches, a total of 9,331 studies were obtained, of which 4,864 were duplicates and were excluded. Thus, 4,467 studies were analyzed according to the inclusion and exclusion criteria by reading the titles and abstracts.

The literature found various uses for eye-tracking in the construction and/or validity of instruments, with a greater focus on experimental studies (17), quasi-experimental studies (2), exploratory studies (3), data-based machine learning approaches, mixed studies and prospective observational studies, each with one study. In relation to the studies' countries of origin, there was a higher prevalence of studies published in the United States and Germany, both with 16%; Australia with 12%; China, Europe, and

the United Kingdom, each with 8%; followed by Belgium, Brazil, Cyprus, France, the Netherlands, Malaysia, New Zealand, and Türkiye, each with 4% of the published studies. As for the databases, there was a higher prevalence of studies published in PubMed (28%), SCOPUS with 20%, Google Scholar and PsycINFO (APA), both with 16%, Embase with 12%, Web of Science with 8%, and LILACS with 4%.

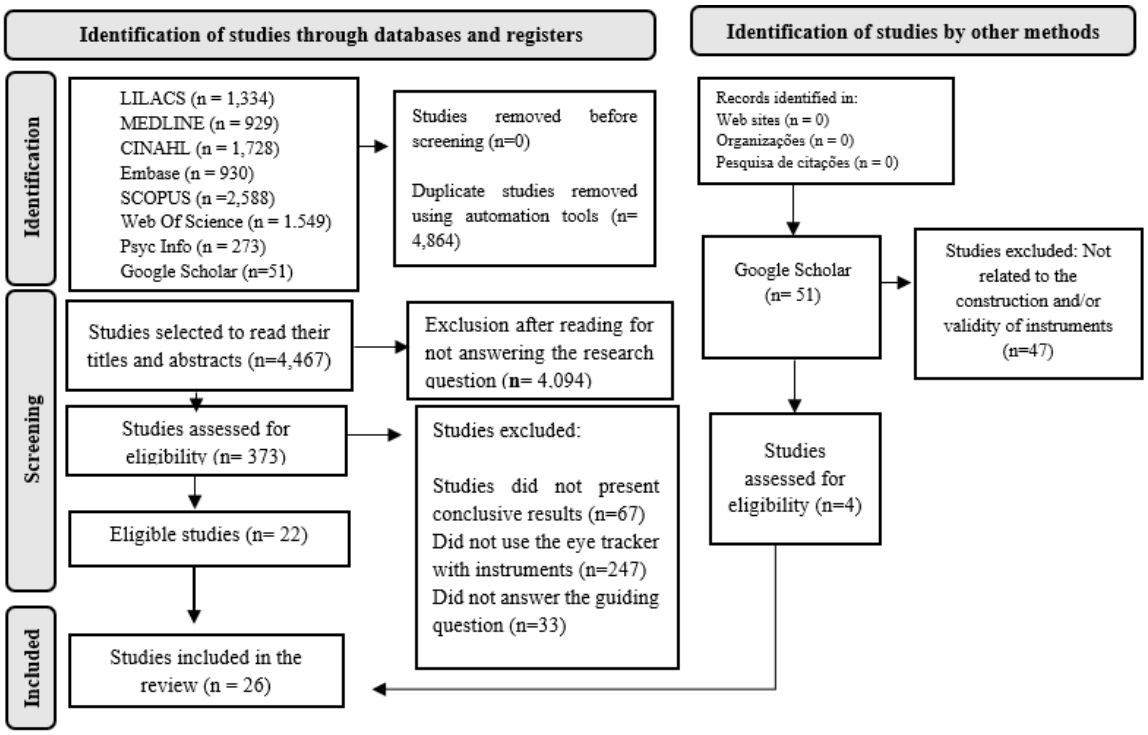


Figure 1
Study selection flowchart. Adapted from Page et al., 2021

Criteria for Selecting Eye-Tracking Devices

As verified in the research, the selection of eye-tracking devices considered criteria such as portability, sampling rate, compatibility with different operating systems, and applicability in work environments.

Identified Eye-Tracking Devices

Based on the study criteria, the most commonly used devices in the analyzed studies were: Eyelink® Portable Duo, Tobii T60, Tobii 1750, Senso Motoric Instruments (SMI) RED250 mobile eye tracker, Gazepoint GP3 HD, Tobii T120, Tobii Pro X3-120, Tobii Pro Fusion, EyeLink Data Viewer, Tobii Pro 2 glasses, SMI EG2 glasses, Tobii Pro X3-120, Tobii 4C, Tobii X120, Tobii Pro X3-120, Tobii T120 Eye Tracker, Tobii x1 Light, most of which were attached to computers and calibrated.

The main eye tracker metrics used in the studies were fixation rates, fixation duration in milliseconds, areas of interest (AOI), AOI dwell time, fixation count and mean fixation duration, GazePlot and Heatmap data, mean saccade size, reading rate and basal pupil diameter, reading rate and refixation rate, frequency, mean and total duration of blinks, saccades and the number of fixations on a word or area of interest.

According to the studies' publication year, there was a greater predominance in 2021 with 6 studies, 2022 with 5 studies, 2019 with 4 studies, 2023 with 3 studies, and 2020 with 2 studies, followed by the years 2018, 2017, 2015, 2013, 2012, 2011, 2008, and 2006, each with only 1 study. Thus, the studies were characterized based on the author, year, country of the study, target audience, hardware/software used, eye-tracking metrics (see Table 2), as well as the instruments applied and main results (see Table 3).

Table 2

Characterization of the studies analyzed **(**Research data, 2024**)**.

Author/Year	Type of Study	Country	Target Population	Hardware/ Software	Eye Tracker Metrics
Yaneva et al., 2021	Experimental	United States	Medical students	Eyelink® Portable Duo Eye Tracker, software Experiment Builder e EyeLink Data Viewer.	Individual fixations; fixation duration in milliseconds; areas of interest (AOI): dwell time, fixation count and mean fixation duration.
Yaneva *et al*., 2022	Data-driven machine learning approach	United States	26 medical school students	Eyelink® Portable Duo Eye Tracker, software EyeLink Data Viewer.	Gaze characteristics were recorded for both the stem and the option regions, and, in some instances, for specific fixtures, balconies, and runs.
Bax, 2015	Experimental	United Kingdom	Students (n = 30)	Tobii T60	Areas of Interest (AOIs), fixations used by participants; included GazePlot data and Heatplot data.
Bax, 2013	Experimental	Malawi	Students (n = 20)	Tobii T60	Eye fixations and individual saccades; Areas of Interest (AOIs); GazePlot; Heatmap.
Bax; Weir, 2012	Experimental	United Kingdom	Students (n = 103)	Tobii T60	Eye movement and facial expression. series of lines (indicating saccades) and circles of various sizes (representing fixations - smaller circles for shorter fixations, larger ones for longer fixations); Gaze Plot; Heat Map.
Galesic et al., 2008	Experimental	United States	Students (n = 108)	Tobii 1750	Fixations, mean fixation time between questions; The mean size of a saccade (a quick eye movement between two fixations).
Neuert, 2019	Experimental	Germany	Students (n = 131)	Senso Motoric Instruments (SMI) RED250 mobile eye tracker and SMI BeGaze Version 3.6.57.	Individual fixation rate, reading rate and basal pupil diameter, fixation count and time, fixation time and fixation count of respondents were considered within “areas of interest” (AOIs).
Koutsogiorgi & Michaelides, 2022	Experimental	Cyprus	Students (n = 87)	Gazepoint GP3 HD. The software Gazepoint Analysis Professional Edition software.	First AOI viewing, time viewed, fixations and revisits. Item responses and overall item response time were also recorded.
Höhne & Lenzner, 2017	Experimental	Germany	Adults (n = 75)	Tobii T120 Eye Tracker and the data was analyzed using Tobii Studio 3.2.1 software.	Individual fixing rate, reading rate and refixing rate.
Chauliac *et al.*, 2020	Experimental	Netherlands	Students (n = 75)	Tobii Pro X3-120. Tobii-Studio (3.4.8) software.	Tobii fixation filter for fixation identification; distinct areas of interest (AOI); total fixation was calculated for each AOI.
Tontini, 2021	Quasi-experimental	Brazil	*Stricto senso* postgraduate students (n = 40)	Pupil Core Eye Tracking Headset. Screen Marker Calibration.	Surface trackers, heat map data, raw fixation data and gaze positions are exported for each surface tracker. The number of fixations, the duration of fixations (minimum, maximum, mean and standard deviation), the number of regressions on the text and scale, the number of response regressions for the text and the number of response corrections.
Fang et al., 2021	Experimental	China	Academics (n = 66)	SMI iView X TM RED. Eye movements were recorded and processed using Experiment Center 3.5 and BeGaze 3.5 on the iView PC.	Pupil size (Pupil diameter), Fixation behaviors (Fixation count, fixation frequency, total fixation duration, fixation duration, mean), Fixation behaviors in areas of interest (Fixation count, percentage of fixation time.
Milte et al., 2023	Experimental	Australia	Older adults in residential care (n = 41)	Tobii Pro Fusion. Tobii Pro Eye Tracker Manager software; and the data was stored: Tobii Pro Lab software.	The number and duration of fixations (i.e. staring in seconds) were calculated. AOI, number of fixations and saccades across the screen.
Büschken et al., 2021	Experimental	Europe	Scholars (n = 405)	Binocular EAS from Interactive Minds	The duration of eye fixation for four elements of a quiz page: (1) The description of the domain at the top of a screen. (2) The description of the end points of the 9-point rating scale. (3) The individual items belonging to the specific and conceptually different attributes of a domain. And (4) the radio buttons representing the DK rating and response options.
Luo & Wang, 2019	Quasi-experimental	New Zealand	Scholars	Tobi eye tracker	Gaze paths, fixation counts, fixation duration and mean are numbers and seconds. 'Difference (visual-verbal)' refers to 'the data generated by the visualizers' minus 'the data generated by the verbalizers.

Durtette et al., 2023	Experimental	France	Scholars	EyeLink Data Viewer 3.2.	The areas of interest, the durations of the initial four fixations on relevant facial features (eyes, nose, mouth), total fixation durations on the face and total dwell time on relevant facial features (eyes, nose, mouth), total dwell time on the face, the mean number of fixations and the mean fixation durations on the whole face for each emotion.
Wang et al., 2020	Exploratory Study	Australia	Older adults and patients and caregivers (n = 20)	Tobii Pro 2 glasses. Tobii Pro Analysis software	Heat Maps, the fixings, eye chart, and this data was then plotted on a bar chart.
Ratcliffe et al., 2023	Mixed study with randomization approach	Australia	Older adults with cognitive impairment and dementia.	Tobii Pro Fusion	Focus duration; heat map; gaze path; The number and duration of fixations. Duration of focus presented as a heat map; gaze path.
Maddox et al., 2018	Exploratory Study	United Kingdom	Administrative staff and postgraduates (n = 14)	Glasses SMI EG2	Scanning paths to explore how respondents engaged with the test items.
Graesser et al., 2006	Experimental	United States	University students	Laboratory Model 501 eye tracker	Duration of the first fixation on a word, number of fixations on a word, total reading time per word, percentage of regressions and jump probability.
Liu et al., 2022	Observational Prospective	China	93 healthy university students aged between 20 and 30.	Tobii Pro X3-120 Eye Tracker Tobii Pro Studio Software	Time to first fixation; duration of first fixation; mean fixation duration; total fixation duration; fixation count; mean visit duration; total visit duration and visit count; reading speed (characters per second).
Baltulionis et al., (2019)	Experimental	Europe	Adults (n = 5)	Tobii 4C	Number and location of fixtures in the Areas of Interest (AoI).
Rivu et al., 2021	Experimental	Germany	Adults (n = 42)	Tobii X120 Eye Tracker. Tobii Studio software.	Gaze path and collected qualitative feedback from semi-structured interviews after the experiment, fixation duration, mean fixation duration, number of regressions per question, mean saccade length per question, time taken to answer the question, mean fixation duration, number of large dilations, maximum pupil dilation, maximum pupil velocity, mean pupil size.
Chauliac et al., 2022	Exploratory	Belgium	Students (n = 70)	Tobii Pro X3-120 eye tracker	Fixation times; area of interest (AOI), total fixation duration and total fixation count.
Lenzner et al., 2011	Experimental	Germany	Adults (n = 44)	Tobii T120 Eye Tracker, Tobii Studio 2.0.3 software	Word/phrase fixation time, question fixation count and question fixation time as indicators of question comprehensibility.
Akgün & Ünaldi, 2022	Experimental	Türkiye	Students (n = 34)	Tobii x1 Light	Total text-based reading time, total text-based fixation count, areas of interest (AoI).

Table 3

Summary of the articles mapped, according to hardware or software, eye-tracking metrics, instrument used and main results (Research data, 2024).

Author/Year	Instruments used	Main results
Yaneva et al., 2021	Multiple choice questions (MCQs) focusing on internal medicine.	The more refined AOIs show that most initial fixations occur in the first phrase of the stem, with many others falling outside the AOIs
Yaneva *et al*, 2022	Multiple choice questions (MCQs) from the National Board of Medical Examiners (NBME) Clinical Mastery Series for Internal Medicine.	Participants with incorrect answers spend more time processing options; correct answers have more fixations on the second pass over the options.
Bax, 2015	An on-screen version of two IELTS reading passages.	Prior reading varies between participants. Eye-tracking data shows an ability to identify key elements in the text and the question, making it easier to answer.
Bax, 2013	Testes de leitura do IELTS (International English Language Testing System).	IELTS items distinguish passers from failers; eye-tracking identifies critical textual elements in differentiating answers, down to the word level.
Bax; Weir, 2012	CAE reading test items.	Gaze Plots and Heat Maps show adequate cognitive processes of the participants; Eye Tracking combined with traditional methods improves the validation of reading test items.
Galesic et al., 2008	The questionnaire included around 20 questions.	Respondents choose more options in the first half of the list, spending more time on them. Drop-down lists are used less, and visible options receive more attention.
Neuert, 2019	Questions from textbooks on questionnaire design and the GESIS pre-test database.	Differences were observed in fixation times and counts between versions of a question, but with no statistical impact on evoked pupillary responses.
Koutsogiorgi & Michaelides, 2022	A 23-item questionnaire designed by the researcher and including two self-relevant and two non-self-relevant items.	Neuroticism negatively influences responses; self-relevance increases responses on self-relevant items; negative words increase difficulty and response time.
Höhne & Lenzner, 2017	Questions used were adapted from the European Social Survey and the International Social Survey Program.	Item-specific questions (IS) generate more fixations and processing time compared to A/D, indicating greater cognitive effort.
Chauliac et al., 2022	Task-specific self-assessment questionnaire to measure your cognitive processing strategies (ILS-SV questionnaire).	At the beginning of the questionnaire, answers are more diverse and processing slower, but they become uniform and faster as you progress.
Tontini, 2021	General Decision-Making Style Inventory (GDMS).	Participants did not read the questionnaire properly. Criteria such as response time and regressions indicated problems. One question was problematic; in the pre-test, 189 problems were identified.
Fang et al., 2021	Questionnaire with 10 questions, including an assessment of the teaching level and attitude towards teachers.	Pupil and fixation data suggest that deception is cognitively demanding. Participants focus on positive items when lying and negative items when being honest.
Milte et al., 2023	Quality of life instrument - EQ-5D-5L.	Participants with cognitive impairment took longer on the EQ-5D-5L questionnaire. They focused more on titles and examples of the dimensions. Eye movements were more random.
Büschken et al., 2021	Satisfaction with various characteristics of their universities and attributes of the city in which the two universities are located on 9-point rating scales.	Fixation duration is correlated with the number of words in the item. Longer fixations indicate more cognitive effort, especially in complex items.
Luo & Wang, 2019	Learning Styles Index (LSI) Questionnaire.	Learning styles vary (visual vs. verbal). Eye-tracking technology can personalize learning materials. Images and text influence style identification.

Durtette et al., 2023	Schizotypal Personality Questionnaire (SPQ) French version.	Schizotypal traits reduce attention to sad facial features, slowing down processing and affecting everyday social interactions.
Wang et al., 2020	Quality of life instrument EQ-5D-5L.	Participants with good cognition focused on multiple key areas evenly. Those with mild cognitive impairment showed difficulty, fewer fixations and limited movement.
Ratcliffe et al., 2023	Quality of life instrument EQ-5D-5L.	Older residents with an MMSE score of 24 have the cognitive capacity to complete the EQ-5D-5L reliably; lower scores may affect reliability.
Maddox et al., 2018	The Program for the International Assessment of Adult Competencies (PIAAC).	Eye-tracking recorded verbal interactions, validating the need to read instructions before responses, with the instructions serving as a reference.
Graesser et al., 2006	Question Understanding Aid.	Interviewees reviewed answer options and switched between question, context and options. Unfamiliar technical terms resulted in more reading time and the risk of misinterpretation.
Liu et al., 2022	Computer Vision Syndrome Questionnaire (CVS-Q).	The computer visual syndrome questionnaire score correlated positively with symptoms such as double vision and difficulty focusing. Ocular parameters can assess asthenopia.
Baltulionis et al., 2019	VARK Questionnaire.	There was a significant correlation between areas of interest and sensory modalities. Linear models highlighted the importance of titles for different modalities. Eye Tracking complements subjective questionnaires.
Rivu et al., 2021	Questionnaire with 17 questions reported in the interviews. The questionnaire as problematic ("vague sentences, undefined word, etc").	Number and regression of fixations are significant indicators. Double negation increases processing time. Key features for forecasting include fixations and regressions.
Chauliac et al., 2022	Task-specific version of the ILS-SV questionnaire.	Consistency in response behavior is significantly related to the total duration of fixation on an item. When answering self-report questionnaires, there seems to be a tipping point where a longer focus on the item does not lead to a more consistent response pattern.
Lenzner et al., 2011	Questionnaires with 28 experimental questions on various topics such as social inequality, the environment, health, leisure and citizenship.	In the comprehension phase, they fixate on the stem of the question, if there is a difficulty in understanding more fixations in this region, and while carrying out the remaining tasks of the response process (information retrieval, judgment, formatting and editing), they are more likely to fixate on the answer options.
Akgün & Ünaldi, 2022	Two reading texts adapted from the TOEFL iBT practice tests, in each test there were six questions.	In the open-ended (OE) short answer format, the entire text is read for longer; there is more fixation on the overall text; participants indicated that they understood the text more in the OE format because they had to read and understand it more carefully in order to produce their own answers in their own words.

Analysis of Keyword Co-Occurrence

To examine the relationship between the main terms used in the analyzed studies, a keyword co-occurrence analysis was conducted using VOSviewer® software, which allows for the visualization of term frequency and interconnectivity. Initially, for data preparation, a file containing the references of the articles extracted from the databases was saved in .ris format and processed in VOSviewer®. The type of analysis selected was keyword co-occurrence, generating a word occurrence map structured into clusters and exported in .png format.

As a result, three distinct groups were identified, totaling 17 items, as shown in Figure 2. These clusters were categorized based on the semantic proximity of the terms and are visually represented by three distinct colors: red for terms related to Eye Tracking Technology, Surveys and Questionnaires, and Humans; blue for terms associated with Cognition and Feasibility Studies; and green for terms related to Self-Report.

Thus, the following terms—Cognition, Eye Tracking Technology, Surveys and Questionnaires, and Humans—had the highest frequency in the analyzed studies. This indicates a strong co-occurrence pattern, highlighting that eye-tracking technology has been widely used in studies evaluating cognitive processes involved in the application of self-report instruments, particularly in the use of questionnaires.

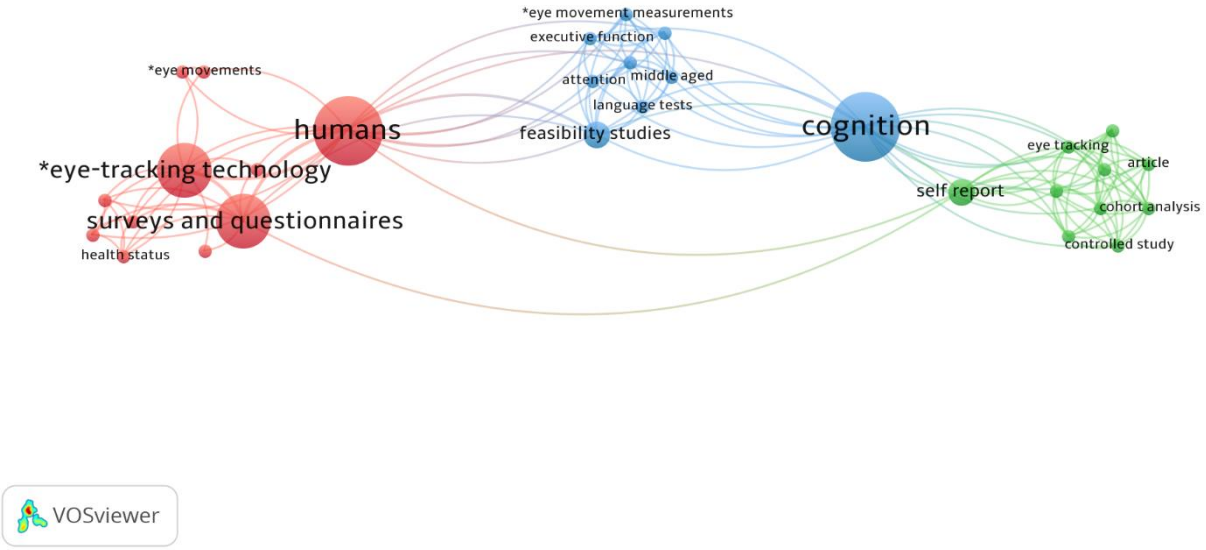


Figure 2
Keywords co-occurrence of included articles. Prepared by the researchers using VOSviewer software.

Discussion

Eye-tracking technology has emerged as an innovative tool in investigating the cognitive processes involved in reading, comprehension, and responding to assessment instruments, by capturing ocular data such as fixations, saccades, reading time, and areas of interest. This technology provides valuable insights for the improvement of psychometric and educational tools, contributing to their validity, reliability, and usability. This section discusses the main contributions of eye-tracking to these domains, based on an extensive analysis of recent literature.

Psychometric Item Evaluation and Linguistic Processing

Eye-tracking has been widely used to investigate visual behavior in response to different item formats in measurement instruments. Yaneva et al., (2021, 2022) demonstrated that, in multiple-choice questions, respondents tend to focus their initial fixations on the first sentences of the stems, indicating

a cognitive effort directed at comprehension before analyzing the alternatives. Respondents who make errors tend to show more scattered and prolonged fixation patterns, suggesting interpretative difficulties.

Çorbacı and Kahraman (2022), in an experimental study using latent growth modeling, demonstrated that eye-tracking data can be converted into item-level process data to investigate reading behavior in multiple choice tests. Quadratic models with the response variable as a covariate showed the best fit, allowing for the identification of reading patterns associated with correct and incorrect answers. The findings highlight the potential of process data to detect response strategies and atypical behaviors, such as the direct selection of options without fully reading them, particularly in task-oriented reading contexts.

Supporting these findings, Akgün and Ünaldi (2022) emphasize that open-ended items, although more challenging, encourage more careful and reflective reading, promoting more elaborate cognitive strategies. These observations highlight the usefulness of eye-tracking in the psychometric evaluation of items, as it enables the identification of textual constructions that compromise clarity and hinder the respondent's task.

Specific linguistic aspects also significantly affect eye movement patterns. Studies such as those by Bax (2015) and Lenzner et al., (2011) showed that complex linguistic structures, low-frequency vocabulary, and syntactic ambiguities increase eye fixation time, indicating greater cognitive effort. Similarly, Koutsogiorgi and Michaelides (2022) observed that the presence of negations especially in self-referential items disrupts reading fluency and increases the need for rereading. These findings support the importance of text analysis mediated by eye tracking to enhance item of understanding and, consequently, the validity of responses.

Cognitive Strategies, Perceived Difficulty, and Psychosocial Variables

Heat maps and gaze plots reveal distinct patterns of visual attention that vary according to item complexity and respondent characteristics. Bax (2012) and Bax & Weir (2013) demonstrated that successful respondents tend to focus on keywords and relevant segments of the text, indicating efficient cognitive strategies. On the other hand, studies involving specific populations such as older adults with cognitive decline show less directed fixations and omission of critical item areas (Milte et al., 2023; Ratcliffe et al., 2023; Wang et al., 2020), highlighting the value of eye-tracking in validating instruments aimed at groups with particular needs.

Galesic et al., (2008), Chauliac et al., (2022), and Akgün & Ünaldi (2022) identified an attentional bias toward the first response options in lists— a phenomenon that may reduce cognitive effort but compromise the reliability of responses. These findings underscore the importance of carefully ordering alternatives to mitigate positional biases.

Additionally, Neuert (2019) and Rivu et al., (2021) emphasized that the presence of vague terms, double negatives, and undefined expressions significantly increases cognitive effort, making eye-tracking a valuable tool for detecting and correcting such textual elements.

Educational Applications and Instrument Optimization

In the educational context, eye-tracking has significantly contributed to identifying learning patterns and comprehension strategies during reading. Luo and Wang (2019) demonstrated that learners with a visualizer profile exhibit distinct eye movement patterns compared to those with a verbalizer profile, highlighting the technology's potential for customizing educational materials.

Baltulioni et al. (2019) identified correlations between visual areas of interest and reading preferences, while Büschken et al. (2021) showed that item length, measured by the number of characters, directly correlates with fixation time, reinforcing the importance of considering informational density in instrument design.

Recent studies have expanded on this evidence. Liu et al. (2023) introduced a multistrategy psychometric model that integrates traditional performance data with eye-tracking metrics, such as proportional viewing time and focus shifts in Raven's Matrices tasks. Meanwhile, Man et al., (2022) proposed a three-pronged joint model responses, response time, and fixations-that enhances the

estimation of skills and engagement, representing a significant advance in multimodal psychometric modeling.

Additionally, Junior et al., (2021) demonstrated that, in clinical vignette questions, cognitive load increases with item complexity. This overload can be detected through the number of fixations and re-visits, providing objective support for the redesign of assessments in health education.

Validity of Responses, Visual Fatigue, and Eye Health

The validity of responses may be compromised by selective reading patterns, in which participants do not read the items in full, relying only on keywords (Graesser et al., 2006; Maddox et al., 2018). Eye-tracking can help identify these behaviors and act preventively during validation processes.

Furthermore, Liu et al., (2022) correlated symptoms of Computer Vision Syndrome (such as difficulty focusing and eye redness) with reading patterns and visual fatigue when interacting with digital questionnaires, suggesting that this technology can be applied to optimize both visual ergonomics and the accuracy of responses.

Despite the limitations of this study, such as the unavailability of some full-text studies and challenges in retrieving a larger number of studies on the topic, the findings highlight the potential of eye-tracking in understanding cognitive processes, refining methodological approaches, and improving measurement instruments in various fields.

And as contributions, the study highlights that the metrics used in eye-tracking can provide insights into the cognitive processes involved in understanding information, allowing access to data that would otherwise be inaccessible to researchers without the aid of this technology. Furthermore, the research contributes to the knowledge and expansion of methodological possibilities, enabling its application in different thematic areas, with a focus on the development and validation of measurement, educational, and behavioral instruments.

Through the conducted review, it was also possible to understand the different applications of eye-tracking, the main methods employed, as well as the key metrics explored, offering a comprehensive view of its potential. The findings discussed not only reinforce the robustness of eye-tracking as an auxiliary validation method but also indicate its potential for clinical, neuroeducational, and behavioral applications, especially in populations with cognitive impairments, neurodevelopmental disorders, or reading difficulties. Future studies may explore in greater depth the association between eye movement patterns and latent variables such as motivation, attention, working memory, and decision-making, thereby expanding the scope of the technology's application in diagnostic and formative contexts.

Conclusion

Eye-tracking has been used with different audiences and contexts and applied in various research approaches based on multiple-choice questionnaires, adapted and applied in exploratory and experimental research using printed or computerized media. In this way, technology becomes a differential in data collection, since it makes visual records that occur during the cognitive process and makes it possible to identify problems with the writing and comprehension of items, the order of options and the style of responses, which can impact on the validity and reliability of instrument responses.

In this way, this study's relevance is highlighted, since we analyzed the main scientific evidence for the use of eye-tracking in instruments in areas focused on internal medicine, in a series of clinical domains for undergraduates, reading tests, processes for the development and validation of measurement instruments, the writing of instrument items, cognitive strategies, the assessment of teaching levels and attitudes, learning styles, individual competencies and skills, and assessments of quality of life.

Eye-tracking has therefore been identified in the scientific literature as an innovative technological resource that can help researchers capture subjective gaze data, such as fixation rates, saccades, areas of interest and dwell time on certain topics, which directly influence how the participant decodes and interprets what is asked of them and is useful for verifying problems with writing and formulating questions in self-administered instruments or in digital format.

Declarations

Conflict of Interest: No potential conflict of interest was reported by the authors.

Ethical Approval: I declare that all ethical guidelines for the author have been followed. This study did not require approval from an ethics committee as it is a scoping review, which involves the analysis of secondary data already published and does not include the collection of data directly from human subjects.

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Appendix

Search Queries of Databases

Table 1

Search expression in the Latin American and Caribbean Health Sciences Literature (LILACS) via the Virtual Health Library (BVS). Adapted from Araújo (2020).

EXTRACTION (LILACS)			
DESCRIPTION	**ACRONYM**	**TERMS**	
Population	**P**	**“Surveys and Questionnaires”**	
Concept	**C**	**"Eye Tracking Technology”**	
Context	**C**	**------**	
CONVERSION AND COMBINATION			
Database	**ACRONYM**	**MeSH**	**Keyword**
LILACS	**P**	"surveys and questionnaires"[MeSH Terms]	“Questionnaires and Surveys” “Surveys” “Survey” “Questionnaire Design” “Design, Questionnaire” “Designs, Questionnaire” “Questionnaire Designs” “Respondent” “Randomized Response Technique” “Randomized Response Techniques” “Techniques, Randomized Response” “Questionnaires” “Questionnaire”
	C	"Eye Tracking Technology"[Mesh]	“Eye Tracking Technology” “Eye-Tracking Technologies” “Technology, Eye-Tracking” “Eyetracking Technology” “Eyetracking Technologies” “Gaze-Tracking Technology” “Gaze Tracking Technology” “Gaze-Tracking Technologies” “Eye-Tracking System” “Eye Tracking System” “Eye-Tracking Systems” “Eyetracking System” “Eyetracking Systems” “Eye Movement Data Analysis” “Gaze-Tracking” “Gaze Tracking” “Gaze-Tracking System” “Gaze Tracking System” “Gaze-Tracking Systems” “Eye-Tracking” “Eye Tracking”
	C	------	------
ACRONYM	**CONSTRUCTION AND USE**		
P	(mh:(“Surveys and Questionnaires”)) OR (“Questionnaires and Surveys”) OR (“Surveys”) OR (“Survey”) OR (“Questionnaire Design”) OR (“Design, Questionnaire”) OR (“Designs, Questionnaire”) OR (“Questionnaire Designs”) OR (“Respondent”) OR (“Randomized Response Technique”) OR		

	(“Randomized Response Techniques”) OR (“Techniques, Randomized Response”) OR (“Questionnaires”) OR (“Questionnaire”)
C	(mh:("Eye Tracking Technology")) OR (“Eye Tracking Technology”) OR (“Eye-Tracking Technologies”) OR (“Technology, Eye-Tracking”) OR (“Eyetracking Technology”) OR (“Eyetracking Technologies”) OR (“Gaze-Tracking Technology”) OR (“Gaze Tracking Technology”) OR (“Gaze-Tracking Technologies”) OR (“Eye-Tracking System”) OR (“Eye Tracking System”) OR (“Eye-Tracking Systems”) OR (“Eyetracking System”) OR (“Eyetracking Systems”) OR (“Eye Movement Data Analysis”) OR (“Gaze-Tracking”) OR (“Gaze Tracking”) OR (“Gaze-Tracking System”) OR (“Gaze Tracking System”) OR (“Gaze-Tracking Systems”) OR (“Eye-Tracking”) OR (“Eye Tracking”)
C	------
Expression end of search	((mh:(“Surveys and Questionnaires”)) OR (“Questionnaires and Surveys”) OR (“Surveys”) OR (“Survey”) OR (“Questionnaire Design”) OR (“Design, Questionnaire”) OR (“Designs, Questionnaire”) OR (“Questionnaire Designs”) OR (“Respondent”) OR (“Randomized Response Technique”) OR (“Randomized Response Techniques”) OR (“Techniques, Randomized Response”) OR (“Questionnaires”) OR (“Questionnaire”)) AND ((mh:("Eye Tracking Technology")) OR (“Eye Tracking Technology”) OR (“Eye-Tracking Technologies”) OR (“Technology, Eye-Tracking”) OR (“Eyetracking Technology”) OR (“Eyetracking Technologies”) OR (“Gaze-Tracking Technology”) OR (“Gaze Tracking Technology”) OR (“Gaze-Tracking Technologies”) OR (“Eye-Tracking System”) OR (“Eye Tracking System”) OR (“Eye-Tracking Systems”) OR (“Eyetracking System”) OR (“Eyetracking Systems”) OR (“Eye Movement Data Analysis”) OR (“Gaze-Tracking”) OR (“Gaze Tracking”) OR (“Gaze-Tracking System”) OR (“Gaze Tracking System”) OR (“Gaze-Tracking Systems”) OR (“Eye-Tracking”) OR (“Eye Tracking”))
Number of articles	**(1.334)**
Search date	**23/01/2024**

Table 2

Search strategy in MEDLINE/PubMed (via National Library of Medicine). Adapted from Araújo (2020).

EXTRACTION (MEDLINE via PubMed)			
DESCRIPTION	**ACRONYM**	**TERMS**	
Population	**P**	**“Surveys and Questionnaires”**	
Concept	**C**	**"Eye Tracking Technology”**	
Context	**C**	------	
CONVERSION AND COMBINATION			
Database	**ACRONYM**	**MeSH**	**Keyword**
MEDLINE/PubMed	**P**	"surveys and questionnaires"[MeSH Terms]	“Questionnaires and Surveys” “Surveys” “Survey” “Questionnaire Design” “Design, Questionnaire” “Designs, Questionnaire” “Questionnaire Designs” “Respondent” “Randomized Response Technique” “Randomized Response Techniques” “Techniques, Randomized Response” “Questionnaires” “Questionnaire”
	C	"Eye Tracking Technology"[Mesh]	“Eye Tracking Technology” “Eye-Tracking Technologies” “Technology, Eye-Tracking” “Eyetracking Technology” “Eyetracking Technologies” “Gaze-Tracking Technology” “Gaze Tracking Technology” “Gaze-Tracking Technologies” “Eye-Tracking System” “Eye Tracking System” “Eye-Tracking Systems” “Eyetracking System” “Eyetracking Systems” “Eye Movement Data Analysis” “Gaze-Tracking” “Gaze Tracking” “Gaze-Tracking System” “Gaze Tracking System” “Gaze-Tracking Systems” “Eye-Tracking” “Eye Tracking”
	C	------	------
ACRONYM	**CONSTRUCTION AND USE**		
P	((((((((((("surveys and questionnaires"[MeSH Terms]) OR ("Questionnaires and Surveys")) OR (Surveys)) OR (Survey)) OR ("Questionnaire Design")) OR ("Design, Questionnaire")) OR ("Designs, Questionnaire")) OR ("Questionnaire Designs")) OR (Respondent)) OR ("Randomized Response Technique")) OR ("Randomized Response Techniques")) OR ("Techniques, Randomized Response")) OR (Questionnaires)) OR (Questionnaire)		
C	((((((((((((((((((("Eye Tracking technology"[MeSH Terms]) OR ("Eye Tracking Technology")) OR ("Eye-Tracking Technologies")) OR ("Technology, Eye-Tracking")) OR ("Eyetracking Technology")) OR ("Eyetracking		

	Technologies")) OR ("Gaze-Tracking Technology")) OR ("Gaze Tracking Technology")) OR ("Gaze-Tracking Technologies")) OR ("Eye-Tracking System")) OR ("Eye Tracking System")) OR ("Eye-Tracking Systems")) OR ("Eyetracking System")) OR ("Eyetracking Systems")) OR ("Eye Movement Data Analysis")) OR ("Gaze-Tracking")) OR ("Gaze Tracking")) OR ("Gaze-Tracking System")) OR ("Gaze Tracking System")) OR ("Gaze-Tracking Systems")) OR ("Eye-Tracking")) OR ("Eye Tracking")
C	------
Expression end of search	((((((((((((("surveys and questionnaires"[MeSH Terms]) OR ("Questionnaires and Surveys")) OR (Surveys)) OR (Survey)) OR ("Questionnaire Design")) OR ("Design, Questionnaire")) OR ("Designs, Questionnaire")) OR ("Questionnaire Designs")) OR (Respondent)) OR ("Randomized Response Technique")) OR ("Randomized Response Techniques")) OR ("Techniques, Randomized Response")) OR (Questionnaires)) OR (Questionnaire)) AND ((((((((((((((((((("Eye Tracking technology"[MeSH Terms]) OR ("Eye Tracking Technology")) OR ("Eye-Tracking Technologies")) OR ("Technology, Eye-Tracking")) OR ("Eyetracking Technology")) OR ("Eyetracking Technologies")) OR ("Gaze-Tracking Technology")) OR ("Gaze Tracking Technology")) OR ("Gaze-Tracking Technologies")) OR ("Eye-Tracking System")) OR ("Eye Tracking System")) OR ("Eye-Tracking Systems")) OR ("Eyetracking System")) OR ("Eyetracking Systems")) OR ("Eye Movement Data Analysis")) OR ("Gaze-Tracking")) OR ("Gaze Tracking")) OR ("Gaze-Tracking System")) OR ("Gaze Tracking System")) OR ("Gaze-Tracking Systems")) OR ("Eye-Tracking")) OR ("Eye Tracking") AND (fha[Filter]))
Number of articles	(929)
Search date	23/01/2024

Table 3

Search strategy in CINAHL via (EBSCO). Adapted from Araújo (2020).

EXTRACTION CINAHL (EBSCO)			
DESCRIPTION	**ACRONYM**	**TERMS**	
Population	**P**	**"Questionnaires"**	
Concept	**C**	**"Eye Movements"**	
Context	**C**	**------**	
CONVERSION AND COMBINATION			
Database	**ACRONYM**	**CINAHL Subject Headings**	**Keyword**
CINAHL	**P**	"Questionnaires"	----------
	C	"Eye Movements" "Saccades" "Eye Movement Measurements"	"Eye-Tracking"
	C	------	----------
ACRONYM	**CONSTRUCTION AND USE**		
P	Questionnaires OR "Structured Questionnaires" OR "Health Perceptions Questionnaire"		
C	"Eye Movements" OR "Saccades" OR "Eye Movement Measurements" OR "Eye-Tracking"		
C	------		
Expression end of search	(Questionnaires OR "Structured Questionnaires" OR "Health Perceptions Questionnaire") AND ("Eye Movements" OR "Saccades" OR "Eye Movement Measurements" OR "Eye-Tracking")		
Number of articles	(1.728)		

Search date	23/01/2024

Table 4

Expressão de busca na Embase (Elsevier). Adapted from Araújo (2020).

EXTRACTION - Embase (Elsevier)			
DESCRIPTION	**ACRONYM**	**TERMS**	
Population	**P**	Questionnaire	
Concept	**C**	Eye Tracking	
Context	**C**	------	
CONVERSION AND COMBINATION			
Database	**ACRONYM**	**EMTREE**	**Synonym**
Embase (Elsevier)	P	Questionnaire	'questionnaire' 'questionnaires' 'surveys and questionnaires' 'questionnaire'
	C	Eye Tracking”	'eye movement, tracking' 'optical tracking' 'pursuit eye movement' 'tracking eye movement' 'tracking, visual' 'visual tracking' 'Eye Tracking'
	C	------	------
ACRONYM	**CONSTRUCTION AND USE**		
P	'questionnaire'/exp 'questionnaires' OR 'surveys and questionnaires' OR 'questionnaire'		
C	'Eye Tracking'/exp 'eye movement, tracking' OR 'optical tracking' OR 'performance, tracking' OR 'pursuit eye movement' OR 'tracking eye movement' OR 'tracking performance' OR 'tracking task' OR 'tracking, visual' OR 'visual tracking' OR 'Eye Tracking'		
C	------		
Expression end of search	('questionnaire'/exp AND 'questionnaires' OR 'surveys and questionnaires' OR 'questionnaire') AND ('Eye Tracking'/exp AND 'eye movement, tracking' OR 'optical tracking' OR 'performance, tracking' OR 'pursuit eye movement' OR 'tracking eye movement' OR 'tracking performance' OR 'tracking task' OR 'tracking, visual' OR 'visual tracking' OR 'Eye Tracking')		
Number of articles	(930)		
Search date	23/01/2024		

Table 5

Search strategy in SCOPUS. Adapted from Araújo (2020).

EXTRACTION - Web of Science (Clarivate Analytics)			
DESCRIPTION	**ACRONYM**	**TERMS**	
Population	**P**	"Surveys and Questionnaires"	
Concept	**C**	"Eye Tracking Technology"	
Context	**C**	------	
CONVERSION AND COMBINATION			
Database	**ACRONYM**	**MeSH**	**Keyword**
Web of Science (Clarivate Analytics)	**P**	"surveys and questionnaires"[MeSH Terms]	"Questionnaires and Surveys" "Surveys" "Survey" "Questionnaire Design" "Design, Questionnaire" "Designs, Questionnaire" "Questionnaire Designs" "Respondent" "Randomized Response Technique" "Randomized Response Techniques" "Techniques, Randomized Response" "Questionnaires" "Questionnaire"
	C	"Eye Tracking Technology"[Mesh]	"Eye Tracking Technology" "Eye-Tracking Technologies" "Technology, Eye-Tracking" "Eyetracking Technology" "Eyetracking Technologies" "Gaze-Tracking Technology" "Gaze Tracking Technology" "Gaze-Tracking Technologies" "Eye-Tracking System" "Eye Tracking System" "Eye-Tracking Systems" "Eyetracking System" "Eyetracking Systems" "Eye Movement Data Analysis" "Gaze-Tracking" "Gaze Tracking" "Gaze-Tracking System" "Gaze Tracking System" "Gaze-Tracking Systems" "Gazetracking System" "Gazetracking Systems" "Eye-Tracking" "Eye Tracking"
	C	------	------
ACRONYM	**CONSTRUCTION AND USE**		
P	ALL=("Surveys and Questionnaires") OR ALL=("Questionnaires and Surveys") OR ALL=(Surveys) OR ALL=(Survey) OR ALL=("Questionnaire Design") OR ALL=("Design, Questionnaire") OR ALL=("Designs, Questionnaire") OR ALL=("Questionnaire Designs") OR ALL=(Respondent) OR		

	ALL=(“Randomized Response Technique”) OR ALL=(“Randomized Response Techniques”) OR ALL=(“Techniques, Randomized Response”) OR ALL=(Questionnaires) OR ALL=(Questionnaire)
C	ALL=("Eye Tracking Technology") OR ALL=(“Eye Tracking Technology”) OR ALL=(“Eye-Tracking Technologies”) OR ALL=(“Technology, Eye-Tracking”) OR ALL=(“Eyetracking Technology”) OR ALL=(“Eyetracking Technologies”) OR ALL=(“Gaze-Tracking Technology”) OR ALL=(“Gaze Tracking Technology”) OR ALL=(“Gaze-Tracking Technologies”) OR ALL=(“Eye-Tracking System”) OR ALL=(“Eye Tracking System”) OR ALL=(“Eye-Tracking Systems”) OR ALL=(“Eyetracking System”) OR ALL=(“Eyetracking Systems”) OR ALL=(“Eye Movement Data Analysis”) OR ALL=(“Gaze-Tracking”) OR ALL=(“Gaze Tracking”) OR ALL=(“Gazetracking System”) OR ALL=(“Gaze-Tracking System”) OR ALL=(“Gaze Tracking System”) OR ALL=(“Gaze-Tracking Systems”) OR ALL=(“Gazetracking Systems”) OR ALL=(“Eye-Tracking” “Eye Tracking”)
C	------
Expression end of search	(ALL=("Eye Tracking Technology") OR ALL=(“Eye Tracking Technology”) OR ALL=(“Eye-Tracking Technologies”) OR ALL=(“Technology, Eye-Tracking”) OR ALL=(“Eyetracking Technology”) OR ALL=(“Eyetracking Technologies”) OR ALL=(“Gaze-Tracking Technology”) OR ALL=(“Gaze Tracking Technology”) OR ALL=(“Gaze-Tracking Technologies”) OR ALL=(“Eye-Tracking System”) OR ALL=(“Eye Tracking System”) OR ALL=(“Eye-Tracking Systems”) OR ALL=(“Eyetracking System”) OR ALL=(“Eyetracking Systems”) OR ALL=(“Eye Movement Data Analysis”) OR ALL=(“Gaze-Tracking”) OR ALL=(“Gaze Tracking”) OR ALL=(“Gazetracking System”) OR ALL=(“Gaze-Tracking System”) OR ALL=(“Gaze Tracking System”) OR ALL=(“Gaze-Tracking Systems”) OR ALL=(“Gazetracking Systems”) OR ALL=(“Eye-Tracking” “Eye Tracking”)) AND (ALL=(“Surveys and Questionnaires”) OR ALL=(“Questionnaires and Surveys”) OR ALL=(Surveys) OR ALL=(Survey) OR ALL=(“Questionnaire Design”) OR ALL=(“Design, Questionnaire”) OR ALL=(“Designs, Questionnaire”) OR ALL=(“Questionnaire Designs”) OR ALL=(Respondent) OR ALL=(“Randomized Response Technique”) OR ALL=(“Randomized Response Techniques”) OR ALL=(“Techniques, Randomized Response”) OR ALL=(Questionnaires) OR ALL=(Questionnaire))
Number of articles	**(1.549)**
Search date	**23/01/2024**

Table 6

Search strategy in Web of Science (Clarivate Analytics). Adapted from Araújo (2020).

EXTRACTION - Web of Science (Clarivate Analytics)			
DESCRIPTION	**ACRONYM**	**TERMS**	
Population	**P**	"Surveys and Questionnaires"	
Concept	**C**	"Eye Tracking Technology"	
Context	**C**	------	
CONVERSION AND COMBINATION			
Database	**ACRONYM**	**MeSH**	**Keyword**
Web of Science (Clarivate Analytics)	**P**	"surveys and questionnaires"[MeSH Terms]	"Questionnaires and Surveys" "Surveys" "Survey" "Questionnaire Design" "Design, Questionnaire" "Designs, Questionnaire" "Questionnaire Designs" "Respondent" "Randomized Response Technique" "Randomized Response Techniques" "Techniques, Randomized Response" "Questionnaires" "Questionnaire"
	C	"Eye Tracking Technology"[Mesh]	"Eye Tracking Technology" "Eye-Tracking Technologies" "Technology, Eye-Tracking" "Eyetracking Technology" "Eyetracking Technologies" "Gaze-Tracking Technology" "Gaze Tracking Technology" "Gaze-Tracking Technologies" "Eye-Tracking System" "Eye Tracking System" "Eye-Tracking Systems" "Eyetracking System" "Eyetracking Systems" "Eye Movement Data Analysis" "Gaze-Tracking" "Gaze Tracking" "Gaze-Tracking System" "Gaze Tracking System" "Gaze-Tracking Systems" "Gazetracking System" "Gazetracking Systems" "Eye-Tracking" "Eye Tracking"
	C	------	------
ACRONYM	**CONSTRUCTION AND USE**		
P	ALL=("Surveys and Questionnaires") OR ALL=("Questionnaires and Surveys") OR ALL=(Surveys) OR ALL=(Survey) OR ALL=("Questionnaire Design") OR ALL=("Design, Questionnaire") OR ALL=("Designs, Questionnaire") OR ALL=("Questionnaire Designs") OR ALL=(Respondent) OR		

	ALL=(“Randomized Response Technique”) OR ALL=(“Randomized Response Techniques”) OR ALL=(“Techniques, Randomized Response”) OR ALL=(Questionnaires) OR ALL=(Questionnaire)
C	ALL=("Eye Tracking Technology") OR ALL=(“Eye Tracking Technology”) OR ALL=(“Eye-Tracking Technologies”) OR ALL=(“Technology, Eye-Tracking”) OR ALL=(“Eyetracking Technology”) OR ALL=(“Eyetracking Technologies”) OR ALL=(“Gaze-Tracking Technology”) OR ALL=(“Gaze Tracking Technology”) OR ALL=(“Gaze-Tracking Technologies”) OR ALL=(“Eye-Tracking System”) OR ALL=(“Eye Tracking System”) OR ALL=(“Eye-Tracking Systems”) OR ALL=(“Eyetracking System”) OR ALL=(“Eyetracking Systems”) OR ALL=(“Eye Movement Data Analysis”) OR ALL=(“Gaze-Tracking”) OR ALL=(“Gaze Tracking”) OR ALL=(“Gazetracking System”) OR ALL=(“Gaze-Tracking System”) OR ALL=(“Gaze Tracking System”) OR ALL=(“Gaze-Tracking Systems”) OR ALL=(“Gazetracking Systems”) OR ALL=(“Eye-Tracking” “Eye Tracking”)
C	------
Expression end of search	(ALL=("Eye Tracking Technology") OR ALL=(“Eye Tracking Technology”) OR ALL=(“Eye-Tracking Technologies”) OR ALL=(“Technology, Eye-Tracking”) OR ALL=(“Eyetracking Technology”) OR ALL=(“Eyetracking Technologies”) OR ALL=(“Gaze-Tracking Technology”) OR ALL=(“Gaze Tracking Technology”) OR ALL=(“Gaze-Tracking Technologies”) OR ALL=(“Eye-Tracking System”) OR ALL=(“Eye Tracking System”) OR ALL=(“Eye-Tracking Systems”) OR ALL=(“Eyetracking System”) OR ALL=(“Eyetracking Systems”) OR ALL=(“Eye Movement Data Analysis”) OR ALL=(“Gaze-Tracking”) OR ALL=(“Gaze Tracking”) OR ALL=(“Gazetracking System”) OR ALL=(“Gaze-Tracking System”) OR ALL=(“Gaze Tracking System”) OR ALL=(“Gaze-Tracking Systems”) OR ALL=(“Gazetracking Systems”) OR ALL=(“Eye-Tracking” “Eye Tracking”)) AND (ALL=(“Surveys and Questionnaires”) OR ALL=(“Questionnaires and Surveys”) OR ALL=(Surveys) OR ALL=(Survey) OR ALL=(“Questionnaire Design”) OR ALL=(“Design, Questionnaire”) OR ALL=(“Designs, Questionnaire”) OR ALL=(“Questionnaire Designs”) OR ALL=(Respondent) OR ALL=(“Randomized Response Technique”) OR ALL=(“Randomized Response Techniques”) OR ALL=(“Techniques, Randomized Response”) OR ALL=(Questionnaires) OR ALL=(Questionnaire))
Number of articles	**(1.549)**
Search date	**23/01/2024**

Table 7

Search strategy in PsycINFO (APA). Adapted from Araújo (2020).

EXTRACTION - PsycINFO (APA)			
DESCRIPTION	**ACRONYM**	**TERMS**	
Population	**P**	**"Questionnaires"**	
Concept	**C**	**"Eye Movements"**	
Context	**C**	**------**	
CONVERSION AND COMBINATION			
Database	**ACRONYM**	**APA THESAURUS**	
PsycINFO (APA)	**P**	**Questionnaires**	
	C	**Eye Movements**	
	C	**------**	**------**
ACRONYM	**CONSTRUCTION AND USE**		
P	Questionnaires		
C	"Eye Movements"		
C	------		
Expression end of search	Questionnaires *AND* Any Field: "Eye Movements"		
Number of articles	(273)		
Search date	23/01/2024		

Table 8

Search strategy in Google Scholar. Adapted from Araújo (2020).

EXTRACTION - Google *Scholar*			
DESCRIPTION	**ACRONYM**	**TERMS**	
Population	**P**	"Surveys and Questionnaires"	
Concept	**C**	"Eye Tracking Technology"	
Context	**C**	------	
CONVERSION AND COMBINATION			
Database	**ACRONYM**	**DeCS**	**Palavra-chave**
Google Acadêmico	**P**	**"Inquéritos e Questionários"**	
	C	**"Movimentos Oculares"**	
	C	**------**	
ACRONYM	**CONSTRUCTION AND USE**		
Expression end of search	**("Inquéritos e Questionários" OR "questionario") AND "Movimentos Oculares")**		
Number of articles	**(46)**		
Search date	**23/01/2024**		