

**Table S1.** Main characteristics of reviewed studies

Author	Year	Title	Field	Country	Respondents	Scale	Criteria*	Factors	Methods
<b>Anacta, Schwering, Li, &amp; Muenzer</b> [145 <sup>*</sup> ]	2017	Orientation information in wayfinding instructions: evidences from human verbal and visual instructions	geography, psychology	Germany, USA	college students	route map	CF	content of the map	draw from memory
<b>Appleyard</b> [74]	1970	Styles and Methods of Structuring a City	architecture and city planner	USA	adults (non – students) <20, 20-30, >30	town	PA, CF, CCM	age, gender, level of education, socioeconomic status, familiarity of place	draw from memory
<b>Bahrck</b> [132]	1983	The Cognitive Map of a City: Fifty Years of Learning and Memory	psychology	USA	adults (non – students)	town	CF	gender, length of stay	draw from memory
<b>Bailly, MacCabe, &amp; Saarinen</b> [96]	1995	Images of francophone countries and francophone images of the world	geography	USA, Switzerland	college students	world	CF	place of residence, familiarity of place, shape of region, size of region	draw from memory
<b>Beatty &amp; Tröster</b> [75]	1987	Gender differences in geographical knowledge	unknown	USA	college students	region	CF, PA	gender, map reading, mobility, place of residence, level of education, content of media	draw from memory (experiment 5), learning from map (experiment 3)
<b>Blades</b> [7]	1990	The reliability of data collected from sketch maps	psychology	United Kingdom	college students (age 18-42)	route map	CF	age, gender, familiarity of place	draw from memory
<b>Bomfim &amp; Urrutia</b> [102]	2005	Affective dimension in cognitive maps of Barcelona and São Paulo	unknown	Brazil, Spain	college students	town	CF	familiarity of place	draw from memory

\* PA – positional accuracy  
 CF – content frequency  
 CCM – choice of cartographic methods

<b>Çanakcioğlu [113]</b>	2015	Can cognitive maps of children be analysed by space syntax?	engineering	Turkey	unknown	local	CF	gender, socioeconomic status	draw from memory
<b>Casey [121]</b>	2002	Remembering what we do, not what we view: The plasticity of everyday cognitive maps	social science	Australia	college students	route map	PA, CF	learning from environment, learning from map	learning from environment, learning from map
<b>Chiodo [126]</b>	1993	Mental Maps: Preservice Teachers' Awareness of the World	education	USA	college students	world	PA, CF	gender, level of education, cartographic projection	draw from memory
<b>Chiodo [59]</b>	1997	Improving the Cognitive Development of Students' Mental Maps of the World	education	USA	secondary school	world	PA, CF	development of sketch map	teaching
<b>Cho [150<sup>*</sup>]</b>	2010	The role of IQ in the use of cognitive strategies to learn information from a map	education	USA	secondary school	local	CF	intelligence	draw from memory
<b>Chokor [93]</b>	2003	Pattern of representation of countries in cognitive maps of the world with special reference to Africa	geography	Benin	college students	world	CF	mobility, economic maturity, size of region, shape of region	draw from memory
<b>Coluccia, Iosue, &amp; Antonella Brandimonte [131]</b>	2007	The relationship between map drawing and spatial orientation abilities: A study of gender differences	psychology	Italy	college students	local	PA, CF	gender	learning from map
<b>Denis &amp; Zimmere [114]</b>	1992	Analog properties of cognitive maps constructed from verbal descriptions	psychology	France, Germany	college students	region	PA, CF	learning from text, learning from map	learning from map, learning from text
<b>Dickmann [120]</b>	2012	City Maps Versus Map-Based Navigation Systems – An Empirical Approach to Building Mental Representations	geography	Germany	college students	route map	PA, CF	learning from navigation, learning from map	learning from navigation, learning from map

<b>Drumheller [48]</b>	1968	Conjure Up A Map— A Crucial But Much Neglected Skill	education	USA	secondary school (grade 6), college students, adults	world	PA	age, drawing skills	draw from memory
<b>Evans, Marrero, &amp; Butler [105]</b>	1981	Environmental Learning and Cognitive Mapping	social ecology	USA	college students	town	PA, CF	familiarity of place, regularity of place, frequency of landmark	draw from memory
<b>Ferguson &amp; Hegarty [115]</b>	1994	Properties of cognitive maps constructed from texts	unknown	USA	college students	town	PA, CF	learning from map, structure of text, type of text	learning from map, learning from text
<b>Gillespie [146*]</b>	2010	How Culture Constructs Our Sense of Neighborhood: Mental Maps and Children's Perceptions of Place	geography	USA	primary school	local	PA, CF	cultural differences	draw from memory
<b>Golledge &amp; Spector [110]</b>	1978	Comprehending the Urban Environment: Theory and Practice	geography	USA	adults	town	CF	socioeconomic status	draw from memory
<b>Goodehild [112]</b>	1974	Class Differences in Environmental Perception: an exploratory study	architecture and city planner	United Kingdom	adults	town	PA, CF, CCM	gender, socioeconomic status	draw from memory
<b>Gourley, Saarinen, &amp; MacCabe [106]</b>	1993	Comparison of Sketch Maps Drawn by Students from Armidale, Australia and Dunedin, New Zealand	geography	USA	college students	world	PA, CF	gender, nationality, economic maturity, place of residence, content of geographical education	draw from memory
<b>Greenberg Raanan &amp; Shoval [149<sup>†</sup>]</b>	2014	Mental maps compared to actual spatial behavior using GPS data: A new method for investigating segregation in cities	geography	Israel	college students	town	CF	cultural differences (arab, jewish)	draw from memory

<b>Grieve &amp; van Staden</b> [111]	1988	A Cross-Cultural Study of Children's Cognitive Maps	psychology	South Africa	primary school	town	CF, CCM	age, gender, race, socioeconomic status	draw from memory
<b>Gutsche</b> [147]	2014	News place-making: applying 'mental mapping' to explore the journalistic interpretive community	journalist	USA	adults	town	CF	employment (journalist, office, resident)	draw from memory
<b>Harwood &amp; Rawlings</b> [58]	2001	Assessing Young Children's Freehand Sketch Maps of the World	unknown	United Kingdom	primary school	world	PA, CF	development of sketch map	teaching
<b>Herman, Hawkins, Barron, &amp; Berryman</b> [89]	1988	World Place Location Skills of Elementary School Students	education	USA	primary school (grade 4-6)	world	CF	age, gender, intelligence, socioeconomic status, mobility	draw from memory
<b>Hussein Snaf</b> [103]	1991	College students' cognition of the Arab World map	education	Saudi Arabi	college students	region	CF	attitudes, familiarity of place	draw from memory
<b>Huynh, Doherty, &amp; Sharpe</b> [70]	2010	Gender Differences in the Sketch Map Creation Process	geography	USA, Canada	adults	local	CF	gender	draw from memory
<b>Jenkins &amp; Walmsley</b> [90]	1993	Mental maps of tourists: A study of Coffs Harbour, New South Wales	geography, art	Australia	adults	local	CF	mobility	draw from memory
<b>Karan &amp; Bladen</b> [94]	1982	Perception of the Urban Environment in a Third-World Country	unknown	USA	adults	town	PA, CF	mobility, place of residence, length of stay, level of education	draw from memory
<b>Kask &amp; Hannust</b> [95]	2013	Does a Dozen Years Change a Thing? Estonian Children's Drawings of Europe in 2000 and 2012	public law	Estonia	primary school	region	PA	mobility	draw from memory

<b>Kitchin</b> [134]	1996	Are There Sex Differences in Geographic Knowledge and Understanding?	geography	United Kingdom	college students	region	PA, CF	gender, content of geographical education	draw from memory
<b>Kong, Savage, Saarinen, &amp; Maccabe</b> [100]	1994	Mental Maps of the World: The Case of Singapore Students	geography	Singapore, USA	college students	world	PA, CF	place of residence, content of textbooks, size of region	draw from memory
<b>Lee &amp; Schmidt</b> [83]	1986	Urban Spatial Cognition: A Case Study of Guangzhou, China	regional planning, geography	USA	college students	town	CF, CCM	age, gender, place of residence	draw from memory
<b>Lloyd</b> [86]	1989	Cognitive Maps: Encoding and Decoding Information	geography	USA	college students	town	PA	learning from environment, learning from map, map reading	learning from map
<b>Long &amp; Baran</b> [151 <sup>*</sup> ]	2012	Does Intelligibility Affect Place Legibility? Understanding the Relationship Between Objective and Subjective Evaluations of the Urban Environment	architecture	China, USA	college students	town	CF	legibility of place	learning from environment
<b>Louwerse &amp; Benesh</b> [118]	2012	Representing Spatial Structure Through Maps and Language: Lord of the Rings Encodes the Spatial Structure of Middle Earth	psychology	USA	college students	region	PA	learning from text, learning from map	learning from map, learning from text
<b>MacEachren</b> [87]	1991	The role of maps in spatial knowledge acquisition	geography	USA	college students	region	PA	map reading	learning from map
<b>Madaleno</b> [98]	2010	How Do Remote Southern Hemisphere Residents Perceive the World? Mental Maps Drawn by East Timorese and Mozambican Islanders	nature science	Portugal	Primary school, secondary school	world	PA, CF	place of residence, content of textbooks, colonial past	draw from memory
<b>Matthews</b> [71]	1980	Children Represent their Environment: Mental Maps of Coventry City Centre	geography	United Kingdom	secondary school (grade 6–12, age 11–18)	town	PA, CF, CCM	age	draw from memory

<b>Matthews [8]</b>	1984	Cognitive Mapping Abilities of Young Boys and Girls	geography	United Kingdom	primary school, (grade 1–7, age 6–11)	local	PA, CF, CCM	age, gender	draw from memory
<b>Matthews [71]</b>	1984	Environmental Cognition of Young Children: Images of Journey to School and Home Area	geography	United Kingdom	primary school (grade 1–5, age 6–11)	local	PA, CF, CCM	age	draw from memory
<b>Matthews [77]</b>	1986	Gender, Graphicacy and Geography	geography	United Kingdom	primary school (grade 1 – 5)	local	PA, CCM	gender	draw from memory
<b>Meneghetti, Borella, Gyselinck, &amp; De Beni [116]</b>	2012	Age-differences in environment route learning: The role of input and recall-test modalities in young and older adults	psychology	Italy, France	adults	route map	PA, CF	age, learning from text, learning from map	learning from map, learning from text
<b>Meneghetti, Fiore, Borella, &amp; De Beni [136]</b>	2011	Learning a map of environment: The role of visuo-spatial abilities in young and older adults	psychology	Italy	adults (age 20-30 and 60-72)	town	CF	age, mental rotation, spatial perception, spatial visualization	learning from map
<b>Meneghetti, Muffato, Varotto, &amp; De Beni [128]</b>	2017	How directions of route descriptions influence orientation specificity: the contribution of spatial abilities	psychology	Italy	college students	route map	PA	mental rotation, spatial perception, orientation of map	learning from map, learning from listening
<b>Meneghetti, Pazzaglia, &amp; De Beni [137]</b>	2015	Mental representations derived from spatial descriptions: the influence of orientation specificity and visuospatial abilities	psychology	Italy	college students	local	CF	mental rotation, spatial perception, spatial visualization, orientation of map	learning from listening
<b>Meneghetti et al. [45]</b>	2016	Mental representations derived from navigation: The role of visuo-spatial abilities and working memory	psychology	Italy, Spain	college students (women)	town	CF	mental rotation, spatial perception, spatial visualization	learning from navigation
<b>Metz [49]</b>	1990	Sketch Maps: Helping Students Get the Big Picture	unknown	USA	college students	world	PA, CF	content of school atlases, teaching style	learning from map, teaching

<b>Mondschein, Blumenberg, &amp; Taylor</b> [125]	2010	Accessibility and Cognition: The Effect of Transport Mode on Spatial Knowledge	urban planning	USA	adults	route map	PA, CF	age, gender, race, level of education, familiarity of place, mode of transport	draw from memory
<b>Montello, Lovelace, Golledge, &amp; Self</b> [76]	1999	Sex-Related Differences and Similarities in Geographic and Environmental Spatial Abilities	psychology, geography, anthropology	USA	adults	route map, world	PA, CF	gender, map reading	learning from environment, learning from map
<b>Muffato, Meneghetti, Di Ruocco, &amp; De Beni</b> [84]	2017	When young and older adults learn a map: The influence of individual visuo-spatial factors	psychology	Italy	adults	local	PA, CF	age, mental rotation, spatial perception, spatial visualization, map reading	learning from map
<b>Murray &amp; Spencer</b> [92]	1979	Individual Differences in the Drawing of Cognitive Maps: The Effects of Geographical Mobility, Strength of Mental Imagery and Basic Graphic Ability	psychology	United Kingdom	college students, adults	route map, town, region, world	CF, CCM	drawing skills, mobility	draw from memory
<b>Nieścioruk</b> [140]	2016	The Use of Mental and Sketch Maps as a Tool to Evaluate Cartography Teaching Effectiveness	geography	Poland	college students	local	CF, CCM	gender, content of geographical education	teaching
<b>Okabayashi &amp; Glynn</b> [88]	1984	Spatial Cognition: Systematic Distortions in Cognitive Maps	psychology	USA	college students	world	PA	map reading, orientation of map, segmentation boundary	learning from map
<b>Pearce</b> [135]	1977	Mental Souvenirs: A Study of Tourists and their City Maps	psychology	United Kingdom	adults	town	PA, CF	gender, length of stay, place of residence	draw from memory
<b>Pearson &amp; Ialongo</b> [129]	1986	The relationship between spatial ability and environmental knowledge	psychology	USA	college students	route map	PA	mental rotation, spatial perception, spatial visualization	learning from map
<b>Pinheiro</b> [148]	1998	Determinants of Cognitive Maps of the World as Expressed in Sketch Maps	psychology	Brazil	college students	world	CF	place of residence, content of media, size of region, economic maturity	draw from memory

<b>Pocock [41]</b>	1976	Some Characteristics of Mental Maps: An Empirical Study	geography	United Kingdom	adults	town	CF, CCM	age, gender, length of stay, socioeconomic status, familiarity of place	draw from memory
<b>Potter [82]</b>	1985	The Development of Spatial Cognitive Maps among Barbadian Children	geography	United Kingdom	secondary school (age 13-16)	region	CF, CCM	age	draw from memory
<b>Quaiser-Pohl, Lehmann, &amp; Eid [138]</b>	2004	The relationship between spatial abilities and representations of large-scale space in children—a structural equation modeling analysis	psychology	Germany	primary school	local	CF	mental rotation, spatial perception	draw from memory
<b>Ramadier &amp; Bronner [130]</b>	2006	Knowledge of the Environment and Spatial Cognition: JRS as a Technique for Improving Comparisons between Social Groups	unknown	France	college students	town	CF	level of education	draw from memory
<b>Ramadier &amp; Moser [107]</b>	1998	Social Legibility, The Cognitive Map and Urban Behaviour	psychology	France	secondary school, college students	town	PA, CF	nationality, activities in space	draw from memory
<b>Reynolds &amp; Vinterek [123]</b>	2016	Geographical locational knowledge as an indicator of children's views of the world: research from Sweden and Australia	education	Australia, Sweden	primary school	world	CF	age, place of residence, colonial past, content of geographical education	draw from memory
<b>Rittschof, Stock, Kulhavy, Verdi, &amp; Doran [104]</b>	1994	Thematic Maps Improve Memory for Facts and Inferences: A Test of the Stimulus Order Hypothesis	unknown	USA	college students	region	PA	learning from text, learning from map	learning from map, learning from text
<b>Rittschof, Stock, Kulhavy, Verdi, &amp; Johnson [119]</b>	1996	Learning from Cartograms: The Effects of Region Familiarity	education, psychology	USA	college students	region	PA, CF	familiarity of place, cartographic method	learning from map
<b>Saarinen [42]</b>	1988	Centering of mental maps of the world	geography	USA	college students	world	PA	place of residence, content of textbooks	draw from memory



<b>Saarinen &amp; MacCabe</b> [73]	1995	World Patterns of Geographic Literacy Based on Sketch Map Quality	geography	USA	college students	world	CF	nationality	draw from memory
<b>Saarinen, Parton, &amp; Billberg</b> [99]	1996	Relative Size of Continents on World Sketch Maps	geography	USA	college students	world	PA	place of residence, content of textbooks, cartographic projection	draw from memory
<b>Sanders &amp; Porter</b> [62]	1974	Shape in Revealed Mental Maps	geography	USA	college students	region	PA	place of residence	draw from memory
<b>Seibert &amp; Anooshian</b> [142]	1993	Indirect Expression of Preference in Sketch Maps	psychology	USA	primary school, secondary school, college students, adults	local	CF	emotion	draw from memory
<b>Schmeinck &amp; Thurston</b> [91]	2007	The influence of travel experiences and exposure to cartographic media on the ability of ten-year-old children to draw cognitive maps of the world	education	Germany, United Kingdom	primary school	world	CF	gender, experience with mapping, mobility	draw from memory
<b>Shin</b> [124]	2006	Using Geographic Information System (GIS) to Improve Fourth Graders' Geographic Content Knowledge and Map Skills	education	USA	students (not specified)	town, region	CF	familiarity of place, content of geographical education	learning from GIS
<b>Singh</b> [108]	1982	Image of Varanasi City: Reflections on Geography of Tourism	geography	India	adults	town	PA, CF	nationality	draw from memory
<b>Spencer &amp; Weetman</b> [72]	1981	The microgenesis of cognitive maps: a longitudinal study of new residents of an urban area	psychology	United Kingdom	college students	town	CF, CCM	gender	draw from memory
<b>Stock, Peterson, Hancock, &amp; Verdi</b> [117]	1995	Mental Representations of Maps and Verbal Descriptions: Evidence They May Affect Text Memory Differently	unknown	USA	college students	region	PA, CF	learning from text, learning from map	learning from map, learning from text

<b>Thomas &amp; Willinsky</b> [101]	1999	Grounds for Imagining a Pacific Community: Mapping Across Boundaries and Great Divides	education	Canada	secondary school	world	PA, CF	nationality, content of geographical education	draw from memory
<b>Thommen, Avelar, Sapin, Perrenoud, &amp; Malatesta</b> [109]	2010	Mapping the journey from home to school: a study on children's representation of space	education	Switzerland	primary school	route map	CF, CCM	age, gender, nationality, level of education	draw from memory
<b>Torrens</b> [85]	2001	Where in the world? Exploring the factors driving place location knowledge among secondary level students in Dublin, Ireland	geography	Ireland	secondary school	region, world	PA, CF	age, gender, mobility, place of residence, level of education, socioeconomic status, content of media	draw from memory
<b>Tversky</b> [122]	1981	Distortions in memory for maps	psychology	United Kingdom	adults	town	PA	learning from environment, learning from map	learning from map
<b>Walmsley, Saarinen, &amp; MacCabe</b> [66]	1990	Down under or centre stage? The world images of Australian students	geography	Australia, USA	college students	world	PA, CF	place of residence, content of media, content of school atlases, migration, economic maturity, content of geographical education	draw from memory
<b>Webley</b> [133]	1981	Sex differences in home range and cognitive maps in eight-year old children	psychology	United Kingdom	primary school	town	CF	gender, intelligence	learning from environment
<b>Whittaker J. O. &amp; Whittaker S. J.</b> [68]	1972	A Cross-Cultural Study of Geocentrism	unknown	USA	college students	world	PA	place of residence, cartography projection, content of geographical education	draw from memory
<b>Wiegand</b> [9]	1995	Young children's freehand sketch maps of the world	education	United Kingdom	kindergarten, primary school	world	PA, CF	age, economic maturity, shape of region	draw from memory

<b>Wiegand [11]</b>	1998	Children's Free Recall Sketch Maps of the World on a Spherical Surface	education	United Kingdom	primary school	world	PA, CF	age, gender, segmentation boundary	draw from memory
<b>Wiegand &amp; Stiell [127]</b>	1997	Mapping the Place Knowledge of Teachers in Training	education	United Kingdom	college students	region	PA	gender, place of residence, level of education, segmentation boundary, scale	draw from memory
<b>Wiegand &amp; Stiell [97]</b>	1997	The Development of Children's Sketch Maps of the British Isles	education	United Kingdom	primary school, secondary school	region	PA	age, gender, place of residence, cartographic method	draw from memory
<b>Wise &amp; Kon [69]</b>	1990	Assessing Geographic Knowledge with Sketch Maps	unknown	USA	primary school	world	PA, CF	cartographic projection, development of the sketch map	teaching