When spatial agency bias and the advantage of the first mention are in contradiction: Evidence from Czech, German, and Spanish

Anna Marklová and Renate Delucchi Danhier
Humboldt University, Berlin, Germany
Technical University Dortmund, Germany

Abstract

Evidence from Art (History), perceptual psychology, and (psycho-)linguistics support the claim that in Western culture (or rather within left-to-right writing languages), people depict or visualize more important or salient figures to the left. However, linguistics studies investigating this topic almost exclusively use active sentences with standard Subject-Verb-Object (SVO) syntax as stimuli, where the subject takes the role of an agent. However natural language exhibits much more syntactical variation. To determine if this pattern is also present when the less common syntax is used, we asked native German, Spanish, and Czech speakers (N=300) to draw situations representing ten sentences varying in syntactic structure. These drawings, simplified versions of the mental representation of the situation, provide a glimpse into the conceptualization of the scenes. The spatial placement of the agent figures in the sentences was coded. Results show that although the asymmetrical effect is strong in prototypical SVO sentences, where the subject has the function of an agent and the object a function of a patient, the effect is weaker or disappears in passive sentences, where the subject at the first position is a patient and object on the second position is an agent, as well as in topicalized (OVS) sentences. Furthermore, we found cross-linguistic differences, which suggests that the character of the bias is language-specific. We postulate that placing the agent to the left is only one of the factors influencing spatial placement. The other factor playing an important role is the naming order.

Keywords: mental representation; reading-writing direction; spatial agency bias; advantage of first mention; crosslinguistic comparison

1. Introduction

Contrary to what may be assumed, when visually constructing a scene (i.e., drawing a picture), the placement of the figures is not arbitrary. Art historians, psychologists, and linguists have investigated the factors affecting decisions regarding the composition of a scene for at least half a century. In this paper, we show that, especially from a linguistic point of view, these factors are yet to be sufficiently understood. The good enough approach to language comprehension

(Ferreira et al. 2002) assumes that a listener does not translate linguistic input into a detailed representation. Instead, the comprehension system creates a suitable and sufficient representation for the listener's current purposes. While this approach was empirically tested mainly on the processing of ambiguous sentences (e.g., Frazier et al. 1999; Pickering and Frisson 2001), we can also apply the basic idea to the visual representation of scenes described by another speaker. It is not probable that a listener imagines many possible spatial constellations and features of objects while listening to a sentence such as, e.g., 'The lamp is on the table between the book and the computer.' A quick suitable understanding and representation of the described utterance would suffice for satisfying the current communicative requirements of the listener. Similarly, Gigerenzer and Todd (1999) argue that because of time and resource limitations during decision-making, the cognitive system works better by making fast, heuristic decisions that do not consider every single interpretation of all the available information. Models of decision-making, which assume that all possible interpretations of a given information are activated simultaneously (e.g., MacDonald, Pearlmutter, and Seidenberg 1994; Stevenson 1994), have been developed, but the weakness of these models is the assumption of 'unbounded rationality' (Ferreira and Patson 2007). It does not seem probable that a human being can run all the possible representations in a short time.

Moreover, there is evidence showing that different listeners tend to choose a particular representation over others consistently. In the example mentioned above, 'The lamp is on the table between the book and the computer,' there is a tendency to imagine this scene with the objects ordered from left to right as book-lamp-computer rather than computer-lamp-book. However, both compositions represent the sentence equally accurately (Jahn et al. 2007; see Section 2 of this paper).

Previous studies recognized two linguistic phenomena contributing to the decision-making process of listeners for spatially determining the placement of objects in (imagined or real) space. These phenomena are both connected to the fundamental influence of the reading-writing direction. They can be found in left-to-right writing cultures and right-to-left writing cultures but with mirrored effects. The first phenomenon is the so-called spatial agency bias. It refers to the tendency to place more agentic subjects on the left side of pictures (in left-to-right writing cultures) (Maass et al. 2009). The second phenomenon describes the tendency to place the entity mentioned first in the first position in the visual image, according to our reading-writing direction. As defined by Jahn et al. (2007: 2076), this bias "reflects a cultural tendency to scan in the same direction as reading and writing." This second phenomenon does not have a conventional term. Jahn et al. (2007) call it left-to-right preference. We consider this term problematic since this term carries a West-centric connotation, yet the same bias is also found in right-to-left writing cultures. We will instead follow the terminology of Gernsbacher and Hargreaves (1988), who described a phenomenon in comprehension where speakers tend to remember the first-mentioned referent in a sentence better and recall them quicker than the second-mentioned referent. They call this phenomenon *the advantage of first mention*. In this case, the advantage means the faster access of the participants mentioned first in the sentence. We apply this term also at the situation at hand, i.e., on the tendency to place the first mentioned figure in the first position in the picture, ordered according to reading-writing direction.

Both phenomena have been supported by evidence from different fields. However, there is little evidence that could help us to understand what happens when they interact. Consider the following sentence:

(1)   A dog is chasing a cat.

In this sentence, the dog is the agent; thus, according to spatial agency bias, speakers from left-to-right writing cultures should tend to place it to the left position in a picture and speakers from right-to-left writing cultures to the right position. The dog is also mentioned first; thus, according to the advantage of first mention, left-to-right writing cultures should prefer to position it on the left side of the picture and right-to-left writing cultures on the right side. The two phenomena would have the same outcome: the dog is set to the picture's left side (relative to the position of the other named entity). Now consider the following sentence:

(2)   A cat is chased by a dog.

In this second example, the dog is still the agent. The effect of spatial agency bias should be the same as in (1). One would expect listeners from left-to-right writing cultures to place the dog on the left side of the pictures and listeners from right-to-left writing cultures to place it on the right side. However, the dog is not mentioned first – the cat is. Thus, according to advantage of first mention, we expect the cat to be placed on the left side of the picture in left-to-right writing cultures and on the right side in RWL cultures. In this case, the two phenomena would lead to different outcomes.

Since the previous studies have focused on one of the two phenomena separately but not combined, an understanding of their interaction is lacking. In the present paper, we address this question. We are interested in if these phenomena are universal or language specific. We assume that syntax plays an important role when it comes to spatial agency bias. Previous studies have concentrated on the existence of spatial agency bias but not on its salience. We argue that the salience of spatial agency bias might differ across languages. The reason for this assumption is the syntactic variation of languages. Languages differ in the restrictions for syntactic ordering of the semantic roles in sentences; therefore, they differ in how conventional it is to syntactically place the agent in the first position in the sentence. We expect that the spatial agency bias will have a different salience across languages. Previous studies have focused solely on the existence of spatial agency bias without considering the salience of the syntactic placement of the agent and the patience in different languages. We argue that due to these differences in word order restrictions among languages, the expectation of the agent being in the first position of the sentence also varies. Therefore, we expect to observe these differences when comparing various languages.

In an experimental study, we analyzed 3000 drawings (3 languages x 100 subjects x 10 sentences) representing sentences varying in the order of the agent and patient (agent mentioned before patient, patient mentioned before agent), investigating the spatial placement of the agent. Native speakers of three languages (Czech, German, and Spanish) were asked to draw the situations described in the sentences. We measured the placement of the agent in cases

where spatial agency bias and advantage of first mention agree and when they disagree and compared if the asymmetry of its placement differs cross-linguistically.

2. State of the art: Spatial placement of figures in pictures

Researchers in different areas of science, including art, art history, perceptual psychology, cognitive science, and psycholinguistics have investigated figures' spatial placement. Each field has its research tradition, and the particular explanations within each research area for the tendencies for spatial arrangement are sometimes in contradiction.

Langacker (1990) postulated that the agent surpasses the patient cognitively (and non-linguistically). The evidence for asymmetry in the perception of agent and patient was also observed in psychological research (e.g., Hafri et al. 2013; Hafri et al. 2018). Robertson and Suci (1980) reported a preference for agent over patient in children's attention to short video clips with events. The preference for agents by infants and children was found in perception (Galazka and Nyström 2016; Golinkoff 1975, 1981; Golinkoff and Kerr 1978), as well as in comprehension (Braine and Wells 1978; Corrigan and Odya-Weis 1985). Studies in art history have observed that there are some tendencies in how to construct a visual scene and how to place figures and objects in a scene. This was firstly explained by universal habits in aesthetical preference (e.g., Bisiach et al. 1990; Gaffron 1950; Gordon 1981; Jewell and McCourt 2000). However, the evidence has shown that asymmetry is not the same throughout different cultures. Chokron and De Agostini (2000) compared the preferences of French and Israeli subjects and discovered that the former group preferred rightward directionality in pictures while the latter preferred leftward directionality. Since French subjects were left-to-right readers and Israeli subjects were right-to-left readers, the different preference among these groups was explained by reading habits. Other studies (e.g., Beaumont 1985; Heath et al. 2005; Ishii et al. 2011; Levy 1976; Nachson et al. 1999) also argue for the influence of reading-writing direction on aesthetic judgments and even on the artist's choice of composition (e.g., González 2012).

Maass et al. (2009) investigated the composition of pictures according to the spatial agency bias — the tendency to place more agentic subjects to the left side of images (in left-to-right writing cultures). They observed that groups stereotypically perceived as more agentic (e.g., males compared to females, young compared to an elderly group) are positioned on the left side in left-to-right reading-writing direction cultures (and on the right side in right-to-left writing cultures, respectively). Moreover, in a drawing task, this tendency was enhanced when the more agentic group was mentioned first, but it disappeared when it was mentioned second. In this context, the agency is defined as either having control over their own behavior, being able to affect other entities, or being responsible for a given outcome (Duranti 2005). An eye-tracking study by Gerwien and Flecken (2016) revealed differences in the visual fixation of agents between Spanish and German speakers. In an experiment where they presented an agent performing a single simple event in a short video clip, German participants (n=20) fixated on the agent more than Spanish participants (n=20). Moreover, they report on Spanish speakers mentioning agents less than German speakers, probably due to the pro-drop quality of Spanish.

The advantage of the first mention has been observed both in spoken and written discourse (Gernsbacher and Hargreaves 1988; Gernsbacher et al. 1989; Von Eckardt and Potter 1985).

Using memory tasks and priming tasks, it was established that readers and listeners have easier access to the first mentioned participant in a sentence compared to the one mentioned second. Sauppe and Flecken (2021) observed that a sentence structure immediately affects the visual attention of Dutch participants (n=40) in their eye-tracking experiment. The participants were presented with a sentence either in passive or active voice, and then a presentation of a video clip depicting a simple agent-patient event followed. When the sentence was active, the first participants´ fixation was on the agent more than on the patient, and vice versa. Gernsbacher and Hargreaves (1988) demonstrated this effect in comprehension studies on English. They concluded that the advantage of the first mention is based on general cognitive processes, and it is not language-specific. However, their research employed only speakers of English, a language with a high importance on word order for encoding semantic and syntactic roles.

Finally, Jahn et al. (2007) examined the advantage of first mention in a language comprehension study. Participants (n=27, English speakers) were asked to evaluate the consistency of spatial descriptions (e.g., 'A table is between the TV and a chair. The light is on the left of the TV. The table is next to the light.') The analysis uncovered that the construction of the scene was influenced by the reading-writing direction – English participants, who belong to a left-to-right writing culture, constructed a mental model of the scene following the order of mention. It was difficult for them to rebuild this model when the additional information provided by the last sentence of the stimulus was inconsistent with their original representation. In a follow-up experiment, another group of participants (n=34, English speakers) had to arrange three objects according to sentences such as "The pen is between the candle and the stapler." Most (n=24) of them put the objects in the order candle-pen-stapler, i.e., according to the word order, in compliance with the advantage of first mention.

Since our experiment prompts participants to draw, we have to mention another influence connected to spatial placement: handedness. This factor was found to play a role in drawing individual objects such as a line or geometrical shapes. It was also observed that right-handedness from left-to-right writing cultures correlates with a strong tendency to draw a face profile or animals from a profile facing to the left. This tendency is weakened or disappears when the drawer is left-handed (Dreman 1974; Shanon 1979). However, a systematic influence on the placement of figures in a visual scene or the composition of a complex scene has not been observed.

3. The current study

In our study, we explore the influence of spatial agency bias and the advantage of first mention on German, Spanish, and Czech. The chosen languages share the left-to-right writing direction, a prototypical subject-verb-object (SVO) structure (to a certain extent, more below), and they are Indo-European languages embedded in the Western tradition. We have chosen these languages because we wanted to look at the influences of reading-writing-direction with a magnifying glass. There is evidence for the existence of the spatial agency bias and the advantage of the first mention. However, if we want to start researching the interaction between both spatial biases, the first logical step for us is to explore typologically similar languages. While the basic SVO structure is preferred in all three languages, the commonness of this structure differs, and the rules for word order differ as well. Suppose these three languages differ in the strength

of the influence of spatial agency bias, although the writing direction of all the languages is left-to-right. In that case, we can assume that the reason for it is based on the differences in the prototypicality of the agent being placed syntactically in the first position in the sentences.

In this section, we will describe the rules of word order for all three languages in detail. In order to do that, we first need to define the concept of semantic roles. In a prototypical action involving two interacting physical entities, the one who acts or initiates physical contact with the other is called the agent. In contrast, the other undergoes the action of the verb and is called the patient (Langacker 1990). Palmer (1994) has described these semantic roles across languages for most two-argument syntactic structures. We will follow Palmer's concept of semantic roles in this study. Languages use different morphosyntactic means to signal the semantic roles of agent and patient, where word order and inflectional morphology (case marking and verb agreement forms) are the most common means used (Chan et al. 2009). Languages have different levels of freedom for ordering syntactic constituents in a sentence (Tomlin 1986). In the next section, we will describe the specifics of Czech, German, and Spanish regarding the agent-patient position within a sentence in detail. We concentrate on phrases with nominalized semantic roles. Some changes to the expected word orders can occur when some semantic roles are verbalized using pronouns instead of nouns. For example, in German, there is a tendency to place pronouns before nouns in the middle field. Czech, being a pro-drop language, can omit a subject altogether. When a pronoun expresses the object, it often chooses clitics (the short form of the pronoun), which is fixed on the second position in the sentence. Spanish is also a pro-drop language, so it can also leave subject pronouns implicit.

3.1. Czech word order

Modern Czech is a language with subject-verb-object (SVO) as the dominant word order (Dryer 2013). It is a so-called non-configurational language with relatively free word order, where the grammatical roles are expressed by flexion. It means that the word order is also driven by other factors which interact with the primary word order, namely informational structure, grammatical factors, rhythmical factors, and style (Daneš et al. 1987).

The informational structure is the main factor determining the word order of Czech sentences. A sentence can be separated into a part with lower informative importance because of the information already known in the discourse (thema/topic) and a second with higher informative importance because it contains new information (rhema/focus). Since there is a tendency to place thema before rhema syntactically, the informative importance typically develops from left to right[1]. An agent is not guaranteed to be in the first position in the sentence or to be expressed before the patient since the principles of informational structure often lead to a different organization. Consider (3), an example of an active sentence with object=patient expressed before subject=agent (from Křen et al. 2020).

(3) *Řidička   osobního vozu   vjela   z   dosud   neznámých*
     driver   passenger vehicle drove   from   yet   unknown

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[1] For more information and different concepts of the informational structure of Czech see Mathesius (1947), Sgall et al. (1980), Panevová et al. (2014).

příčin	*do*	*protisměru,*	*nakonec*	*skončila*	*mimo*	*silnici,*
reasons	into	opposite line	ultimately	ended	outside	road,

kde	*narazila*	*do*	*betonového*	*mostu.*	*Ženu*		*museli*
where	crashed	into	concrete	bridge.	Woman-ACC		must

hasiči		*z*	*auta*	*vystříhat.*
firefighters-NOM		from	car	cut out.

'A driver of a passenger vehicle entered the opposite lane for unknown reasons, ultimately ending up off the road where she crashed into a concrete bridge. Firefighters had to cut the woman out of the car.'

In summary, Czech is a language that offers high flexibility in word order, and the grammatical roles are expressed by flexion. The agent does not have a guarantee to be in the first position in the sentence or to be expressed before the patient since the principles of informational structure often lead to a different organization.

3.2. German word order

German is a language with flexible word order since the semantic roles of the phrases are marked by the grammatical case of the articles (and determiners or pronouns) and not by word order. In main transitive clauses without an auxiliary, the finite verb must be placed in the second position. But both SVO and OVS are quite common. In subordinate clauses and clauses containing an auxiliary verb, the SOV order is used. In the main clause, the finite verb in the second position and the infinite parts of the predicate at the end of the sentence form a verb parenthesis. Only one constituent (usually the topic) can be placed before the finite verb, mainly the subject or adverbial phrases. The center field inside the verb parenthesis can be either empty or contain many phrases. Especially at the left and right edges of the central field, the order of the phrases is relatively fixed, but the rest can be placed freely with some general principles guiding the ordering: Subject before object; thema before rhema; known before unknown; alive before non-alive; start before the end; short phrases before longer phrases (Eisenberg 1999).

The neutral word order SVO used together with a middle field that complies with these general principles is compatible with most contexts (4). while deviating from it makes the word order marked, signaling that a particular part of a sentence is being highlighted (5) (Fandrych 2005):

(4)	*Die*	*Mutter*		*gab*	*dem*	*Kind*		*einen*	*Kuss.*
	The	mother-NOM		gave	the	child-DAT		a	kiss.

'The mother gave a kiss to the child.'

(5)	*Dem*	*Kind*		*gab*	*die*	*Mutter*		*einen*	*Kuss.*
	The	child-DAT		gave	the	mother-NOM		a	kiss.

'The mother gave a kiss to the child.'

Summarizing, word order as a cue for agent-patient relations is not very reliable in German because the subject/agent or the object/patient is not strictly tied to a particular position in the sentence. In German, the most important constraint is for the verb to be in the second position in main clauses without auxiliaries. Still, it can be considered a language with canonical SVO

word order with additional variable word order for pragmatic functions and grammatical reasons (Chan et al. 2009).

3.3. *Spanish word order*

Although Spanish has a relatively free word order (Contreras 1976; Kail 1989), it is usually considered an (S)VO-Language since this is the most common, unmarked word order (Dryer 2013). The parenthesis reflects that the pronominal subject in Spanish is frequently omitted because the verb's conjugation already expresses the subject's person and number. The flexible word order is used as a syntactic tool for communicating pragmatic and contextual information while keeping the same propositional content (Carreiras et al. 1995). Information presented at the beginning of the sentence (thema) is already known from context. In contrast, the information towards the end (rhema) has more informative value and is new for the listener. Depending on the communicative purpose, the speaker may mark a particular piece of information as more thematic by moving this element to the head of the sentence, while moving it to the end makes them more rhematic, as shown in examples (6) and (7). The inversion of semantic roles is also possible when a direct and indirect object exists. If the whole sentence is new information — marked by both agent and patient having an indefinite article — the unmarked SVO word order is preferred.

(6)   *Juan   compra flores   a su madre.*
      John-NOM buys   flowers-ACC for his mother.
      'John buys flowers for his mother.'

(7)   *Flores   compra Juan   para su   madre.*
      Flowers-ACC buys   John-NOM for   his mother.
      'John buys flowers for his mother.'

Articles also play a role in determining word order: Indefinite subjects tend to go after the verb (especially in the case of intransitive unaccusative verbs where the subject has no agency).

(8)   *Crecen flores   en el   campo.*
      Grow   flowers-NOM on the field.
      'Flowers grow on the field.'

Passive sentences are not very common in Spanish (especially not in spoken communication). To present the object as topical, it is more usual to put the object at the head of an active sentence and repeat the object as a pronoun in what is usually called a topicalized sentence or cleft sentence.

(9)   *Era con su jefe con quien quería hablar.*
      'It was with his boss with whom (he) wanted to speak with.'

In conclusion, although Spanish is commonly categorized as an (S)VO language, several other factors contribute to its word order. The flexible word order in Spanish functions as a syntactic tool for conveying contextual and pragmatic information while preserving the propositional

content of the sentence. Additionally, the placement of elements within a sentence can indicate whether they are more thematic or rhematic. Therefore, identifying the agent solely based on the word order in a sentence is unreliable, as the agentive role is not strictly linked to the initial position in Spanish syntax.

3.4. Hypotheses

Following the known effects of the advantage of first mention and spatial agency bias, we postulate the following predictions for the spatial organization of scenes by German, Spanish, and Czech speakers. All languages have left-to-right writing system; therefore, we expect:

1. HA1: In agent-patient sentences, both spatial biases agree, so the agent, which is also the first mentioned, will be placed to the left of the patient.
2. HA2: In patient-agent sentences, the influence of the spatial agency bias competes with the advantage of first mention. We hypothesize that this competition will diminish the strength of the spatial agency bias, resulting in a reduced tendency to place the agent prominently on the left side compared to the agent-patient order.

While HA1 replicates previous findings, HA2 creates a new paradigm by connecting the research done on spatial agency bias with research done on advantage of first mention.

A secondary research question was formulated: Will different languages show different salience of the spatial agency bias in the patient-agent condition? While the previous hypotheses target tendencies in the two conditions in all three languages altogether, this secondary question aims to take a closer look at each language separately.

The prevalence of patient-agent word order in each language can impact the intensity of the spatial agency bias observed in that specific language. For example, Spanish and Czech have a more flexible word order than German. The main organizing principle in Czech is informational structure, which causes patient-agent construction to be very common and is not perceived as marked. Since SVO is the prevalent word order in all three languages, the first condition (agent-patient) should bring comparable results across languages, but we expect differences in the second condition. Thus, we formulated the additional hypotheses:

3. HB1 There will be cross-linguistic differences in the salience of spatial agency bias in the patient-agent condition.
4. HB2 There will be no cross-linguistic differences in the salience of spatial agency bias in the agent-patient condition.

4. Methods

4.1. Participants

We recruited speakers of three languages with a left-to-right writing direction to participate in the study: German, Spanish, and Czech. In each language group, one hundred persons

participated. The recruitment took place in December 2018, January 2019, and March 2019. The German participants were recruited in and around Dortmund (Germany), and Spanish-speaking participants were recruited in Santiago and Concepción (Chile), as well as Lima (Peru) and Barcelona (Spain). The Czech participants were recruited in Praha, Děčín, and Starý Kolín (Czech Republic). There was no financial reward for participation in the study. The participants were recruited from the general population. Table 1 gives an overview of the biographical data of the participants.

Table 1: *Participants in the study*

	N	age (average / median)	left-handed	women
Czech native speakers	100	34.42 / 32.5	12	61
German native speakers	100	30.76 / 24	7	69
Spanish native speakers	100	35.21 / 33	7	58

4.2. Materials

The set of stimuli contained ten sentences. We did not choose a higher number since the drawing task was demanding for participants, and their motivation to draw the scenes dropped quickly. There were three kinds of sentences:

1. Agent-patient syntactic structure (3 items): active sentences with the agent mentioned first, and the patient mentioned second (in this condition, the spatial agency bias and advantage of first mention agree).
2. Patient-agent syntactic structure (3 items): one passive and two topicalized sentences with the patient mentioned first, and the agent mentioned second (in this condition, the spatial agency bias and advantage of first mention disagree).
3. Filler sentences (4 items): sentences with no agent-patient spatial relationship (or vertical spatial relationship).

All sentences are presented in Table 2. The materials are available by requesting the authors. We presented the sentences in a fixed order, with fillers distributed evenly between the critical items.

Table 2: *Experimental items with English translation*

	Czech	German	Spanish	English translation
agent-patient	*Princ mává princezně.*	*Der Prinz winkt der Prinzessin.*	*El principe saluda a la princesa.*	'A prince is waving to a princess.'
	Chobotnice postrkuje rybu.	*Der Krake schiebt den Fish.*	*El pulpo empuja al pez.*	'An octopus pushes a fish.'
	Dívka fotografuje chlapce.	*Ein Mädchen fotografiert einen Jungen.*	*Una niña le saca una foto a un niño.*	'A girl is taking a picture of a boy.'

patient-agent	*Farmář je pronásledován vlkem.*	*Ein Bauer wird vom Wolf gejagt.*	*Un campecino es perseguido por un lobo.*	'A farmer is chased by a wolf.'
	Doktorovi pomohl policista.	*Dem Artz hilft der Polizist.*	*Al policía le ayuda un médico.[2]*	'A policeman helped a doctor.'
	Vnukovi dává jeho dědeček dárek.	*Seinem Enkel gibt der Opa ein Geschenk.*	*A su nieto le da un regalo el abuelo.*	'A grandfather is giving a present to his grandson.'
filler	*Slon stojí pod stromem.*	*Ein Elephant steht unter einem Baum.*	*Un elefante está parado bajo un árbol.*	'An elephant is standing under the tree.'
	Pták vletěl do hnízda.	*Der Vogel flog ins Nest.*	*El pájaro voló al nido.*	'A bird flew into the nest.'
	Kočka sedí na střeše	*Eine Katze sitzt auf dem Dach.*	*Un gato está sentado en el tejado.*	'A cat is sitting on the roof.'
	V zahradě je květina.	*Im Garten gibt es eine Blume.*	*En el jardín hay una flor.*	'There is a flower in the garden.'

4.3. Procedure

The data collection was conducted either in a group setting (among students or coworkers) or individually. The experimenters did not intervene at any point during the competition of the task. The participants were asked to sketch drawings representing the sentences. The sentences were presented in written form, arranged on a piece of paper where each sentence was written above a square space for drawing. The reason for choosing the written modality was to maximize the potential influence of the reading-writing direction since reading implies directly looking at the writing direction. It was emphasized that artistic ability is not a concern and that simple sketches suffice. All participants were presented with the sentences in the same order, and the task was self-paced so that participants were not under time pressure. The task took approximately 10 to 15 minutes. After the experimental items, participants noted the date and location of the experiment's conduction, as well as their gender, handedness, and age.

4.4. Coding

The participant's choice of spatial placement of the agent was analyzed, taking advantage of the fact that most adults are unable to draw in perspective and therefore tend to draw the figures corresponding to the agent and the patient next to each other in two-dimensional space. For this analysis, we coded if the agent was placed to the left or right of the patient. Drawings in which no lateralization (left-right relationship) could be discerned (agent placed at other positions with respect to the agent e.g. up-down, or front-back) were coded as "other," while cases where the drawing was missing or could not be understood were coded as "NA" (not available). Figure 1 gives examples of drawings coded as left, right, and other for an agent-patient-sentence in all three languages.

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[2]   An error occurred during the translation of this sentence into Spanish. The structure is patient-verb-agent, but the patient is, in this case, the policeman, and the agent is the doctor. We have decided to keep the sentences since, in the screening beforehand, we did not find any preferences for one of the roles being perceived as more agentive.
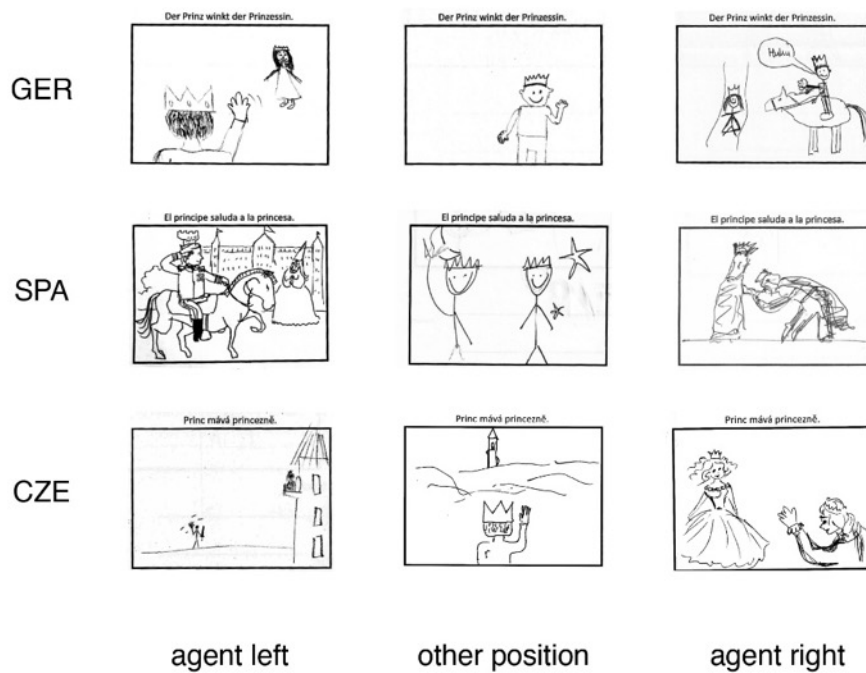
Figure 1: Examples for the coding of drawings. The examples in the middle show drawings that could not be coded. In the German example, only the agent is shown; in the Spanish drawing, the figures cannot be identified, and in the Czech case, the drawing is done with such a perspective that the agent is neither left nor right with regard to the patient.

4.5. Results

The results of the spatial placement of the agent in the drawings are presented in Tables 3 and 4.

Table 3: Spatial placement of the agent, drawings of sentences with agent-patient word order.

Agent-Patient	left	right	other	NA
German	241	52	6	1
Spanish	258	28	12	2
Czech	217	68	12	3

Table 4: Spatial placement of the agent, drawings of sentences with patient-agent word order.

Patient-Agent	left	right	other	NA
German	145	146	5	4
Spanish	152	135	5	8
Czech	124	158	16	2

We fitted a logistic mixed model (estimated using Laplace Approximation) on the data set t predict the spatial placement (left or right) in the drawings. The model was run using the package lme4 in R (Bates et al. 2015).

The model's total explanatory power is substantial (BIC 2648.0). The model's intercept for Czech as the reference language is at −0.2437. The model includes language (German, Czech, and Spanish) as well as the syntactic structure (agent-patient or patient-agent). Additionally, the model has a random intercept on the participant level, since each participant drew ten

images, so the observations cannot be assumed to be independent. In logistic regression, one-hot coding is used to represent categorical variables as binary variables. Each category is encoded as a separate binary variable, where a value of 1 indicates the presence of that category, and 0 indicates the absence. When interpreting the coefficients of one-hot coded variables in a logistic regression model, it's important to keep in mind that each coefficient represents the log-odds ratio between the category being represented and the reference category (the category that is encoded as all zeros). Here language is a categorical variable with three categories, i.e., German, Czech, and Spanish. We chose the language German firstly as the reference category, and later Czech was chosen as the reference category. The logistic regression model equation with German as the reference category would look as follows:

$\log(\text{odds of spatial placement}_i) = \beta_0 + \beta_1 * CZE_i + \beta_2 * SPA_i + \beta_3 * \text{syntactic\_structure\_AP}_i, + (1 \mid \text{participant})$ for all i in 1,2,⋯,n.

Within this model:

- β_0 represents the intercept or baseline log-odds of agent position for language German and syntactic structure PA
- β_1 represents the coefficient for the Czech language variable, indicating the log-odds ratio between language Czech and language German
- β_2 represents the coefficient for the Spanish language variable, indicating the log-odds ratio between language Spanish and language German
- β_3 represents the coefficient for the syntactic_structure_AP variable, indicating the log-odds ratio between syntactic structure_AP and syntactic_structure_PA
- Odds of spatial placement = (pi/(1−pi)), where pi is the probability of that the agent position of ith observation is left (The agent position value of 1 indicates left and 0 indicates right.) Odd means the probability of one outcome (left) over the probability of another (right).

To better understand the model, the predicted probabilities of all the observations are shown in Figure 2. Only the left and right placement of the subject was considered for the statistical analysis. Other placement and missing responses (NA) were excluded from the statistical analysis. In total, 76 pictures were excluded, which represents 0,025 % of the data).

The odds ratios of the syntactic order are highly significant regardless of the language taken as the reference. is 0.27 (= e−1.3020), indicating that participants with syntactic order agent-patient have 73% (= 1-0.27) higher odds of placing the agent to the left compared to participants drawing sentences with syntactic order patient-agent. Syntactic order is the most significant factor in the model, explaining most of the variation.

There is a significant difference between Spanish and German as well as between Spanish and Czech: The odds ratio of the Spanish language compared to German as a reference is 0.65 (= e−0.4366), indicating that participants with the language Spanish have a 35% (= 1-0.65) higher odds of the left agent position compared to German participants. On the other hand, compared to Czech as the reference, the odds ratio of Spanish is 0.57 (= e−0.5555), indicating

that Spanish participants have a 43% (= 1-0.57) higher odds of placing the agent to the left compared to Czech participants. There is no significant difference between Czech and German.
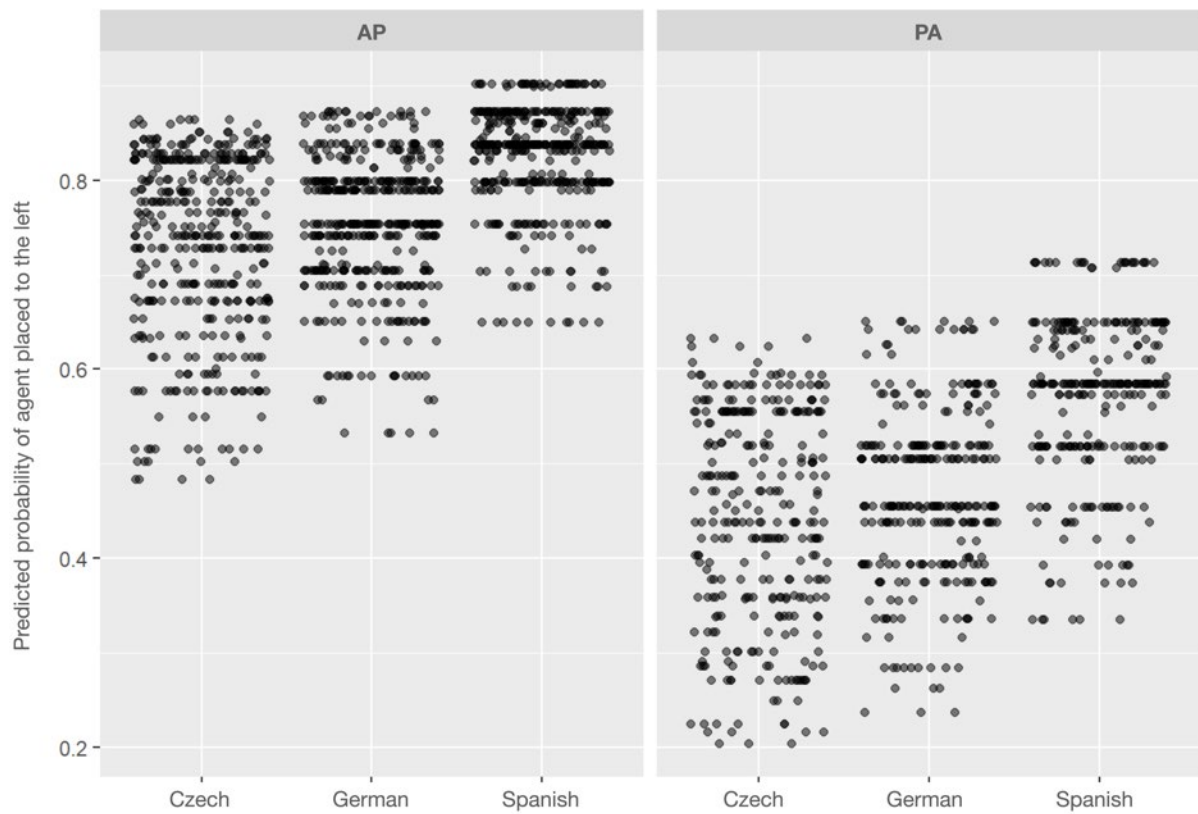

Figure 2: *Predicted probability for the spatial placement of the subject character to the left in both conditions: agent-patient word order (left) and the less common patient-agent word order (right).*

Table 5: *Beta values of the model with German as the reference category and Czech as the reference category. The significance codes are expressed by *** < 0.001, ** < 0.01 and * < 0.05.*

Reference GER				
Fixed effects	Estimate	std.Error	z value	Pr(>|z|)
(Intercept)	-0.1248	0.1194	-1.046	0.29578
CZE	-0.1189	0.1513	-0.786	0.43206
SPA	0.4366	0.1542	2.832	0.00463 **
Syn_order_AP	1.3020	0.1010	12.886	< 2e-16 ***
Reference CZE				
Fixed effects	Estimate	std.Error	z value	Pr(>|z|)
(Intercept)	-0.2437	0.1194	-2.040	0.04132 *
SPA	0.5555	0.1547	3.590	0.00033 ***
GER	0.1189	0.1513	0.786	0.43205
Syn_order_AP	1.3020	0.1010	12.886	< 2e-16 ***

5. Discussion

Spatial biases have long been a topic of interest within the field of linguistics. The prevailing understanding suggests that these biases are well-established, but this is only true when

considering sentences with canonical agent-patient syntactic order, which for many languages is not by any means the only possibility. This study delves into the notion of symmetric spatial preferences, aiming to shed light on its intricacies. While a comprehensive understanding of this phenomenon has been purportedly achieved concerning the canonical agent-patient order, we contend that the situation becomes significantly less straightforward when the syntactic order deviates from the standard agent-patient sequence, such as in the case of passive voice or topicalized sentences, which both have patient-agent configurations. Further, studies employing drawing tasks for investigating special placement biases often have used a small number of participants, or they have been focused only on the influence of either the advantage of first mention or the spatial agency bias exclusively. Our study mends these shortcomings by investigating the influence of the advantage of first mention and the spatial agency bias in interaction based on data from 300 speakers. We conducted the experiment in three languages (Spanish, German, and Czech) with different cues for signaling agency in sentences. We measured the effect of the spatial agency bias in these languages. The analysis of the corpus data revealed a significant disparity in the manifestation of spatial agency biases when departing from the canonical AP order. Unlike the well-documented and understood biases present in agent-patient sequences, the non-canonical patient-agent configurations exhibited less clarity regarding the underlying mechanisms: As stated in our main hypotheses (HA1), we predicted that in all languages, the stimuli with agent-patient-order would mainly produce drawings where the agent is placed to the left of the patient, since in these cases the spatial agency bias and the advantage of first mention agree. These results agree with previous findings from studies employing a similar methodology using sentences with a typical agent-patient word order as stimuli. Further, we predicted that in the three languages studied, for the stimuli in the patient-agent condition, the tendency to place the agent to the left would either be weaker or no longer present. This was also found to be the case since, as seen in Figure 2, the probability of placing the agent to the left when drawing a sentence with a patient-agent position is much lower. Thus, Hypothesis HA2 was confirmed. This is a key finding since previous research has rarely tested for noncanonical syntactic order. When it did, the focus was not on pitting the advantage of first mention and spatial agency bias phenomena against each other.

In our secondary research question, we asked if there are cross-linguistic differences in the prominence of the spatial agency bias. In HB1, we predicted these differences to appear in the patient-agent condition. In HB2, we predicted that in the agent-patient condition, languages would not differ. Our results did not show any significant differences in the spatial placement of the agent within the patient-agent condition. Therefore, HA2 must be rejected. On the other hand, there were significant differences between some language pairs found in the agent-patient condition, which contradicts our prediction. Thus, HB2 was rejected as well. Although the unexpected outcome was not anticipated, upon closer examination of the data depicted in Figure 2, we gain insight into potential explanations for this phenomenon. Notably, all three languages exhibited a consistent trend across both conditions. Specifically, Czech consistently displayed the lowest likelihood of positioning the agent to the left in both conditions, while Spanish consistently exhibited the highest likelihood. It is conjectured that, in Czech, the cues that typically guide the placement of semantic roles towards the beginning of sentences may generally be comparatively weaker than those observed in German and Spanish. Conversely,

Spanish may possess a stronger inclination towards associating an agentic role with the initial position in a sentence. Consequently, the spatial agency bias may be more pronounced in Spanish when compared to the other two languages.

Although our results did not support our hypotheses (HB) about the cross-linguistic differences regarding the prominence of the spatial agency bias and the advantage of first mention, they show clearly that their influence is not as straightforward and clear-cut as previously assumed. Further research considering more languages and sentences with different syntactic structures is needed to understand this phenomenon comprehensibly since our findings suggest that the spatial agency bias has a different prominence across languages. In the future, we want to work towards a plausible model explaining the factors influencing spatial agency bias by collecting more data in different languages using stimuli with different entities as agents and patients. At this point, we can show that the advantage of first mention is one of the factors influencing spatial bias based on a large amount of data from three different languages. Expanding the research by collecting new data using new materials is essential. At this point, having used only ten sentences with the same named entities as stimuli is a limitation of the study. We cannot exclude the possibility that some idiosyncratic effects played a role. For the present study, we aimed for a large number of participants reacting to the same stimuli to avoid the potential noise that several lists of items could create. However, it is necessary to use a higher number of various sentences in future research. Moreover, other variables should be considered to achieve a complete picture of the phenomenon: Comparison of languages with different script directionalities (left-to-right vs. right-to-left), changing the modality of items presentation (oral vs. written), comparing illiterate and literate people, and analyzing the development of the influences in children while they learn to read and write (compared to adults) are aims for further research.

We need to be careful when generalizing our results. The design of our study aimed to analyze quickly made decisions of spatial placement, which transfer a complex scene into a two-dimensional visual representation. In this setting, we found a pattern in positioning the agent in the drawings. We assume that this pattern carries information about how the spatial organization of the scenes works in the speaker's mind. However, it does not reflect the full range of human imagination.

It is evident that the factors influencing agency assignment and interpretation undergo a distinct shift in non-canonical configurations. Future research should delve deeper into these phenomena, incorporating psycholinguistic experiments and cross-linguistic analyses to provide a more comprehensive understanding of the mechanisms at play. In general, it is crucial for future studies on spatial bias to include also sentences with less common syntactic structures as stimuli. Otherwise, it is not possible to discern the influences of the special agency bias and of the advantage of first mention separately. It is important to keep in mind that languages differ greatly in their preferred syntactic order and how obligatory the ordering of the semantic roles is. The data presented in this study provides evidence of cross-linguistic variations, highlighting the need for further investigation into this phenomenon.

In conclusion, this study addresses the gap in the current understanding of spatial biases when departing from the canonical agent-patient order. This paper contributes to understanding how two spatial biases phenomena – the spatial agency bias and the advantage

of first mention – interact. Evidence from Czech, Spanish, and German uncovers that the strength of those phenomena manifests differently across languages, with Spanish being the language where the asymmetry is most strongly marked. Consequently, further investigation is warranted to elucidate the complexities associated with the special placement of agent and patient in non-canonical orderings in different languages and the underlying dynamics between the advantage of first mention and the spatial agency bias in different languages and sentence structures.

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