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# THE ROLE OF SYNTACTIC STRUCTURE IN LANGUAGE ACQUISITION

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1. INTRODUCTION

Language is an element that characterizes humans and sets them apart from any other creature. However, there is still a lot of controversy about the inner processes that take place in our brain that lead us to develop this capacity. Linguistics is the scientific examination of all these mental operations. However, it is a relatively young field of study as it emerged in the late 19<sup>th</sup> century. In the following decades, different schools of thought were created aiming to offer insight to why humans have this structured system ingrained in their minds. Especially, they were looking to explain how language is acquired during the early stages of life, when children do not appear to be making any conscious effort to achieve so. The two major theories that resulted from thorough research on this domain were Behaviourism, introduced by psychologist Burrhus F. Skinner, and Nativism (also known as *Innatism*), proposed by Noam Chomsky, who is now considered the founding father of modern Linguistics. These two approaches held completely incompatible views, causing dissonance within the linguistic society.

On the one hand, Behaviourism, which gained widespread popularity in the early 1950s, proposed that language was acquired through imitation (Skinner, 1957). It compared its acquisition to that of a new habit, stating that children mimic sound patterns, until finally repeating entire words and lastly incorporating them into conversation. It also sided with distributional theories, which considered that infants learn the semantic and syntactic properties of words with reference to the positions they occupy in a sentence (Konieczna, 2014). The behaviourist approach was based strictly on observable responses, rejecting the idea of underlying mental processes stimulating this learning. Skinner used behavioural conditioning to support his ideals, defending that human and animal learning were parallel. Nonetheless, despite his efforts to defend and propagate this reasoning, Skinner's ideology was soon challenged with the publishing of *Review of Verbal Behaviour* (1959) by Noam Chomsky. Moreover, the Nativist theory soon spread and became dominant in both America and Europe. Nativism sustained that every person is born with a genetically-coded universal grammar that provides them with a set of rules that eases language acquisition. Thus, this fixed mechanism would predispose humans to produce speech and would invalidate the thought that such is acquired through imitation. This idea of innatism is supported by the poverty of the

stimulus argument (Chomsky, 1965). In reference to Lasnik & Lidz (2016), this hypothesis claims that kids are able to build their own complex language system despite having limited linguistic experience. In other words, if they were to learn by mimicry, kids would only be able to produce a narrow set of utterances and could never come up with unheard phrases or expressions of their own. Furthermore, based on the fact that they would be imitating adult speech, all of their production should be grammatical. Nonetheless, it is known that kids usually take a while to perfect their grammar, as they often make mistakes when having to conjugate irregular verbs (e.g. *I goed*) or when trying to derivate certain words (e.g. *foots*). This proves they do own knowledge about language since theirs is systematic and rule-governed. Furthermore, this kind of errors tends to be common to most kids, and so are the stages they follow when learning to communicate, hence, demonstrating they all share a common cognitive structure. But this regular sequence of 'milestones' children usually go through in the language acquisition process is not only a significant argument in favour of the Nativist perspective, but it also provides insight about the linguistic knowledge and competence they have very early on.

The four different stages that have been traditionally distinguished are the following (Ojea, 2001): the holophrastic or one-word stage (encompassing the ages of ten to twelve months), the two-word stage (encompassing the ages of one and half to two years), the telegraphic stage (encompassing the ages of two to two and a half years) and the later multiword stage (encompassing the ages of two and a half to three years). Particularly, the telegraphic stage plays a key role in the development and reinforcement of proper grammar. This phase is characterized by the expression of short, three-word sentences that lack inflectional and grammatical morphemes, as well as function words. They are usually made up mainly of content words, such as nouns, verbs and adjectives. For instance, it would not be strange to hear a kid going through this stage producing a sentence such as *man sit down* (rather than *the man is sitting down*) or even *sit on piano* (totally disregarding the missing subject). Aiming to give an explanation to this phenomenon, the Minimalist Program, the most recent Chomskyan theory, has been studying the possible causes to why this omission takes place, and whether it does or not affect the children's linguistic comprehension (Ojea, 2001). This generativist

hypothesis states that, while kids in this telegraphic stage cannot include grammatical markers in their messages, it has been proved they do display a clear understanding of them, which would confirm the fact that they bear an innate syntactical knowledge. Thus, the exclusion of these morphemes and function words in their speech could be accounted for pragmatic and processing restrictions. It is not that kids have a different grammar to that present in adult speech, but that they just need to acquire certain features of it. Chomsky believes this restriction could be due to maturation, stating that we all have a genetically determined time that enables us to adopt new grammatical principles gradually. Although both languages are very different, there has been research in Spanish that backs up this theory too. For instance, a longitudinal research of a monolingual Spanish kid studied from the age of 16 to 22 months carried out by Ojea (2001), showed that, while she seemed to incorporate some inflectional markers in her utterances, these were not being used with a sense of temporality. That is, she was only using them to refer to the culmination of an event (e.g., *cayó colonia papa*). As a matter of fact, when actually trying to refer to something that had happened in the past, she was not able to access the past tense morphemes (e.g., *llora nena en casa de Alba* instead of *una nena lloró en casa de Alba*). It was not until she surpassed the age of 21-22 months that she was able to acquire and incorporate into her vocabulary this notion of *past*, as well as indeterminate articles and markers specifying number. These restraints in certain areas of language cannot be rectified through explicit correction, but depend solely on the kid's internal linguistic process. This can be seen as well in the resistance they put up when being corrected (Konieczna, 2014). In fact, teaching and intensive practice have somewhat little effect on their perfection of grammar, which shows they have their own set of parameters and that the developing and mastering of language comes from within.

All in all, exposure to language is also an essential factor for children to acquire without any restriction this capacity— despite them not acquiring it through imitation. In agreement with Eric Lenneberg's theory (1967), Chomsky admitted there is a critical period in which kids need to be exposed to adult speech. While according to him we all have an inborn mechanism that facilitates language acquisition, exposure to a rich linguistic environment is crucial for its activation. This is what allows infants to develop

the ability to distinguish speech sound and units, understand the various properties of the linguistic system and engage in evaluation when it comes to generating their own sentences and deciding the appropriate tense to use. This all proves that, while their performance might be low, their internal understanding of language goes beyond what is apparent, since they are unawaresly collecting linguistic data in their minds. This establishes a clear difference between competence and performance, demonstrating that the relationship between the two is not transparent. In fact, infants have great morphological, syntactical, phonological and semantical knowledge that allows them to prepare for producing speech effectively in the near future (Effendi & Halimah, 2016). Aiming to find out more about the role these four main language components play, many linguists have carried out numerous experiments tapping into each of these four elements, aiming to find how they enhance the kids' ability to both understand and subsequently produce speech. Syntax in particular, which will be our matter of study, is a key element in this process, as many word categories, such as verbs or function words, can be abstract in meaning and thus, difficult for the kid to fully comprehend their usage and meaning. Without the constraints provided by syntax, it would be extremely difficult to both understand the relationships between the participants of a sentence, and to be selective when receiving input, so that we can extract the main meaning behind what it is being transmitted to us. In accordance with Gleitman (1990:12), "the trouble is that an observer who notices everything can learn nothing, for there is no end of categories known and constructable to describe a situation." Once again, this reasoning takes us back to the Universal Grammar theory, the one explanation that could account for the rapid and systematic acquisition of syntax experienced by most humans. As a matter of fact, syntactic generalizations are structure-dependent (Gleitman, 1990), which is why having been endowed a highly restrictive set of language principles would serve us as great guidance in the syntactical acquisition process.

In order to better understand how syntax eases the development of our language competence and performance, and how early this occurs, I will now proceed to review the main dominant theories that deal with this matter. Furthermore, I will also be examining different experiments that have been performed in order to find out how early on kids show awareness about the syntactical principles that rule human speech,

and how much knowledge they have about them. Specifically, I will be placing a special stress on the theory of syntactic bootstrapping proposed by Gleitman (1990), even though the premises postulated by him had already been tested in an experiment carried out by Harvard's student Roger Brown in 1957. This hypothesis, which constitutes one of the greatest pillars in the field of developmental psycholinguistics, analyses the role syntax plays in verb learning and evidences the high linguistic competence children display from a very young age.

## 2. THE STUDY OF SYNTAX

The examination of sentence structure was closely related to the scientific research carried out in the start of the cognitive revolution, when it began to be acknowledged that there exist complex mental processes underlying behaviour and language acquisition (Britannica, 2023). As a result, it was found that human brains are predisposed to accomplish higher-level mental activities, one of the major influences of this movement being Chomsky's radical reinterpretation of grammar. In the following sections the gradual conception of syntactic structure as we know it today and its impact in language acquisition will be analysed.

### 2.1. EARLY THEORIES AND THE GENERATIVE SYNTAX APPROACH

A critical point of departure in the theorization about syntax was Chomsky's *Syntactic Structures* (Chomsky, 1957). In this essay, Chomsky separates syntax from semantics, exposing that a syntactically correct sentence does not necessarily need to be semantically acceptable. This difference established by Chomsky was key to deepen the study of syntax as an independent and crucial component of language acquisition. Therefore, as time went on, more emphasis began to be placed on the multiple constituents that form a phrase and the different restrictions that are placed upon them, so that they are organised in a logical and congruent way. But rather than establishing a universal word arrangement according to the category each word belonged to (i.e., verb), it was assumed the solution to insert an appropriate lexical item into a certain

structure depended on the compatibility of the former's properties (i.e., a transitive verb inserted into a structure in which a Noun Phrase (NP) followed).

This hypothesis was called the Standard Theory, and while it gave syntax a prominent role, it disregarded the influence of semantics in the composition of logical utterances. In fact, there are sentences that are acceptable structurally-speaking but are nonsensical from a semantic perspective. Thus, it did not take long until this theory went under revision. However, it is still deemed an important foundational concept in the linguistics field, since it paved the way for the formulation of generative linguistics. This new approach aimed to find out cross-linguistic commonalities to identify a core system of grammar shared by all natural languages. This is closely related to the Universal Grammar principle, since it affirms there is a series of parameters and rules that allow us to generate an infinite number of grammatically correct sentences. Therefore, generative linguistics and generative syntax place a great stress on the cognitive processes that underpin the making of coherent sentences, rather than on merely word order. These mental processes are key in the understanding of child language acquisition since they entail a great comprehension of the grammatical properties of words from a very young age. Thus, while the memorization of proper word order already seems like a difficult task, the acquisition of syntax in the early stages of life entails more than that, it requires the compilation of a great amount of information regarding not just how to adequately place each constituent in a sentence but to understand what characteristics are associated with each of them and how they interact with their neighbouring words. Thus, syntactical knowledge plays also a major role in the acquisition of word meaning, especially when the concepts we are trying to understand cannot be matched to an observable event or are considered ambiguous.

## 2.2. THE ROLE OF SYNTACTIC CONSTRAINTS

Real word scenes often tend to be uninformative or misleading. When trying to learn a new concept, we found ourselves surrounded by many characteristics that can obscure the one in particular we are trying to grasp. For instance, when an adult points out at a cat aiming to help their kid associate this word with such animal, they do not



realise that not only their kid is perceiving the living being but also the different parts that make it up, such as its long tail, its coat colour, and so on. It has been claimed that the reason why kids can reach to the right conclusion in such cases is because they have been provided with certain constraints that allow them to interpret the environment correctly. However, these have been designed mainly for nouns, which still makes the acquisition of verb meaning a hard task (Gleitman, 1990).

Professor Lila Gleitman published in 1990 a paper entitled *The Structural Source of Verb Meanings*, in which she delved into the multiple challenges infants face when learning verb meanings and also explained what factors come into play for the kids to successfully identify which particular phonological item ascribes to which particular verb concept. One of the main issues they encounter, to begin with, is the richness of perception children own, which favours many interpretative possibilities at great degrees of abstraction for single scenes. Thus, when it comes to word learning, it can be very challenging to select from those countless options which is the right one.

Initially, it was suggested that the correct interpretation of a scene by a child was due to their close relationship with their mother. That is, they were able to associate a single scene with the expected lexical item based on what their mother was thinking because, seemingly, their strong bond allowed them to nonverbally understand each other's desires. Nonetheless, this theory must be disregarded as an experiment carried out by Golinkoff (1986) showed that interactions between mothers and their infants are not always successful when the latter tries to communicate their needs. As a matter of fact, when examining the communicative episodes taken place between mothers and their respective children, whose ages ranged from 11 to 18 months, it was discovered that only half of the times the babies were to express a desire did their mothers understand what they were trying to convey.

A second problem infants encounter as well is how to differentiate what particular event the verb is encoding. That is, even the simplest verb refers to more than just an action or perceivable incident. It also implicitly transmits the beliefs, intentions and interests of the speaker. For instance, when it comes to learning motion verbs, the ideas they represent can easily get mixed up and mislead the young learner. If a kid were told to "push the toy car," the car would naturally move as a result of such action. Thus,

the question that could arise is: Which of those two events was the verb *push* referring to? Not to take into account the many other representations that could potentially get in the way too such as 'speeding,' 'rolling,' and so on. It has been suggested that these ambiguities are possibly removed by observing at and comparing the verb's uses across situations (Pinker, 1987). Nevertheless, it has been argued that due to the great and varied stimulus children receive, they should not permanently discard any apparent feature that may contradict the coexistence of a verb with the current situation they are experiencing, since they could be conceiving it mistakenly or the adults talking could be focusing on a different aspect than them (Gleitman, 1990). That is, a scheme based on word-to-word pairings is dubious because there are many occasions in which verbs mismatch the current situation (as it happens with positive imperative forms), and if kids were to exclude these verb forms permanently from other interpretations on that basis, they would not be able to understand many situations. Therefore, a kid's confirmation metric for the meaning of a verb cannot be that narrow.

Moreover, similar to the example posed between *push* and *move*, another great challenge implicit in verb learning is when two different verbs allude to a single kind of event. Pairs such as *give* and *receive*, *chase* and *flee*... they both can be used in the same situations, although each of them describes a specific perspective taken by the speaker regarding what is occurring. This again presents a great obstacle because verb meaning cannot be extracted exclusively by observation. Furthermore, verb specificity is a concept that is still difficult to understand how children grasp. In most languages you can find multiple words that refer to the same thing, that are synonyms, and yet their uses vary because they subtly denote very well-defined intentions. That is why, depending on the scenario, regardless of having numerous words that could essentially convey our desired message properly, we make a mindful decision to use the most specialised language possible when choosing a lexical item, so that there is no room for doubt regarding what we are aiming to express. The question however, is: how is the child capable to understand the level of abstraction encoded by the verb we have chosen to employ if until now that word used to be completely unknown to them?

A study between blind and sighted children aged 3 years old actually examined the distinction both groups did between word pairs such as *look* and *see*, and found out

they shared the same unobservable properties when understanding verb meaning and its implications (Landau & Gleitman, 1985). Strikingly, when asked to *see* or *look* at something, blind children contextualised the meaning of such verbs according to their own capacities and rapidly resorted to their haptic perceptions, touching and exploring manually that the caretaker was trying to show them. What is more, they established a clear difference between both verbs, and they commonly understood *look* to be the active term and *see* to be the stative one in the pair. When requested to *look* at something, they assumed the object was nearby ready to be tested with their hands. But they even demonstrated to have a deep knowledge regarding the denotative meaning of this verb, since they differentiated it from that of the verb *touch*, since when asked to “touch but don’t look at [something]” they would only tap the object they were being shown rather than kneading it. On the other hand, when asked to *see* the item, they often assumed it was out of their reach.

In the case of sighted children, they were blindfolded and given the same instructions as the other group. In their case, they too contextualised the meaning of both verbs according to their abilities. When urged to *look* at something, they assumed they were being asked to listen to something, unless being told to *look up*, in which case they raised their heads towards the ceiling (opposed to blind children who raised their arms up in the air expecting to touch something placed above them). Both of their reactions show the profound understanding children own of not only the connotative meaning of verbs but the properties associated with them, which allows them to set apart synonymous words. What works as an aid to this learning too is the fact that children assume their lexicon excludes synonyms due to practical purposes, which makes them perceive the existing differences between similar verbs as more transparent.

Lastly, one of the biggest issues when discerning verb meaning occurs when these do not refer to a perceptible event or feature. Let us take as an example the word *think*: how can a kid comprehend what it means strictly based on observation? Although the production and understanding of verbs describing mental capacities do not normally occur until the end of the third year of life in most children, their acquisition provides evidence to refute the unaided observational verb-learning hypothesis, which claims that verb meaning can be learned based exclusively on observations of the external

world. Most certainly, this is not compatible with words denoting abstract concepts. In fact, what facilitates the acquisition of these is the construction of language-internal evidentiary sources that takes place during the first few years of infants' lives (Papafragou, 2007). This shows children own a great sensibility regarding regularities in syntax-to-semantics mappings, which allows them to gather information about each verb's required and favoured structural environment and thus, increases gradually the kids' understanding about their use in context and their meaning. Moreover, another important factor in the making of this mental scheme are thematic relations, which, concerning subjective verbs, take place cross-linguistically between an animate entity and a proposition. Therefore, even though grasping the significance of these verbs is a hard chore, syntactic information is a device that eases this process, assisting children in the mastering of the use of mental verbs and understanding, as it provides them with helpful constraints that enable them to correlate distinct structural positions to verb meaning and provides them with linguistic-evidentiary sources that allow them to break more effortlessly into the verbs' meaning.

### 2.3. THE SYNTACTIC BOOTSTRAPPING THEORY

One of the main theories that has been proposed – and widely accepted by the linguistic society – to explain the acquisition of verb meaning is that formulated by Landau and Gleitman (1985), known as the Syntactic Bootstrapping Theory. Before getting into detail about what this entails, it is important to note that the inception of this hypothesis dates back to 1957, when Roger Brown published an article relating the linguistic mechanisms affecting the acquisition of verb meaning. Brown had a great interest in the processes underlying the achievement of language proficiency and focused mostly on the language features present in child speech – particularly regarding children who were in the beginning stages of speech production. He was able to show experimentally that preschool-aged children were capable of distinguishing the meaning of made up words in English just by using their profound knowledge of speech structure (Brown, 1957). Thus, he was the first one to imply that syntactic structure could be used as a tool to infer meaning and make this task easier for infants. Brown's contributions opened the way for a deeper study on how syntactic structure works as an aid for the

acquisition of semantics, and stimulated the further investigation Gleitman subsequently carried out.

The syntactic bootstrapping, as Gleitman coined it, stated that the additional information children benefit from, so that verb learning is a plausible operation, derives from the syntactic context in which words appear in speech. That is, syntax is what makes it possible for kids to select one single interpretation (among many others that could potentially be valid too), so that they can successfully understand that their speaker is trying to convey. While they are already well-equipped with complex and advanced perceptual and conceptual capacities that allow them to yield a good many possibilities for analysing any scene, it is syntax that provides them with the capability of narrowing all these options down to just one. Furthermore, this information source is made available through the performance of sentence-to-world mapping, instead of a word-to-world one.

It is because of the great variety of choices a particular real-world scene can provide, that verb learners need to use more data than the one displayed in the observed situation to actually be able to pick one single interpretation and favourably assign the verb a meaning. Whereas languages diverge in their basic conflation patterns for verbs – indicating that a kid cannot deduce in the first instance what components of such scene are being lexicalized in it, and which ones are being represented by other elements such as prepositions, affixes or adjuncts –, the mental strategies we as humans use are universal. That is, cross-linguistically the acquisition of verbs is made possible due to the exploitation of certain regularities between this word type and the sentence structure (Naigles, 1990). This is the ground of the syntactic bootstrapping theory, which is based on the premises that not only do these regularities between syntax and verb semantics exist, but also on the fact that infants are inherently aware of them, and they can use them as means to make assumptions about meaning. What is more, this learning approach allows infants to not just conjecture a novel meaning for a verb, but to do it based on the introduction of a novel syntactic frame.

### 3. EVIDENCE

In order to prove the validity of this theory and gain more insight about the role syntactic structure plays in first language acquisition, several studies and experiments have been carried out, mostly aiming to tap into the tacit linguistic competency infants display. Therefore, in the following sections I will proceed to review some significant studies with meaningful implications in current psycholinguistics research. However, I will first start by explaining some of the existing and most common experimentation methods used in this field, along with their respective applications.

#### 3.1. RESEARCH PROCEDURES IN CHILD LANGUAGE

One of the most common research methods used to examine the cognitive development of infants is the intermodal preferential-looking paradigm (Golinkoff, Hirsh-Pasek, Cauley, & Gordon, 1987). Whereas analysing children's language output was key in the creation of language acquisition theories, focusing solely on production disregarded hidden language sensitivities that in fact, were essential in terms of boosting children's linguistic development and gaining more knowledge about how they experience the world (Golinkoff, Ma, Song & Hirsh-Pasek, 2013). On the contrary, the preferential-looking paradigm allows to access and measure comprehension, making possible to even expand the research on how infants who are going through, or have not even reached yet, the holophrastic (or one-word) stage, process and understand language. Furthermore, since this method does not demand overt responses, it eases interaction with preverbal children who might be noncompliant and meet with resistance the commands of the researchers.

This eye-tracking approach was inspired by a study carried out by Spelke (1979), in which two different scenes along with just one auditory stimuli, were played to 4-month-olds, in order to find out whether they recognised which event corresponded to said sound. The experiment resulted in infants staring longer to the sound-matching scene, thus, showing that visual fixation could be an effective method to assess comprehension, especially when the sample being studied is formed by infants that cannot produce language and that rely on their parents or caretakers to perform any requested action.

Moreover, even though this particular experiment was not aiming to measure linguistic knowledge, it enabled the introduction of a new approach that made possible to access and analyse the different stages of language acquisition an infant goes through, as well as to understand how early on they master their linguistic competences – which include their grammatical, semantical, syntactical, pragmatical and phonological capabilities. Likewise, the formulation of this new approach also worked as a base to eventually develop related research methods such as the looking-while-listening procedure, in which kids are presented with two scenes and hear at the same time a description matching just one of them. As a result, the kids' eye movement toward the displayed scenes is analysed as a way to evaluate if they are interpreting language correctly.

Furthermore, while we will be focusing on studies that have used the preferential looking paradigm as means to analyse the linguistic structure present in kids' minds, another popular nonverbal research method is the habituation procedure. This approach is often used to test questions of language discrimination and assess the infants' ability to learn novel words (Fennell, 2012: 3). It consists of accustoming the targeted child to a particular stimulus and then introducing a new, but similar one, to study their reaction. Their reception, studied as a series of physiological responses, can exhibit to which extent children are capable of differentiating grammatically-similar words, or can be used as well to examine whether they are able to discriminate phonological representations or learn new word-object associations.

In other cases, rather than using screens or auditory stimuli by itself, children can also be tested using real-life objects. This can be beneficial to bring sentences to life and assess their comprehension and level of grammatical discrimination based on how they interact with their environment. Whether it is reaching for a toy instead of for another or pointing to a particular object, all these reactions can provide meaningful insight about how children understand and process language, and to what extent they grasp its perceptual properties. This will be exemplified in Booth and Waxman's study (2009), which has been later replicated by other researchers using instead the preferential-looking paradigm.

Lastly, while using nonverbal methods is highly advised if wanting to explore how children's minds are linguistically structured, which is the main focus of this dissertation,

in terms of evaluating language knowledge and vocabulary production, some of the most popular methods consist of studying spontaneous speech samples and elicited responses (Core, 2012). Collecting language data is useful to identify language regularities present in child speech and to describe what series of events are common to most humans in the beginning of speech production. Transcribing and analysing child speech is by no means an easy task, since sometimes it can be unintelligible. However, the information obtained from such samples goes beyond the utterances explicitly stated, it can also provide important data, for instance, regarding the parents' verbal interaction with their offspring or the impact of bilingualism in vocabulary acquisition.

### 3.2. EXPERIMENTS

Since the emergence of modern psycholinguistics in the late 1950s, multiple studies have been carried out to determine whether syntax plays an active role in language-learning. One of the most well-known experiments concerning that matter was that conducted by Letitia Naigles (1990), which aimed to demonstrate if syntactic structure is used by children to constrain verb meanings when interpreting novel verbs. The preferential looking paradigm was the research method of choice. The experiment consisted of showing a study sample formed by 24 children with a mean age of two years and a month, two video events on two side-by-side monitors simultaneously. The children were seated in their mothers' lap in order to ensure they were feeling comfortable. However, to prevent any interaction between the two from happening, the mothers were blindfolded. A speaker placed in between the monitors played the audio description matching one of the videos, while a hidden observer recorded the child's looking times. The image below illustrates the procedure.



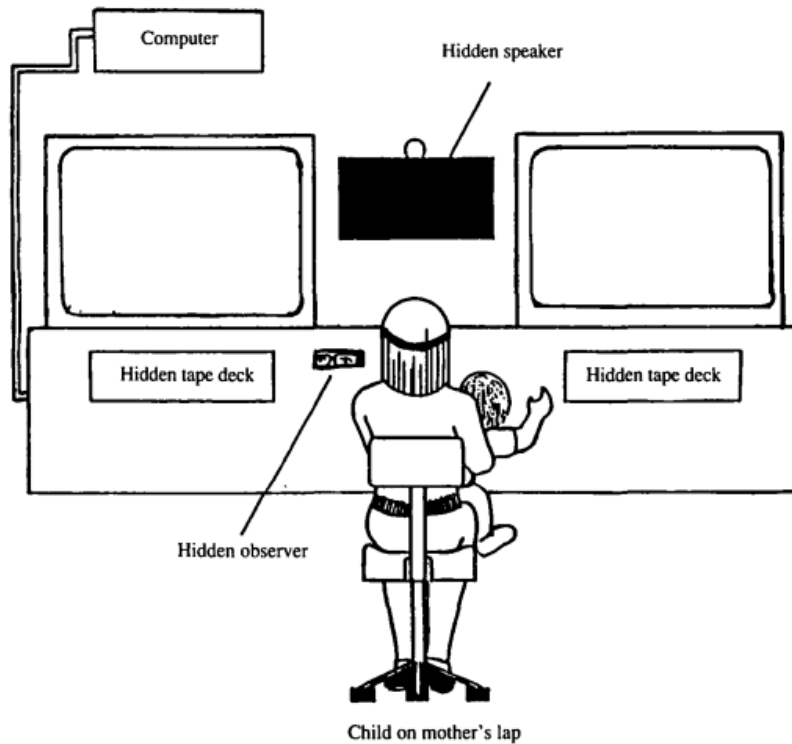


Figure 1. Experimental set-up of the preferential looking paradigm (Naigles, 1990).

While both of the played messages used the same novel verb to describe the actions shown in the videotapes, the syntactic frame the verb occupied differed in each, causing the verb to act as intransitive in one but as transitive in the other. A transitive verb is that depicting a causative action in which both an agent and a patient are required. For instance, one of the videos showed a duck pushing a rabbit into a bending position. The verb *push* is transitive because the performance of such action implies the presence of at least two participants (you cannot say *I push* but *I pushed the door* or *She pushed me*). However, because the verb used in this depiction was made up, children could only rely on the syntactic frame to determine its category and meaning. In this case, the message associated with the portrayed situation was: *Look! The duck is gorp<sup>ing</sup> the bunny*. On the other hand, the second video presented the same animals but on this occasion they were just waving their arms. As a result, the sentence lacked a direct object, which converted the previously mentioned verb into intransitive form: *Look! The duck and the bunny are gorp<sup>ing</sup>*.

Before putting the children to the test, a control trial was carried out in order for them to get familiarised with the subjects and the situations presented in the videos. Thus, these were repeated a few times, both individually and also simultaneously. Then, the auditory stimuli were introduced. Likewise, visual fixation was recorded in order to measure to which screen kids stared longer according to the description played. The results obtained actually showed that they would fixate longer to the matching scene in both syntactic frames. Therefore, regardless of the lack of lexical knowledge the children owned about the verb used, their ability to correctly grasp and understand its meaning proved that sentence structure is a major source of information when it comes to interpreting a scene, inferring who are the participants involved in it and determining verb meaning (Naigles, 1990: 368, 369).

This experiment has been replicated many times. Yuan, Fisher and Snedeker (2012) did in fact use the same methodology and novel verb in their own research, with a study sample of 21- and 19-month-olds, even younger than that examined by Naigles (1990), and yet the same outcome was observed. However, there was one innovation. The scene depicted using the verb in intransitive form portrayed a one-participant event but it also included a 'bystander' in the background. The latter was not performing the same action as the main character but was simply standing still as if awaiting for their time to come into the picture. Therefore, while both scenes featured two people, children did not decode the message based on the number of participants portrayed. Instead, they were capable of mapping their representations of sentence structure onto conceptual representations of events (Fisher, Jin & Scott, 2020). As explained by Gleitman (1990), a child can make sense of word meaning by using event context as an aid, which enables them to build structure-to-world mappings. Moreover, this account has been supported by experiments performed in infants aged 15 months, who have too displayed the capability of giving disparate interpretations to novel transitive and intransitive verbs.

A study by Hirsh-Pasek and Golinkoff (1996) provided more insight on this matter. In their experiment, infants aged 13 and 15 months were shown two videos in which, while the displayed actions varied, the objects featured stayed the same. The first scene portrayed a woman kissing a set of keys while also holding a ball. The other, however,

showed the same woman now kissing the ball and dangling the keys. The auditory stimulus the kids received was the sentence *She's kissing the keys!*, which most certainly referred to the first event. Nonetheless, if the interpretation of both sentences were to be based on the semantic value of the words contained in them, recognizing the matching scene to the played audio-message would be rather impossible, as both featured the same elements (Golinkoff, Ma, Song & Hirsh-Pasek, 2013). However, the results obtained showed that infants did stare longer and more times to the matching video, demonstrating that they do view sentences as packages of words, which far from being independent from one another, are rather interconnected. In fact, it is because of syntax that we are able to understand how the constituents of a sentence relate to and interact with each other. Syntax is what allows humans to acquire the notion of 'compositionality,' which states that the meaning of a sentences does not derive from adding together the meanings of the words that make it up but from how these are combined. Thus, the innate syntactic competency infants, and essentially humans, own plays a big role in understanding both novel sentences and interactions among participants, as evidenced in the study reviewed.

Nonetheless, the structure-to-world mapping children display also implies they the develop the notion of linguistic abstraction very early on (Fisher, Jin & Scott, 2020). In order to test this assumption, Scott et al. (2018) conducted an experiment which aimed to discover whether infants still were able to differentiate between transitive and intransitive verbs, and understand causal chains, even when the transitive verbs employed were not prototypical. As a matter of fact, transitive sentences can also be used to describe perception events (i.e., *see*) or actions with no specified effect (i.e., *hug*). If infants were to correctly grasp their meaning when these displayed fewer prototypical features, that could demonstrate they indeed rely on word order to correctly decode sentences' meaning and that they have access to a flexible range of interpretations.

The study sample Scott et al. (2018) examined was formed by 23-month-olds. These children were shown two animated events: one showing a horse putting a hat on a dog, and another one in which the dog was passing a comb over the horse's mane. Both scenes, while featuring two participants, portrayed no apparent change in the

position or state of the patient to whom the action was being performed. Moreover, the two messages associated with the depicted events contained the same novel verb in transitive form, one saying: *The horse is meeking the dog*, and the other one: *The dog is meeking the horse*. Thus, again, only syntax that can lead to the correct understanding of the meaning of said sentences. As a result, when these were played, it was recorded that children again fixated longer to the matching videos. Therefore, proving that they were able to differentiate between the subject and the object of the played sentences and use that knowledge to arrive at an accurate interpretation. Moreover, to further analyse the capacity of children to discriminate between agent and recipient, the same sample were shown in a second experiment two different events depicting an action in which, while the verb used to describe the scene was transitive, there was zero contact between the agent and the recipient involved. Moreover, the participants of the portrayed scene were not humans nor animals. One of the videos showed a flower circling a ball, and the other one, the ball jumping over the flower. While the action carried out by the mobile participants had no effect whatsoever on the motionless ones, toddlers were able to associate the subject of the played messages with the item moving. This evidenced children also consider potential asymmetries in semantic roles when interpreting transitive word order and thus, that they do not have fixed categories in which to map word-order but rather an intrinsically deep comprehension of syntax that enables them to have access to abstract representations of linguistic form and meaning (Fisher, Jin & Scott, 2020).

Moreover, while useful to discern and acquire verb meaning, syntax can also be employed by infants to differentiate between lexical categories. For instance, whereas the meaning of nouns and adjectives might be easier to grasp than those of verbs, infants still need a set of constraints to narrow the multiple interpretations that could arise from any new word used as a descriptor. For instance, if a young kid were to hear the word *dog* for the first time while their parent pointed out to a furry brown animal, the child could interpret said word according to the object category (the dog), its property (its colour, that is, brown), or a combination of the two (a brown dog). The way they approach such situation could indicate whether they use a category-based or property-based extension to deduce word meaning. Therefore, in the experiment conducted by

Booth and Waxman (2009) the idea was to pit these two options against each other, and change the word order in the three trials (moving the noun to final position throughout the procedure, then the adjective during the familiarization process, and lastly the adjective to penultimate position in the test trial) to observe how this would affect the children's comprehension of the messages produced.

The study sample was formed by 14-month-olds who were individually recorded in a room accompanied by their mother and a female experimenter. The materials used for the experiment involved eight familiarization objects and a pair of test objects, all of which the infants were able to manipulate. The familiarization objects consisted of four different items that shared the same basic level category (four purple stuffed horse toys varying in size and other details) and other four items that shared the same superordinate level category (the colour. E.g., purple-painted stuffed animals). The set of test-objects introduced included an item belonging to the same category but distinct in terms of property (a blue horse) and another one belonging to a different category but painted with the same colour as the familiarization items (a purple chair). In the first part of the experiment, the examined infants were introduced to the familiarization objects. When they were presented the first set, the experimenter said to them "These are *blickets*" and then pointed to them individually saying "This one is a *blicket*... and this one is a *blicket*." Later, when the children were introduced to the second set, she said "These are *blickish*" and then pointed to them saying "This one is *blickish*... and this one is *blickish*." Likewise, some objects that did not share any characteristics in common with the familiarisation items were also introduced to point out the contrast. Consequently, when showed, the experimenter pointed at them and said "Uh oh! Look at this one" or "Uh oh! This one is not *blickish*."

In the test trial infants were presented with the test-toys and asked "Can you give me the *blickish* one?" As a result, they grabbed the one which shared the same property as the familiarization objects (that is, those that were purple). But when asked "Can you give me the *blicket*?" they went for the one that matched their category (that is, the horse toys). Thus, they guessed the changing in meaning of the novel word *blicket* and *blickish* according to the position they occupied in the sentence. That is, they were able to deduce whether the word was referring to a noun or an adjective based on whether

it was occupying a noun-like or adjective-like position. Therefore, they showed they were sensitive to the differences between syntactic categories and that way before producing grammatical sentences, they already owned great knowledge about the principles that rule grammar and syntax (Anderson, 2018).

However, the syntactic competence kids display not only can be reflected on how they correctly make associations between a scene and the words used to depict it, but it is also evidenced on how infants react when hearing a word placed in a not suitable position. For instance, a study by Perkins and Lidz (2021) researched on whether children as young as 18 months old, were able to identify abstract nonlocal dependencies. The aim was to check if they could represent the verb-object dependency in wh-questions, regardless of these not occurring in nearby positions; and to also analyse their reaction towards declarative sentences that lacked direct objects while featuring a transitive verb. In order to do so, the study sample was presented a video that showed a series of abstract shapes moving on the screen, and at the same time listened to a block of sentences, which as mentioned before, were either wh-questions or declaratives. These were presented in two pairs: a grammatical one and an ungrammatical one. For instance, an unnecessary local direct object was introduced in the wh-question when a nonlocal one was already present (i.e., *Which dog did the cat hug him?* Vs. *Which dog should the cat hug?*). On the other hand, the declarative one used the same transitive verb but there was no direct object in one of the examples (i.e., *A dog! The cat should hug* vs. *A dog! The cat should hug him*).

The results revealed that infants showed preference for the declarative sentences that did feature a local object and for the wh-questions that did not. That is, they were able to recognise the correct grammatical structure in each case, which shows that they are able to represent the abstract dependency between verb and object, even when the syntactic frame varies or the dependencies occur at a distance. In fact, wh-question often emerge in child speech when they are about 20 months, therefore, this study demonstrates linguistic comprehension precedes production.

Furthermore, the crucial predisposition children display to learn the syntactic rules that govern speech has been backed up by a EU-funded research by Friederici, Mueller and Oberecker (2011), which examined whether infants are able to identify grammar

rules, not just in their own language but in unfamiliar ones. The sample of study consisted of a group of German babies aged 4 months old — around that time they already display verbal memory and are able to discriminate between disparate phonemes within syllables —, who were played a total of 256 Italian sentences, distributed along four teaching stages, during a 13-minute learning period. In the meantime, their brain activity was measured. Moreover, these sentences always repeated two simple constructions: a modal one (*[la sorella] può cantare* meaning '[the sister] can sing') and another in present continuous tense (*[il fratello] sta cantando* meaning '[the brother] is singing').

The first teaching phase consisted of listening to a series of sentences featuring said constructions for about three minutes. Then, an incorrect sentence was introduced but the babies did not respond any differently than when hearing the correct ones. However, by the end of the fourth teaching phase, their reaction had completely changed when hearing erroneous utterances (e.g., *la sorella può cantando* meaning 'the sister can singing;' or *il fratello sta cantare* meaning 'the brother is sing!'). That is, their brain activation patterns differed when these other non-grammatical constructions were being played as they had begun to recognise and memorised dependencies

However, as reviewed in the previous experiment, grammatically-linked elements do not always occur locally. For instance, the present continuous tense in English features the dependency between the non-adjacent elements 'is' and '-ing,' which are always separated by the stem of the corresponding verb featured. Likewise, this happens as well in Italian. Still, the German infants were able to recognise the dependency between 'può' and '-ando,' and between 'sta' and '-are' in a matter of less than fifteen minutes, even though this was not their native language. Therefore, this demonstrates again how sensitive infants are to grammatical regularities, and as reviewed in this whole project, this unconscious acquisition of syntactical knowledge plays indeed a key role in their comprehension of language and ultimately, in its production. Furthermore, this experiment reinforces the critical period theory since German babies displayed the same brain activity patterns as Italian native-speakers when hearing the ungrammatical utterances, while these did not correlate with those featured in German adults learning Italian as a second language. This again is another reason that supports that children are

biased to learn and acquire language, and it agrees with Chomsky's Universal Grammar, since regardless of the language, they are able to easily identify basic grammar rules and generalise regularities. In fact, the development of L1 syntactic structures can also be used as aid by L2 learners to determine the grammatical verb properties of such language if it resembles their L1 (Booth, Clenton & Van Herwegen, 2018). Thus, syntax enhances language development even across different systems of communication.

Lastly, on top of these insightful researches, it is worth including a meaningful piece of evidence from a study conducted on fetuses that aimed to determine whether they are already sensitive to language while in the womb (Minai et al., 2017). In fact, — through the use of a biomagnetometer to measure changes heart rate —, it has been found fetuses are able to distinguish between rhythmically distinct languages. For instance, fetuses exposed to a maternal English voice changed their fetal heart rates when beginning to hear a Japanese speaker talking. However, this heart rate variation did not occur when another English speaker took over. Given that Japanese and English have a very different paced rhythmic structure, this finding hints that children start familiarising already in the uterus with the phonology of the language they are going to acquire, recognising its rhythmic pattern. Moreover, this prenatal sensitivity towards language that they display could be preparing them for and easing their subsequent development of linguistic constraints.

#### 4. CONCLUSIONS

Syntax consists of a formal system of mental representations that guide the way we combine words and comprehend meaning. While each language has a different set of constraints that rule how sentences are produced and understood by its speakers, linguistic research has shown that human brain seems to be predisposed to develop said system and that this takes place very early on. In fact, this idea is supported by Chomsky's innatism theory, which sustains that humans are biologically endowed with a universal grammar that aids language acquisition. This statement is backed by the research conducted by Friederici, Mueller and Oberecker (2011), which displayed the high sensitivity four-month-olds own to recognize syntactic regularities and nonlocal



dependencies. That is, during the early stages of life, humans are very susceptible to how syntactic constituents are organised because syntactic structure functions as an aid to understand word meaning.

Moreover, words do not always match observable events, sometimes they are used to depict actions or beliefs. Likewise, they can also be used to describe ambiguous scenes from which many interpretative possibilities can be drawn, especially, taking into account the richness of perception children own. This is why syntax plays such an important role: it helps narrow all those potential interpretations down to just one. In fact, this is exposed on how infants are able to link the meaning of novel words that are semantically empty to scenes depicting a particular event. The experiment carried out by Naigles (1990) brought this to light by using a novel verb in different syntactic frames, causing it to act as transitive in one and as intransitive in the other. As a result, the children who listened to both sentences were able to distinguish based on the constituents' organisation, which of them was depicting a causative action and which was not. Therefore, according to this research, the acquisition of word meaning is sometimes made possible due to the exploitation of certain regularities between a particular word type and the place it occupies within the sentence. In other words, infants have the capacity to make the inferences from syntactic form to lexical meaning.

Furthermore, this information they gather regarding the favoured structural environment of certain words, contributes to their increasing understanding about their use in context and enables them to differentiate subtle variations in meaning. However, storing all this linguistic information and recognising dependencies is not an easy task, especially given that these may occur nonlocally. Still, infants have proved capable of representing grammatical action at a distance, as shown in Perkins and Lidz's study (2021), which exhibits they own a great syntactic knowledge regarding accepted and incorrect word order. Furthermore, children have also demonstrated to be flexible and to understand high levels of linguistic abstraction. For instance, in the research conducted by Scott et al. (2018), it was observed that infants were able to recognize transitive verbs even when these did not display their prototypical features. That is, they do not fit words into fixed categories but attend to a subset of grammatically-relevant cues that give them access to a flexible range of interpretations.

Therefore, this analysis highlights the crucial role of syntactic structure in language acquisition and the predisposition of children to develop such system. This process takes place gradually and is enabled by language exposure and interaction with other humans. However, syntax is not learnt through imitation but it is rather, as claimed by Chomsky, a universal grammar ingrained in children's mind. In fact, the various studies included in this thesis back this statement as they display the high linguistic competence infants own prior producing speech and their reliance on syntax to understand word meaning. What is more, infants exhibit a high sensitivity towards language before they have even been born. As exposed in the study conducted by Minai et al. (2017), fetuses can already discriminate languages based on their rhythmic patterns and tune their ears to that their mother speaks, thus, gathering knowledge for its future production.

While there are many unsolved questions in regards to psycholinguistics research, it can be agreed that no matter how young, humans are wired to develop language and even though all linguistic components are crucial to be productive users of such, syntax is indeed a device that constitutes a key in guiding and aiding language comprehension in the early stages of life. Furthermore, it can also be a useful tool for second-language learners. In fact, L2 learners sometimes turn to the syntactic structures present in their L1 to determine the grammatical verb properties of the foreign language they are learning, if such resembles their L1 (Booth, Clenton & Van Herwegen, 2018). Thus, demonstrating the crucial role this linguistic device plays in understanding semantic relations.

Consequently, taking into account all the data gathered in this paper, this could be a great point of departure to examine the acquisition process of syntactical structures in bilingual children. That is, syntax is a crucial device to understand word meaning, but for children who are exposed to two languages with two completely different sets of linguistic constraints it could be difficult to construct and recognise dependencies, given that they could assume both systems of communication belong to the same one. Plus, mastering the languages could take longer if the word order differs between the two, since, seemingly, the syntactical structure of one could not be used to deduce the grammatical properties of the constituents present in the other. Furthermore, since fetuses already begin getting familiarized with their mother's speech in the womb, would

that entail they are to learn faster and more easily their mother's language regardless of being nurtured in a bilingual environment?

Further research in this area would most certainly provide deeper insight on how infants learn syntax and would allow to answer important questions such as how both languages interact and influence one another when representing new words or acquiring syntactic frames and lexical items. Likewise, this matter of study could shed some light on whether infants are able to reach the same levels of linguistic abstraction in both languages at the same time. As a result, the more knowledge about the cognitive underpinnings and processes surrounding language is achieved, the better understanding on how to teach a foreign language to a particular group or on how to tackle communication-impairing diseases will be accomplished.

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