Bilingual Word Learning: Against the Stereotype

An Honors Thesis

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Abstract

The development of bilingualism in children and how they learn words has been a long-studied subject. Past research suggests that monolinguals and bilinguals have a different but distinct trajectory of word learning. The current study compared word learning differences in monolingual, intermittent bilingual, and bilingual children between the age of 17-46 months. Forty-five participants were assigned to three groups based upon their exposure to an additional language and completed choice tasks in a fast-mapping task, a novel noun generalization task, a direct novel name and retention task, and a known word comprehension task. Participants' accuracy and reaction time in making choices were measured across trials and averaged. One-way analysis of variance was carried for each task, and the results indicated no significant difference in accuracy or reaction was noted across the groups for each of these tasks, with the exception of the known word comprehension task. The bilingual participants had lower accuracy than the other two groups for the known word comprehension task. Overall, the results suggest that there was no significant difference in reaction time for all groups- meaning that participants were able to fast-map, retain new novel words, identify known objects, and generalize novel objects at a similar rate to each other. All three groups exhibited a shape bias on novel noun generalization tasks as well.

Introduction

Language is defined as a system of human communication, written or spoken. From before birth, humans begin developing language. The process of developing language has been a subject of interest and study for its dynamic and intricate nature.

The development of language in children occurs through their environment (Onnis, Truzzi, & Ma, 2018). The brain develops language through information from phonemes, and the combination of them, the objects the phonemes refer to, the semantics and syntactical structure of these phonemes, and the amount of exposure to language. For a child, the first 4-5 years are used to develop a substantial portion of language and learn to utilize it (Onnis et al., 2018). The elements needed to accomplish this an environment that uses language in both quantity and quality and a substantial amount of linguistic communication between adults and the child. While cognitive development plays a significant role in the acquisition of language, the environment of a child plays an equal role as well.

During cognitive development, both explicit and implicit learning will occur (Onnis et al., 2018). Explicit learning occurs when a child is receiving direct instruction and storing new information. Implicit learning occurs as the child observes their environment, the situations that arise in it, and the characteristics that are a part of it. Implicit learning also occurs when the child interacts with their environment (e.g., play, babbling). However, implicit and explicit learning occurring in the child's environment could be enriched further based upon parental influence.

Parents (Onnis et al., 2018) bear a significant influence in their child's overall development- however, parents specifically play a role in how their child develops language. Parents provide both quality and quantity language exposure for a child (Onnis et al., 2018). A child needs to be exposed to a high quality of language daily in their environment. An expansive and diverse vocabulary being used in complex sentence structures with correct grammatical structure enriches the information the child is learning. Whether the quality of language is used in direct interaction with the child or adult to adult interaction with the child present, high quality of language is vital to the development of linguistic knowledge. A child also needs to be exposed to a large quantity of language daily in their environment. A large and consistent amount of exposure to language gives the child the necessary, day to day stimulation needed to learn new words thoroughly. The use of child-directed speech or mother-ease in interactions with the child also improves the language environment. Child-directed speech (Harley, 2017) is typically rich in different tones of voice, as well as filled with natural pauses between phrases, and the overall slowing rate of speech allows for phonemes to be heard and differed between at a higher level than during normal speech.

Typical language developments (Onnis et al., 2018) within the first-year include an awareness of phonemes (sounds) and their differences in sound by six months, and in the following months leading up to the first year mark, babbling begins. Babbling is vital in the building of articulation coordination and how to use the articulators (e.g., tongue, teeth, cheeks, alveolar ridge, soft palate, etc.) to produce phonemes. Babbling also helps strengthen the muscles needed to move the articulators. By the first year, a child should produce their first word (Levelt, Roelofs, & Meyer, 1999).

Linguistic Mapping

Carey (1978) wrote that children, no younger than eighteen months, learn about nine words a day. The process of learning a new word occurs within two timeframes: the initial learning of the word and then the extended, consistent full learning of the word. The initial information that a child takes in when they hear a new word happens within a few exposures to the new word. The full learning of new words takes much longer; the amount of time differs for each child based on the amount and consistency of exposures to the new word.

Every individual, as they cognitively develop, begin to create and develop their lexicon. A lexicon refers to an individual's whole capacity for language information (e.g., vocabulary, semantics, phonology, etc.) and their ability to utilize it. As a child is growing cognitively, they are creating and expanding their lexicon to be able to describe the concepts they are learning (Carey, 1978). Lexicon building and concept building are tied to one another- as a child learns new words (building their lexicon) a child is assigning these new words to objects, actions, and ideas (concept building). As a child's lexicon grows, so does the complexity of concepts they are able to understand-essentially a child's learning of language enables them to learn their environment, the objects that exist in it, and how to interact within it. The building of this information begins from the moment a child hears a new word.

First, a child takes in the linguistic context (Carey, 1978) of that new word- how was the word used in a sentence (e.g., noun, verb, adjective). A child also takes in the environmental context (Carey, 1978) of that new word- what way was the word used and how it pertains to the circumstances occurring around the child. Based upon the linguistic and environmental context of a new word, a child is capable of assigning the new word as a thing, a name, or an action. The initial process of breaking down the context of a new word and then the cognitive action of matching the new word with an object, action, name, or concept- Carey (1978) called fast-mapping. Every child begins mapping when they begin learning the language. And fast-mapping is the initial action of attaching a potential meaning to a new word. Mapping, in general, either in the initial intake of a word and its potential meaning or the full learning of a word many times afterward, occurs cognitively all the time. Mapping is assigning of words, word meanings, and word names to concepts the child is attempting to understand (Carey, 1978). So, when a child is learning nine new words a day, a child is specifically mapping nine new words a day- in addition to the words they have been learning previously. It is important to note that fast-mapping is not the full learning of a new word, but rather an amount of information that indicates to the child the existence of a new word, some contextual information surrounding the word, and potential hypotheses of what the new word might mean (Heibeck & Markman, 1987).

For fast-mapping to occur so quickly, the child must simultaneously make hypotheses and assumptions about the potential meaning of a word (Heibeck & Markman, 1987). In a child's environment, the intake of phonological, semantic, syntactic, morphological, and pragmatic information provides clues to the meaning of a word. During fast-mapping, a child, while making hypotheses, also uses assumptions to limit the number of applicable hypotheses and pick one. These assumptions are known as whole-object, taxonomic, and mutual exclusivity (Markman,1990).

Whole-object (Markman,1990) assumes that a new word meaning is assigned to the whole object. For example, a child linguistically maps, utilizing the Whole-object assumption, by hearing the new word *butterfly* and attach word meaning to the entirety of the butterfly. This negates the wings, antennas, legs, and eyes that are all parts of the butterfly.

Taxonomic (Markman,1990) assumes that a new word meaning can be assigned to the new object and also objects that are alike- *not* how they are thematically related. It can be difficult to discriminate between a taxonomic classification and a thematic classification.

Thematic classification can be thought of as two objects or concepts that directly correlate with each other in terms of how they work together. For example, a thematic classification involving the word *butterfly* and *net* could occur. Taxonomic classification can be thought of as two objects or concepts that directly relate to one another in the subject (topic), function, or shape similarity. For example, a taxonomic classification involving *butterfly* and *moth* could occur- meaning a child could classify a moth as a butterfly.

Mutual Exclusivity (Markman,1990) assumes that at least every new object possesses only one new name. Therefore, in vocabulary learning, the child will assign a new meaning to a new object, but will not assign the same new meaning to a second new object. For example, a child linguistically maps, utilizing the mutual exclusivity assumption, by using their receptive language bank, understood vocabulary, when they are shown a *bear* (known object) and a giraffe (novel object). Upon hearing the new name *giraffe*, the child will assign the new name to the new object because they know it is not a *bear*.

While it is at times difficult to identify when a child is using which assumption- the fact that a child must make a linguistic assumption about a word meaning in order to pace with learning at least nine new words a day is evident (Carey, 1978; Markman,1990). Remember that information is present in the semantic (grammatical) and pragmatic (tone, social context, non-verbal communication) framework in which it was used (Heibeck & Markman, 1987)- a clearer picture of fast-mapping comes to light.

While linguistic information is used to fast-map, so is perceptual information. Perceptual information comes from the senses- what the child is seeing, hearing, touching, etc. Novel objects can also be hypothesized during language learning and labeled based upon how they look and are perceived by the child. Furthermore, objects are seen as similar to each other can be classified together, even if differences are present.

Novel Noun Generalization (NNG)

In language development, the learning of what a novel object could be and how it is classified as similar to another novel object is known as noun generalization (Landau, Smith & Jones, 1988). The child learns to do this by attending to certain characteristics of an object (Smith, 1979). The current study analyzes how bilingual, intermittent bilingual, and monolingual children classify novel objects in a novel noun generalization task. An object might be generalized based upon many different characteristics of that object (e.g., shape, size) based upon what they experience through their senses (Landau et al., 1988). Generalization between objects in size occurs when a child associates a novel object of one size (e.g., golf ball) with a novel object of a similar size (e.g., cotton ball). Generalization between objects in shape occurs when a child associates a novel object of one shape (e.g., small, toy hammer) with a novel object of the same shape (e.g., hammer tool). Generalization between objects in material occurs when a child associates a novel object of one material (e.g., plastic basket) with a novel object of the same material (e.g., plastic ball).

Smith (1979) discussed that children develop a generalization bias based on the characteristic that perceptually they attend to the most- noting that the characteristics evolve in complexity with age. For example, a younger children perceptually process objects and attend to them based on the entire object and what it looks like (Smith, 1979). As a child matures in age and cognitively develops, the categories of generalization grows as children are perceptually able to process more complex characteristics of an object (Smith, 1979). In Landau et al. (1988) study, two-year-old children, three-year-old children, and adults were tested in which bias they possessed in generalization between objects. Landau et al. (1988) found that three-year-olds and adults showed a shape bias in yes/no tasks and forced-choice tasks. The objects presented in each trial relate to each other in either shape, size, or material, and the tasks are designed to elicit a choice that will show the bias in each participant.

While it was found that children ages two and three do have some fluctuation in their biases- there is a clear distinction the children did generalize novel objects according to their shape more often than according to the size or texture (Landau et al. 1988). However, there has been evidence to children generalizing novel objects upon many characteristics not solely shape. Jones, Smith and Landau (1991) found that while a shape bias is present in two and three-year-olds, they also are capable of showing a generalization in material as well. In the study (Jones et al., 1991), eyes were added to the novel object to test if the change in material affected the generalization of the novel object. While it did not heavily outweigh the shape-bias, children did show a material-bias that was notable, indicating that there are some cases in which novel objects are not generalized solely based on their shape (Jones et al., 1991). The cases in the Jones et al. (1991) which children showed generalization in material occurred when another element was added to the objects- in this study googly eyes. This indicates that while a child may have a bias towards generalizing novel objects by shape, this does not mean that children exclusively only generalize one way. An additional element to the novel object can lead to variance in how the child might generalize that object This leads to questioning variability in generalization between bilingual, intermittent bilingual, and monolingual children. This variability was present in Schonberg, Russell, and Luna (2019) study which looked at noun generalization differences in a novel noun generalization task between monolingual and bilingual children, with the task being spoken in both English and Spanish. During the NNG task, when performed in English, bilingual children generalized mostly according to shape, however when the NNG task was performed in Spanish, there was no strong bias and results varied between the object generalization categories

(Schonberg et al., 2019). Another study by Colunga, Brojde, and Ahmed (2012) also found variance in bilingual novel noun generalization bias, which was correlated with the pragmatic context of the prompt (e.g. eye gaze) (Colunga et al., 2012).

Smith, Jones, Landau, Stowe, and Samuelson (2002) suggested that while a child is learning words through noun generalization, they are sharpening their ability to attend to the task of learning. Therefore, as a child learns to generalize more, the greater their ability to attend to learning grows, and thus so does their lexicon (Smith et al., 2002). Within generalization there exists first-order generalization and second-order generalization. First-order generalization, is known as the knowledge that, once a shape has been identified, that other shapes similar to it will be identified likewise. For example, identifying the shape of glasses allows other shapes to be found and labels to be assigned to other similar objects (e.g., goggles, sunglasses). Second-order generalization is when novel objects become labeled and organized based on their shape alone, which increases the speed of learning new words.

A novel noun generalization task was used in the current study to examine the biases in how bilingual, intermittent bilingual, and monolingual children generalize novel objects based upon object's shape and material.

Bilingual Language Development

Fast-mapping a language is not an easy task- luckily, at the age of infancy, toddlerhood, and into childhood, the plasticity of the brain and its ability to form new neurological connections, is primed for language learning. Children's young, flexible brains are capable of linguistically mapping multiple languages. As a child is learning multiple words, from different languages, they are mapping in their environment those words to objects. In bilingual language development, two words from two different languages can refer to the same object, therefore the child will map for that one object twice. Individuals who are developing in a bilingual environment are forming two linguistic maps– e.g. a child speaking both English and Spanish refers to footwear as both “shoe” and “zapato” (Byers-Heinlein & Werker, 2009). And so on, with individuals developing in a trilingual environment developing three linguistic maps, and so forth (Byers-Heinlein & Werker, 2009).

Word learning plays an integral role in the language development of each child, despite their language background or how many languages they are learning. The development of language in a child undeniably varies from one environment to the next. Thus, a child’s language development would vary from child to child. A child’s disclosure to language in type and amount also affect their language development. What is incredible is the capability of the child, during the time of infancy and toddlerhood, to learn these two languages fully. However, this begs the question of how does bilingualism affect and differ in the development of language from monolingual children?

Cognitive advantages gleaned from bilingualism range from heightened cognition, metacognition, sociolinguistic competence, and meta-linguistic skill (Winsler, Diaz, Espinosa, & Rodra-Guez, 1999). These cognitive processes (Winsler et al., 1999) exist for everyone, but especially and at a greater amount for bilingual individuals who are learning additional linguistic information and how to utilize it. These heightened cognitive processes give increased advantages in the area of language. Individuals who are fully bilingual are shown to have excellent linguistic consciousness and regulation (Winsler et al., 1999). Linguistic consciousness refers to the awareness that presides over verbal productions and the pragmatic meaning of those productions. While linguistic regulation refers to the brain’s ability to manage and organize the verbal and nonverbal communication. Individuals who are bilingual also possess longevity in neuroplasticity-meaning their brains are able to create new connections longer and later into life than is typical. Individuals who are bilingual additionally are heightened in analytical processing, rationale, and categorization in linguistics (Winsler, et al., 1999). So, cognitively individuals who are bilingual possess higher capabilities and linguistic knowledge (e.g. semantical, syntactical, pragmatic, etc.) than what is typical for an individual who is monolingual. The differences between monolingual and bilingual individuals continue in language development.

There are language development landmarks that every individual reaches in their development- both monolingual and bilingual. All individuals say their first word, expand their receptive language bank, begin to use their expressive language, say their first two-word utterance, and begin using their growing vocabulary though the specifics can vary across individuals. However, differences between bilingual and monolingual language development are not attributable to the fact that of simultaneously learning two languages. In fact, language development and acquisition between monolingual and bilingual individuals develop at similar times and similar rates (Kovács & Mehler, 2009). Therefore, the idea that has emerged in the society that children who are bilingual are more prone to experiencing a language delay is preposterous. King and Fogle (2006) while interviewing parents found that many were concerned about their children experiencing a language delay due to the presence of an additional language. However, as discussed by Byers-Heinlein and Lew-Williams (2013), bilingualism itself does not inherently cause a language delay, a language delay can occur in any individual whether they are bilingual or not- bilingualism and language delays are not correlated.

However, individuals who are bilingual, fast map differently than individuals who are monolingual do. The difference in word learning is attributed to the Bilingual Lexicon Structure

Hypothesis (Byers-Heinlein & Werker, 2009). The Bilingual Lexicon Structure Hypothesis stipulates that when a child is learning two or more languages, the structure and development of their lexicon differs to a monolingual lexicon due to the 2:1 or Many:1 linguistic mapping (Byers-Heinlein & Werker, 2009). The 2:1 linguistic mapping occurs when two words can be labeled onto one object or one concept. These two words used are synonymous in meaning between two different languages. In the case of Many:1 mapping, this can occur when there are multiple synonymous words across multiple languages that can be labeled onto one object or concept. These multiple mappings that can occur onto one object are known as translation equivalents (De Houwer, Bornstein, & De Coster, 2006). The moment a bilingual child learns a new synonym for a word they know in another language (cross-language), a translation equivalent has occurred. When a bilingual child fast-maps, one of three types of mappings are occurring.

The linguistic assumptions, whole-object and taxonomic, are still present in word learning for bilingual language development- mutual exclusivity being an exception. Children typically develop and execute mutual exclusivity at 17-18 months (Byers-Heinlein & Werker, 2009). Because of the possibility that a known object can also be labeled with a novel word, mutual exclusivity is a particularly difficult assumption for bilingual children to make- meaning that their development of mutual exclusivity is weaker than a monolingual's (Houston-Price et al., 2010). Research has also shown that the greater the amount of translation equivalents present in a bilingual's lexicon, the more difficult it is to assume mutual exclusivity and vice versa- the smaller amount of translation equivalents result in ease of assuming mutual exclusivity (Byers-Heinlein & Werker, 2009). This, however, does not mean that a bilingual child never develops mutual exclusivity. Bilingual children have exhibited mutual exclusivity- just at an age that is later than monolingual children (Byers-Heinlein & Werker, 2009; Houston-Price et al., 2010). Therefore, what is altered in the development of language for bilinguals, the ability to develop the assumption of mutual exclusivity, and the development of translation equivalents in their lexicon (Byers-Heinlein & Werker, 2009).

It is also important to note that children who are exposed to any additional language in their environment are also capable of fast-mapping, learning new words, and learning new linguistic information for that language. For example, if a child is exposed to an additional language at daycare, the new linguistic information is being learned. A child does not need to have a complete and equal split in exposure in order for language learning to occur. In this study, participants were exposed to an additional language were grouped together and compared to participants who experienced full exposure to one language or equal exposure to two languages. For the purposes of this study, participants who experienced a 30% exposure to an additional language, were included and classified as 'intermittent bilingual'.

The Current Study

Acknowledging the vast differences in the lexicon structure (e.g. translation equivalents) and development of language between monolinguals, intermittent bilingual, and bilinguals lead to the overall hypothesis of this study- that in completing fast-mapping, retention, novel word learning, and known word comprehension tasks, bilingual children will have decreased accuracy and longer reaction time than monolingual children. The reasoning behind why bilingual children will have a decrease in accuracy, as compared with intermittent bilingual and monolingual learners, is due to the fact that the bilingual children are building a larger lexicon, forming language equivalents in word learning, and possibly mapping during the tasks at a 2:1 or Many:1 ratio. This rationale was also constructed on the basis that for bilingual children, novel labels can be assigned to known objects- this, therefore, could potentially decrease their accuracy in choice and retention tasks. As for reaction time, it was hypothesized that a slower reaction time would incur for multiple reasons. Firstly, based upon the knowledge that bilinguals possess 2:1 or Many:1 linguistic maps or translation equivalents (Byers-Heinlein & Werker, 2009). Secondly, based upon the hypothesis from Soares and Grosjean (1984) that when bilinguals hear a novel word, they cognitively process through each language's lexical information. And thirdly, based on findings by Kohnert and Windsor (2004) and Ivanova and Costa (2008), that bilingual children and adults experienced longer reaction times, compared to monolinguals, during a picture naming tasks. With these considerations, it was hypothesized bilinguals would take additional time to linguistically map and hypothesize during the fast-mapping, novel word learning, and retention tasks.

It was additionally hypothesized that the bilingual group would show a shape bias in their choices during the novel noun generalization task. This was hypothesized based upon the findings in bilingual participants during novel noun generalization tasks when performed in English (Schonberg et al., 2019).

This study analyzes the word learning differences in bilingual, intermittent bilingual, and monolingual 17-43 month olds, from a much larger longitudinal data . The current study analyzed the accuracy and reaction time of the participants during a fast-mapping task, a novel noun generalization task, a direct novel name and retention task, and a familiar word comprehension task. These tasks test word learning, retention, known word comprehension, and generalization abilities.

Methods

Participants:

A total of 45 children (24 females; 21 males) were selected for the current study from a larger sample of 177 children between the ages of 18-46 months from an urban metropolitan area. The 45 participants were divided into three groups- bilingual, intermittent bilingual, and monolingual- based upon their language exposure history and current language environment. Monolingual children were only exposed to one language 100% of the time. Intermittent bilingual children were exposed to their native language on average 70% of the time and a new language for an average of 30% of the time. This small, 30% exposure occurs in various forms and various environments. Bilingual children were exposed to two languages according to the parent report, each on average 50% of the time.

Each individual child in each group was matched with another child based on age. Children were matched within three (at the most four) months of each other. The monolingual group comprised of 15 children between the ages of 19-43 months (*M*=29.93; *SD*=8.3), the intermittent bilingual group comprised of 15 children between 17-43 months (*M*=30.67; *SD*=9.24) and the 15 children in the bilingual group ranged from 17-43 months (*M*=30.8; *SD*=9.39). Parents and guardians of all the participants, reported their child achieved typical linguistic milestones appropriate to their age.

Stimuli

The stimuli consist of objects- known and novel. There are objects that *are highly known* to the participant, have a known label, and are referred to as known items. There are objects that are novel and not known to the participant. The novel objects were entirely different from the known objects. The novel objects were not viewed by the participants prior to beginning the trial.

In the referent selection and retention trials, the participant is presented with both known and novel objects in sets of three. In the novel noun generalization trials, only made up of novel objects, the participant is presented with two novels objects to choose from. In the Direct Novel Naming and Retention, the child is presented and familiarized with four novel objects and novel labels for each object. In the four trials, each novel object is asked for once by the novel label assigned to it. In the Known Word Comprehension trials, the child is presented with only known objects in sets of three; there are four total sets.

Tasks

Referent Selection and Retention Task

In the Referent Selection, there are 16 trials. Every trial in the Known Referent Selection (KRS) and the Novel Referent Selection (NRS) children are presented with two known items and one novel item. In the KRS children are asked to retrieve a known item. In the NRS children are asked to retrieve a novel item. The final four trials tested retention and included three novel items from the NRS trials items previously labeled in the NRS trials, where the retention of the novel labels will be the tested.

Known Referent Selection

In the KRS trials, the child is presented with two known items and one novel item. The child is asked to retrieve the known item by name (e.g., “Can you get the duck?”). The purpose of the KRS tasks was to test the participant’s ability to correctly identify a known item. The presence of the novel item tests what the child will specifically attend to and identify- known or novel objects.

Novel Referent Selection

For NRS trials, the child is presented with two known items and one novel item. The child is asked to retrieve the novel object by name (e.g., “Can you get the fode?”). The purpose of the NRS tasks was to test the participant’s ability to assign a novel name to a novel object.

Referent Selection Retention

The remaining four trials test retention. The child is presented with three previously labeled novel objects and asked to retrieve one by name. The child has heard each novel label and seen each novel object that is presented in these trials. The purpose of the retention tasks was to test the participant’s ability to retain the novel names from the previous NRS trials.

Novel Noun Generalization

In the Novel Noun Generalization (NNG) task the child is presented with an object by the researcher. The participant is told the name of the object (e.g., “This is my zup”). The participant is then presented with two different objects that are each similar to the presenter’s object either by shape or by material. The child is then asked to retrieve an object with the same name (e.g “Where’s your zup?”). This trial is ultimately tested whether the child has a shape bias or a material bias. Shape bias is tested by whether or not the child chooses an object of similar shape. Material bias is tested by whether or not the child being chooses an object of similar material. The child’s choice between an object that is similar to shape or material in the initial object presents their bias in that trial.

Direct Novel Naming and Retention

The Direct Novel Naming and Retention task is based upon word mapping and retention. In these trials, the participant is familiarized with a novel object and a novel name for that object. The participant then undergoes direct naming tasks in each trial for each novel object's name and is subsequently tested on retention for the newly learned names. These tasks test the retention of the participant. The nature of this task is far simpler for the participant to grasp due to all of the novel objects being familiarized and directly named prior to the participant being tested for retention. In the Referent Selection trials, there was no previous familiarization and direct naming that occurred for the novel objects present in those trials- this added extra difficulty for the participant to discern and label the novel objects when they were asked for in the trials.

Known Word Comprehension Task

In these trials, the participant is presented with three highly known and highly similar objects. Similarity is determined based on thematic relations between the objects (e.g., animals- dog, cat, monkey). The participant is then asked to retrieve a specific item by name (e.g., "Can you get the monkey?"). There are four sets, each set possesses three highly known and highly similar objects. These tasks measure the participant's knowledge of highly known objects and their ability to identify them.

Coding

To record the data, Basic Choice (BC) Coding was implemented. BC Coding is known as a partial standardized process of representing the behavior of the participant while they complete the tasks by choosing an item from an array. Often, a participant's choice will not be obvious or they will choose multiple objects. BC Coding works to record the participant's initial and final choice. The initial choice is referred to as the participant's "basic choice". The final choice is referred to as the participant's "choice".

Reaction Time Coding

Reaction Time Coding was implemented as well in the recording of the participant's behavior. Reaction time is measured from the end of the prompt, given at the beginning of every trial, to the participant's final choice (C).

Statistical Data Analysis

Each participant completed multiple trials across various tasks described in the methods section. The average performance of each participant across the tasks was analyzed using separate one-way analysis of variance (ANOVA) for each task. The dependent variables were accuracy and reaction time, and the independent variable was the groups with three levels (bilinguals, intermittent bilinguals, and monolinguals). The significant ANOVA's were followed up with Tukey's post hoc analysis. The results of the statistical analysis are discussed in the results section.

Results

Tasks

Known Referent Selection

The Known Referent Selection (KRS), in which all trials included two known items and one novel item, compared accuracy and reaction time between all three groups; bilingual, intermittent bilingual, and monolingual. The data from the accuracy comparison indicated no significant differences between the three groups for the KRS, $F(2, 42) = .11$, $p=.90$. The data from the reaction time comparison showed no significant differences between the three groups for KRS, F (2, 42) = .48, p=.63. All of the groups during the KRS task showed similarity in their accuracy of choosing the known object based upon the known label and the amount of time it took them to complete each trial.

Novel Referent Selection

The Novel Referent Selection (NRS) trials are similar to KRS. The participants were presented with two known items and a single novel item, they were required to select the novel item by name, and this gave a measure of fast-mapping ability of the participant. The groups did not significantly differ from one another on accuracy F (2, 42) = .45, p=.64 or reaction time, F (2, 42) = .20, p=.82. All of the groups during the NRS task showed similarity in their accuracy of choosing the novel object based upon the novel label and the amount of time it took them to complete each trial.

Referent Selection Retention

The Referent Selection Retention trials consist of only novel objects from the previous KRS and NRS trials. The Referent Selection Retention trials were assessed using the ANOVA test. For the three groups, bilingual, intermittent bilingual, and monolingual, showed no significant difference in the accuracy, F (2, 42) = .25, p=.77 or reaction time, F (2, 42) = .94, p=.40. All of the groups during the retention task showed equality in their accuracy of choosing the correct novel object based upon the novel label and the amount of time it took them to complete each trial.

Novel Noun Generalization

Novel Noun Generalization (NNG) task assessed the ability of a child to make an association between novel words and its referent and to generalize those novel labels to other exemplars of similar category. Children exhibit a remarkable ability in childhood to generalize by shape when learning count nouns (Smith et al., 2002). NNG task results revealed that all the participants, in the three groups- bilingual, intermittent bilingual, and monolingual exhibited they were more likely to choose shape than material, F (2, 42) = .02, p=.98. All of the groups during the NNG choice task primarily displayed a bias toward categorizing novel objects according to shape.

Direct Novel Naming and Retention

In the direct naming task, the participant is familiarized with four novel objects with novel names and then undergoes direct naming tasks. The direct naming task is used to test the child's retention of the novel object's names. The three groups, bilingual, intermittent bilingual, and monolingual all showed no significant differences in accuracy, F (2, 42) = .44, p=.65 or reaction time, F (2, 42) = .83, p=.44. In the direct naming of a novel object and the testing of retention- all of the group performed similarly to one another.

Known Word Comprehension

The Known Word Comprehension (KWC) task familiarized the child with the testing procedure as well as tested the child's knowledge of common items. The accuracy data suggested that there was a significant difference between the three groups for KWC, F (2, 42) = 5.05, p=. 01. The Tukey post hoc test revealed that the participants in the monolingual (M=.85, SD=.15) and intermediate bilingual group (M=.86, SD=.16) performed significantly better than the bilingual participants (M=.61, SD=.35). There was no statistically significant difference between monolingual and intermediate bilinguals (p=.99). The reaction time data suggested that there was no significant difference between the three groups for KWC, F (2, 42) = .27, p=.76.

Therefore, we can conclude that within this task the monolingual and intermittent bilingual groups performed better in accuracy- with no significant differences in reaction time.

Discussion

The current study compared the accuracy and reaction time of bilingual, intermittent bilingual, and monolingual children on retention, novel label learning, retention of the learned labels, and novel noun generalization. Overall, the results revealed that bilingual and intermittent bilingual children were able to fast map novel objects and identify them with similar accuracy to that of monolingual children.

For the Known Referent Selection (KRS) there was no significant difference in the results between the monolingual, intermittent bilingual, and bilingual participants in accuracy or reaction time. In a similar study, Byers-Heinlein and Werker (2013), bilingual and monolingual 17-18 month-olds underwent a comprehension task of known items with both known and unknown items present. The authors noted that 80-100% comprehension occurred for known labels for all participants during the trials that targeted understanding of known objects and that the participants were “successful” during the known object trials. While the study specifically analyzed the differences between bilingual and monolingual in disambiguation capabilities when learning novel labels- no significant difference was reported in comprehension between bilingual and monolingual participants during the known object trials (Byers-Heinlein & Werker, 2013). Another study by Davidson and Colleagues examined disambiguation in bilingual and monolingual 3, 4, 5, and 6-year-old children, separately grouping 3 and 4-year-olds and 5 and 6-year-olds (Davidson, Jergovic, Imami, & Theodos, 1997) The participant’s in the study completed disambiguation tasks where known and unknown objects were presented, and children were asked to identify them. Both bilingual and monolingual groups for each age grouping, similar to the findings of the current study, showed no significant difference in their accuracy of identifying the known items (Davidson et al., 1997).

The current study, similar to the above-mentioned studies, found no significant difference across the three group on the identification of known objects (Byers-Heinlein & Werker, 2013; Davidson et al., 1997). The participants in the bilingual groups were able to accurately identify known objects similarly to monolingual children of the same age. Bilingual children were able to accomplish this within the current study because; firstly, bilingual children, like monolingual children, linguistically map labels to objects, learn labels after repeated exposures, and then identify known objects and secondly, the known objects used in the study received parental confirmation to be known by the participant.

In the current study, for the Novel Referent Selection (NRS) there was no significant difference in the results between the monolingual, intermittent bilingual, and bilingual participants in accuracy or reaction time. As discussed above, Byers-Heinlein and Werker (2013) analyzed the performance of monolingual and bilingual children on the comprehension of novel object labels and found that the bilingual group did not disambiguate during the novel objects trials- meaning that the bilingual children were unable to accurately identify, or mutually exclude, between the objects presented. The authors attributed this to the participant’s possession of a high amount of translation equivalents. Byers-Heinlein and Werker (2013) noted that the bilingual participants who possessed a lower amount of translation equivalents were able to disambiguate, or accurately comprehend the novel labels for the novel objects. The reasoning can be inferred to the current study that the similar accuracy rates in the NRS trials for the bilingual group, similar to the Byers-Heinlein and Werker (2013) study, could be due to a relatively low amount of translation equivalents present. However, the current study did not analyze the number of translation equivalents present in the lexicons of the participants; therefore, this inference is highly speculative. Additional studies need to examine disambiguation in bilingual children

Kalashnikova, Escudero, and Kidd (2018) performed similar tasks, the KRS, NRS, and the Referent Selection Retention tasks in the current study, that examined fast-mapping, novel word learning, and retention of novel words for 18 and 24-month-old bilingual and monolinguals. During the known and novel referent task, the participant was presented with a known and novel object and asked to locate the object by a known or novel label. During the retention task, the participant is presented with two novel objects, previously labeled, and asked to locate the novel object by its assigned novel label. The authors reported 18-month-old bilinguals and monolinguals attended to the known objects, novel objects, and retained, labeled novel objects with no significant difference between the groups. Kalashnikova et al., (2018) also reported for 24-month-old bilinguals and monolinguals attended to the known and novel objects with no significant difference between the groups. Similarly, Davidson et al. (1997) conducted a disambiguation task where the novel objects were referred to with a novel label- bilingual and monolingual children ages 3 and 4-years-old attended to the novel objects with no significant difference between the groups. Within these studies (Kalashnikova et al., 2018 & Davidson et al., 1997), the bilingual children's ages were highly similar to the age range used in the current study (e.g. 17-43 months-old). Although Byer-Heinlein and Werker (2013) and Kalashnikova et al. (2018) reported significant differences in bilingual disambiguation abilities compared to monolingual, both acknowledged that certain bilingual participants were capable of accurately identifying the novel object after hearing the novel label. The current study found no significant difference in accurately identifying novel objects after hearing a novel label, indicating that the bilingual children were able to disambiguate with similar accuracy and similar rate as monolingual children.

While the specific reasons behind this are unknown, there are a few possibilities. One possibility could be a lack of translation equivalents as discussed in Byers-Heinlein and Werker (2013)- while this is not able to be confirmed based on the demographic data, it still remains a possibility. Another possibility could be the significant age variance in bilingual group (e.g. 17-43 months); this variance causes responses, from participants experiencing different levels of cognitive development and language development, to be grouped together and averaged. This implicates that each participant's individual ability to disambiguate is not accurately represented in the results. One last possibility could be unknown variance in each participant's individual language background; while it is known if the participant is bilingual or is exposed to an additional language, it's not known how the participant interacts with their language environment, if the use of disambiguation is high or low.

For the current study, in the Referent Selection Retention task, there was no significant difference between the bilingual, intermittent bilingual, and monolingual groups in accuracy or reaction time. Kalashnikova et al., (2018) reported 24-month-old bilinguals did not retain the novel labels assigned in the previous novel referent trial, but 18-month-old participants did retain the novel labels assigned to novel objects. It should be noted that the participants from the 18-month-old experiment were the same as the 24-month-old participants in the second experiment. This indicates where once at a younger age bilingual children were able to retain novel labels, after a few months within bilingual language development, retention levels were significantly different than monolingual retention levels. The authors discussed the underlying reason behind the significant difference was related to the bilingual participant's exposure to the English language. They reasoned that a large amount of exposure to English might have resulted in higher retention of the novel labels because the word learning strategy of mutual exclusivity would be seen as useful for discerning word meaning (Kalashnikova et al. 2018). The authors additionally stipulated that for the majority of their bilingual participant's language exposure was not equal between the two; but for the participant's whose languages were balanced, their performance on retention was similar to that of the monolingual group. In the current study, the bilingual group consisted of fifteen participants whose reported language exposure to English and an additional language was relatively equal. It can then be inferred that the bilingual participants utilized mutual exclusivity to learn and retain the novel labels at a similar accuracy and rate as the monolingual participants.

For the novel noun generalization (NNG) the results show that the bilingual, intermittent bilingual, and monolingual primarily generalize novel objects through a shape bias. These results are supported by similar findings (Landau et. al., 1988, Jones et. al., 1991) in studies also showing 2 and 3 year olds generalizing based upon shape. While those studies do not directly address the generalizations of bilingual children, they do address the age range in which the current study's participants fall into. A recent study by Schonberg et al. (2019) examined novel noun generalization in bilingual children, ages 18-24 months, in both English and Spanish. The results showed that bilingual children who underwent NNG tasks in English showed a shape bias, while bilingual children who underwent NNG tasks in Spanish showed no clear bias and were highly varying in their responses (Schonberg et al., 2019). The results of this study are highly comparable to the results of this study due to the similar conditions participants were tested under. Both studies used a NNG task and were conducted in English. With this in mind, the results of Schonberg et al. (2019) were similar and replicated in this study- the bilingual participants, ages 17-43 months-old, showed a shape bias in an NNG task that was conducted in English. While Schonberg et al. (2019) conducted another NNG task in Spanish and resulted with variance in the bias of the bilingual participants, the current study did not. Therefore, only part of the results from the Schonberg et al. (2019) study were replicated in a similar task in the current study- it is unknown whether the current study could've replicated the remaining results (Schonberg et al., 2019) of variance in bias.

For the Direct Novel Naming and Retention there was no significant difference between the groups in accuracy and reaction time. Similar to the Referent Selection Retention task, the reasoning implemented by Kalashnikova et al. (2018) can be inferred here as well; that bilingual participants whose language exposure was relatively equal were able to retain the novel labels similar to the monolingual group; meaning that the bilingual participants employed disambiguation when word learning. The current study also had bilingual participants who reported relatively equal exposure to language. If the bilingual group, with relatively equal language exposure, accomplished word learning and retention, the same reasoning can be inferred for the intermittent bilingual group who experienced less exposure to an additional language. While the Direct Novel Naming and Retention task differ from the NRS and RS Retention Task, participants were familiarized with novel labels for novel objects and then retention of novel labels were tested. It cannot be claimed that bilingual participants were completely accurate in identifying these novel objects, the results report that the bilingual participants were similar in their accuracy to the monolingual participants. This indicates that bilingual participants' word learning abilities match those of monolingual children.

For the Known Word Comprehension task, the results indicated in accuracy the monolingual and intermittent bilingual groups differed significantly from the bilingual group. In reaction time however, there was no significant difference between the groups. Vagh, Pan, and Mancill-Martinez (2009) studied the vocabulary growth of Spanish and English-speaking bilingual and monolingual children from the age 24 to 36 months, specifically looking at the English vocabulary growth. Vocabulary growth was examined through the “MacArthur Bates CDI: Words and Sentences” toddler assessment, the Picture Vocabulary subtest of Woodcock Language Proficiency Battery-Revised, and the Peabody Picture Vocabulary Test-3rd Edition. Their findings indicated that monolingual and mostly English-speaking bilinguals had a larger vocabulary than the bilingual children who had relatively equal or more exposure to Spanish than English. A smaller English vocabulary in the bilingual participants could be a reason for the significant difference during the KWC task. It is also important to note that the KWC task was performed in English; therefore, it is likely that the significant difference in accuracy was found in the bilingual group due to a smaller amount of English vocabulary compared to the intermittent bilingual and monolingual group. Another reason for the significant difference in the bilingual group could be the possibility of existing 2:1 and Many:1 mapping for words present in the KWC task (Byers-Heinlein & Werker; 2009). Again, the current study did not assess the potential translation equivalents that could be present in the participant’s lexicon- therefore, while this is possible, it cannot be confirmed. In the current study parents reported vocabulary size of the children. While the vocabulary size was not statistically analyzed, the descriptive data suggests that monolinguals had more words in their vocabulary than bilinguals (e.g. bilingual M=219, intermittent bilingual M=213, monolingual M=303). The current study found a significant difference in the KWC task between bilingual group and the intermittent bilingual and monolingual groups; reasoning for this significant difference is different sizes of vocabulary in English and potentially a large amount of translation equivalents. It is more likely that the vocabulary sizes between the groups differed based upon the findings of Vagh et al. (2009)- that participants who were monolingual, or predominantly used English more than their additional language (intermittent bilingual), would show a significant difference in accuracy during a vocabulary task than the bilingual participants.

Overall, in the word-learning and retention tasks, bilingual children were able to fast-map novel objects and identify them with similar accuracy to the monolingual children. It was reasoned that this was due to disambiguation potentially being viewed as an efficient word-learning strategy. This suggests that all of the participants shared a similar ability to hear the novel name, see the objects presented, create hypotheses based on the objects presented, and fast-map using their previous linguistic knowledge of known names and objects. Their ability to perform similar to the other groups could be due to if they had consistent exposure to the known objects in the trials if they had already fully learned and assigned labels to the objects, or even correctly hypothesized the answer. The results support that all children, with various language environments, are able to fast-map novel objects and names and identify them.

For the majority of the tasks, bilingual children were able to identify known objects with similar accuracy, like monolingual children. This suggests that all of the participants shared a similar knowledge in labels of the known objects, and all participants, regardless of their linguistic background, were able to identify them accurately. The rate of word learning was also similar between the groups, indicating that the presence of an additional language did not hinder bilingual participants from completing the tasks. This suggests that although bilingual and intermittent bilingual participants possess additional lexical information and linguistic mapping to sort through to reach an answer, they were able to do so with the same efficiency in time as the monolingual participants. This time efficiency could be due to longer and consistent exposure to these known objects, and therefore, the ability to identify them accurately was high. The lack of difference between the groups in accuracy and reaction time supports that children, with consistent exposure to the word, can efficiently and accurately identify an object regardless of whether or not they are learning an additional language.

Bilingual children, though they are linguistically developing in two languages, do not inherently display a language delay because they are learning an additional language. In tasks featuring fast-mapping and retention, the children who were exposed to more than one language showed no difference in performance to the children who were only exposed to one language. In all tasks, bilingual children showed a similar reaction time to monolingual children, which means that a bilingual child's rate of word learning and retention is comparable to a monolingual child. Regardless of the original reasoning of this study, those bilingual children will have a decreased accuracy and longer reaction time; the results indicate that even with a more extensive lexicon, bilingual children performed similarly to monolingual children in both accuracy and reaction time.

Limitations

A large limitation of this study was the significant age variance in the participants (e.g. 17-43 months). The variance in age implicated a few factors into the study. Language development for children at seventeen months is vastly different than language development for children at forty-three months. Word learning, Carey (1978), typically begins at eighteen months, meaning that participants in the current study had just begun word learning. By forty-three months, vocabulary size, word learning skills, and overall language development, are operating far beyond eighteen-month-olds. The data recorded for all individuals in each group was averaged and analyzed. The differences in data for seventeen month-old children and forty-three month-old children therefore were not represented in the current study. For example, a bilingual, intermittent bilingual, and monolingual children, of relatively similar age, could have varied significantly in the tasks in accuracy and reaction time. A potential implication of the significant age variance could be differences in children's ability to attend to tasks; while younger children may struggle to maintain attention where older children can cognitively maintain attention for longer periods of time. Attention to tasks may have varied across the participants due to age differences.

For future studies, it would be beneficial examine the data of fast-mapping, word-learning, generalization, and retention tasks of children a similar age, categorized into bilingual, intermittent bilingual, and monolingual language groups. Data from a future study like this could show significant differences in the results.

Conclusion

In conclusion, bilingual children have an amazing ability to learn words from different languages with a similar accuracy and at a similar rate as children who are only learning words from one language. Bilingual children also showed their ability to retain new novel labels with similar accuracy and at a similar rate as monolingual children. Contrary to the hypothesis of the study that bilingual children would demonstrate decreased accuracy and increased reaction time, the results revealed that bilingual did not deter or complicate word learning and retention in the presence of an additional language. Results could be influenced significantly in future studies by a smaller age variance between the participants. For this study, however, the results should reinforce that children who are bilingual do not experience a language delay, difficulty in learning new words, and an inability to accurately identify objects in their environment. Bilingualism possesses these specific linguistic stereotypes- despite the fact that multiple studies, including this study, has indicated that bilingual language development occurs similarly to monolingual language development. In fact, bilingualism possesses multiple cognitive advantages in linguistics that carry into adulthood. Future studies might look into the cognitive advantages that are already present in bilingual children as compared to monolingual children. Only time will tell whether or not bilingualism will continue to impact the perceptions of individuals despite the evidence present.

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