

RESEARCH ARTICLE

Acquisition of Multiple-Meaning Words, Including Polysemy and Homonymy, in the Expressive Lexicon of 3–5-Year-Olds, and the Impact of a Gamified Intervention Program

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Abstract

Vocabulary development is essential to early language acquisition, supporting cognitive, social, and academic growth. While much research focuses on general vocabulary, studies on multiple-meaning words – polysemous (related meanings) or homonymous (unrelated meanings) – are limited. This study focused on the expressive lexicon, examining (1) the progression of multiple-meaning word acquisition across ages 3, 4, and 5; (2) differences in acquisition between polysemous and homonymous words; and (3) the impact of a gamified intervention program on multiple-meaning word knowledge. Results showed age-related gains in multiple-meaning word knowledge, from ages 3 to 5. Polysemous words showed a trend of improvement from age 3, whereas homonymous word gains emerged only from age 4. The intervention program enhanced retrieval across all ages, with greater benefits for ages 4 and 5. These findings deepen understanding of expressive multiple-meaning vocabulary development in preschoolers and highlight age-related and semantic-category differences.

Keywords: vocabulary development; multiple-meaning words; polysemy and homonymy; expressive lexicon; preschool language acquisition; intervention program

תקציר

התפתחות אוצר המילים היא רכיב מרכזי ברכישת השפה בגיל הרך, ויש לה תרומה חשובה לתפקוד הקוגניטיבי והחברתי. אף שמחקרים רבים עוסקים באוצר המילים הכללי, המחקר על מילים מרובות-משמעות, כמו מילים פוליסמיות (בעלות משמעויות קשורות) או הומונימיות (בעלות משמעויות בלתי קשורות), עדיין חסר. מחקר זה התמקד בלקסיקון האקספרסיבי ובחן: (1) מהו קצב הרכישה של מילים מרובות-משמעות בגילים 3, 4 ו-5; (2) מהם ההבדלים ברכישה בין מילים פוליסמיות להומונימיות; ו- (3) מהי התרומה של תוכנית התערבות משולבת מִשְׁחֻזָּק על הידע של מילים מרובות-משמעות. הממצאים הצביעו על עלייה עם הגיל בידע של מילים מרובות-משמעות, בין גיל 3 לגיל 5. במילים פוליסמיות נראתה מגמת שיפור כבר מגיל 3, בעוד שהתקדמות

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במילים הומונימיות הופיעה רק החל מגיל 4. תוכנית ההתערבות תרמה לשיפור השליפה בכל הגילים, עם השפעה חזקה יותר בגילים 4 ו-5. ממצאים אלו מעמיקים את ההבנה של התפתחות אוצר המילים האקספרסיבי של מילים מרובות-משמעות בקרב ילדי גן, ומדגישים הבדלים הקשורים לגיל ולסוג הסמנטי של המילים.

1. Introduction

Early childhood (ages 3 to 5) is a period of accelerated vocabulary growth, characterized by both the expansion of word categories and an increasing grasp of abstract, relational, and multiple-meaning words (Hansen & Broekhuizen, 2021). This development occurs in tandem with advancing cognitive, social, and emotional skills, which allow children to use vocabulary in more complex and varied contexts (Denham et al., 2003; Rhoades et al., 2011). Vocabulary plays a crucial role in literacy skills, with vocabulary acquisition processes predicting literacy abilities at later developmental stages (Duff et al., 2015). Numerous studies have explored vocabulary acquisition in early childhood from various angles, such as lexicon size at each age (Asaridou et al., 2017), the types of words acquired (e.g. verbs, nouns, or adjectives) (Sandhofer & Smith, 2007), the role of memory and cognitive abilities (Nicolay & Poncelet, 2013), the impact of enrichment programs on vocabulary (Gonzalez et al., 2011), and more.

However, a unique subset of vocabulary – multiple-meaning words (ambiguous words) – has received relatively limited attention, particularly in Hebrew. This group includes words with multiple semantic representations (e.g. the English word *network*, equivalent to the Hebrew *reshet*, can mean a fishing net, a social network, a computer network, or a broadcasting network), and these words are typically more challenging to acquire than single-meaning words (Eddington & Tokowicz, 2015; Jalongo & Sobolak, 2011). While single-meaning words involve encoding a single semantic representation, multiple-meaning words require the encoding and integration of multiple, distinct representations for the same lexical item. This added complexity can increase cognitive demands for storage, retrieval, and processing within the mental lexicon, as the brain must manage and differentiate between meanings based on context (Klepousniotou et al., 2012; MacGregor et al., 2015). The current study therefore aims to focus on multiple-meaning words, examining the extent to which young children acquire varied meanings of multiple meanings of words, and investigating how acquisition progresses across the three age groups (3- to 5-year-olds) in the expressive lexicon. Additionally, the study seeks to assess the effectiveness of an intervention program in enhancing multiple-meaning vocabulary, with a specific focus on evaluating its impact separately for each age group.

1.1. Vocabulary of words with multiple meanings

The growth of multiple-meaning words in a person's mental lexicon occurs as existing words take on new, distinct meanings. These words represent a range of meanings associated with a single word form (Aitchison, 2012). Such words can be divided into two primary semantic categories: polysemy and homonymy (Murphy, 2010). Polysemous words include different meanings that are conceptually related by a shared underlying idea. For example, in the word *network*, mentioned above, all the meanings relate to the core idea of a "structured web of connections." Speakers may extend word meanings based on this underlying concept, as seen in the evolution from "network of people" (i.e. social network) to "computer network" (Saeed, 2015). In contrast, homonymous

words often develop through lexical borrowing or historical change, leading to meanings that are unrelated. For example, the English word *bat* can mean “a flying mammal” or “a piece of equipment used in sports,” with no conceptual connection between these meanings. Similarly, in Hebrew, the word *bar* primarily means “grain,” but also acquired additional meanings such as “a place that serves drinks” from English and “outside” from Aramaic (Crystal, 2010; Haspelmath, 2009).

Brain imaging studies (magnetoencephalography, MEG) reveal distinct patterns in how ambiguous words are stored and organized in the mental lexicon, specifically between polysemous and homonymous words. In polysemous words, which have multiple related meanings, these meanings are represented by a single, abstract lexical entry (Pykkänen et al., 2006). In contrast, each meaning of a homonymous word – where meanings are unrelated – is stored separately, with its own lexical entry (Beretta et al., 2005). Furthermore, these types of words are processed differently in the brain: when an ambiguous word appears, the activation duration for polysemous words is longer than for homonymous words (Klepousniotou et al., 2012). A possible explanation is that the related meanings of polysemous words reinforce one another, while the unrelated meanings of homonymous words compete, leading to faster decay in brain representations (MacGregor et al., 2015).

Polysemous words are more common than homonymous words, though estimates vary by measurement method. Using the Wordsmyth dictionary, 7% of words are homonymous and 84% are polysemous (Srinivasan et al., 2019). In contrast, an analysis based on frequently used words estimates that 4% are homonymous and 40% are polysemous (Barak et al., 2019).

1.2. Acquisition of multiple-meaning words in childhood

The process of acquiring multiple-meaning words in childhood differs significantly between polysemy and homonymy (Doherty, 2000). Research shows that toddlers as young as 2 years old can recognize and respond to multiple meanings of polysemous words. For instance, when hearing the word *cap*, they looked at both a bottle cap and a hat, demonstrating an ability to link related meaning (Floyd et al., 2020).

In contrast, the acquisition of homonymous words, which involve recognizing unrelated meanings for the same word, typically begins around age four (Doherty, 2000). This process requires metalinguistic ability – the capacity to distinguish between a word and its referents – which develops later than the ability to process polysemous words. Peters and Zaidel (1980) and Backscheider and Gelman (1995) found that by acknowledging that distinct objects can share the same name, children could reliably identify homonym pairs. Peters and Zaidel reported that children aged 3;10 performed at ~50% accuracy, improving to 84% by age 4;9. Similarly, Backscheider and Gelman observed ~75% accuracy among children aged 3;9 when using explicit prompts. These findings suggest that homonym processing relies on developing metalinguistic skills, with significant refinement occurring after age 4.

While the acquisition of homonyms relies on metalinguistic ability to distinguish unrelated meanings, the process of generalization plays a central role in acquiring polysemous words. Researchers have found that the semantic closeness between meanings in polysemous words facilitates the acquisition of additional meanings (Srinivasan et al., 2017). For example, English words like *hammer* and *shovel* can be understood as having dual representations: one as a noun (e.g. *hammer*) and another as an action

(e.g. *hammering*). This ability to generalize meanings extends to novel words; when children encountered a new noun like *dax*, they readily inferred that it could also represent an action, demonstrating their capacity for semantic extension (Srinivasan & Rabagliati, 2015).

As language development advances, children's ability to generalize becomes more sophisticated, enabling them to group meanings from different categories under a single word. For example, the word *chicken* can represent both an animal (taxonomy of "animal") and a type of meat (taxonomy of "food"), and *glass* can mean both a material and a drinking vessel, each with its own category. These words share a semantic relationship of material and use, allowing this relationship to extend from one word to another (Srinivasan & Snedeker, 2014). Early in language acquisition, the meanings of polysemous words tend to be concrete and tangible – such as *bow* meaning a *hair bow*. Later, these meanings often expand to abstract ("network" as in a "broadcast network"), metaphorical ("bow" as in "bow of emotions"), or psychological interpretations ("stream" as in "life stream") (Berman, 2007).

The expansion of semantic representations is facilitated by various factors, such as exposure to words in diverse contexts and the generalization of semantic relationships from one word to another (Floyd & Goldberg, 2021; Srinivasan & Rabagliati, 2015), frequent exposure to varied language in the home and educational settings (Hoff, 2006), interactions with adults and other children (Tomasello, 2003), as well as role-playing and storytelling activities in which children actively participate (Weisberg et al., 2013).

The rate of polysemous word acquisition is rapid in early stages, with a sharp increase in acquisition rate by 31 months, which then moderates but continues through later ages (Casas et al., 2018). However, homonymous words present more complex acquisition challenges and are sometimes even harder to learn than completely new words. A possible reason is the interference and delay caused by the competing meanings within homonymous words (Srinivasan et al., 2019). While young children, particularly those aged 4 to 8, may initially rely on a single, dominant meaning of homonymous words, their ability to interpret multiple meanings improves with age as they develop greater meta-linguistic awareness and learn to use contextual cues (Mazzocco, 1997). Additionally, explicit instruction can aid in the acquisition of homonymous words even at a young age (Zipke, 2011).

A distinct aspect of vocabulary acquisition involves the type of lexicon – expressive or receptive. Early vocabulary development predominantly occurs within the receptive lexicon, as children first comprehend words before using them. Research highlights that the receptive lexicon develops earlier and more rapidly than the expressive lexicon, following a universal sequence of language acquisition. This foundational vocabulary is critical for later language skills, including grammar and phonology. For instance, Stolt et al. (2008) demonstrated that receptive vocabulary growth surpasses that of expressive vocabulary and plays a pivotal role in achieving subsequent linguistic milestones. Similarly, Patrucco-Nanchen et al. (2019) emphasized that early receptive vocabulary is a strong predictor of later language abilities, underscoring its importance in overall language development.

However, the expressive lexicon gains increasing prominence between ages 3 and 5, particularly in relation to pre-literacy skills. A longitudinal study of 66 monolingual children assessed vocabulary skills at 18 months and 2 years, with follow-up at 5 years, and revealed that receptive vocabulary at age 2 strongly predicted later language outcomes, including phonological awareness, grammar, and letter knowledge. By age 5, however, the expressive lexicon emerged as a significant factor, directly influencing pre-

literacy skills and overall language development (Vehkavuori et al., 2021). Accordingly, the current study focuses on the expressive lexicon, given its dominant role in language development during the ages 3 to 5.

1.3. Intervention programs to promote vocabulary knowledge in early childhood

Language intervention programs designed to enhance vocabulary in early childhood can have a significant impact. During the preschool years, children are in the midst of an important stage for language acquisition (Al-Harbi, 2020), and tailoring these programs to their developmental needs ensures optimal language growth (Marulis & Neuman, 2010), fostering both cognitive and social skills that are foundational for future success (Wilson et al., 2013).

Most intervention studies related to vocabulary improvement have tested basic and regular vocabulary and demonstrated significant advancements in young learners. For instance, a meta-analysis by Marulis and Neuman (2010) revealed that interventions incorporating explicit and implicit instructional strategies delivered by trained adults significantly enhanced vocabulary learning in kindergarten children. Similarly, Silverman (2007) compared three methods of vocabulary instruction during storybook reading, finding that anchored (explicit explanations and use of concrete referents) and analytical (discussion of word parts, categories, and relationships) methods were significantly more effective than contextual approaches (inferring word meanings from story context alone) in promoting word learning. Kindergarteners with higher baseline language abilities demonstrated significant improvements in language skills after focusing on the subcomponents of vocabulary and decoding (Johanson et al., 2016). Many other studies have explored the impact of interventions on children with lower-level vocabulary, demonstrating their effectiveness in improving vocabulary skills and emphasizing the value of tailored approaches for early language development (e.g. Coyne et al., 2019; Korat et al., 2022; Lefebvre et al., 2011).

However, intervention studies specifically addressing multiple-meaning vocabulary in typically developing preschoolers are relatively uncommon. While they often report the benefits of the intervention, they typically either do not differentiate between the developmental stages of ages 3, 4, and 5 or focus on only one age group. For example, Storkel et al. (2013) examined how preschoolers aged 3–5 learn homonyms in comparison with novel words. The study found that high-frequency exposure to homonyms in adult speech facilitated the understanding of their multiple meanings, as repetition reinforced associations with different contexts. Homonyms were learned more rapidly than novel words, particularly when articulation matched between adult and child. High-frequency homonyms were also learned more accurately than low-frequency ones, underscoring the role of familiarity in building lexical representations. Notably, these findings were reported for the group as a whole, without separating results by age.

Other studies targeted specific age groups. For instance, a study on kindergarteners' ability to detect lexical ambiguities and homophones involved children aged 5;5–6;6, with half the participants receiving training on lexically ambiguous sentences and homophones (experimental group), while the other half received vocabulary training (control group). Pre-tests and post-tests evaluated their abilities, revealing that training significantly improved detection of homophones and lexical ambiguities (Kamowski-Shakibai & Cairns, 2016).

Similarly, Casenhiser (2005) reported improvements in multiple-meaning vocabulary when working with 4-year-olds. The study examined the children's challenges with

homonymy, focusing on their ability to assign multiple unrelated meanings to familiar words. It consisted of two experiments: experiment 1 showed that while children could successfully assign novel meanings to nonsense words, they struggled to associate an additional, unrelated meaning with a known word. However, experiment 2 demonstrated that their performance improved when the known word appeared in a syntactic frame that indicated a new meaning was required (e.g. presenting a verb in a noun frame).

Expanding upon the gaps identified in previous research, this study aims to address the limited research on how an identical intervention program specifically affects children aged 3, 4, or 5. By implementing the same program across these age groups, the study offers a systematic examination of its effectiveness in enhancing multiple-meaning vocabulary within the expressive lexicon across these three developmental stages.

1.4. A gamification-based intervention program

To investigate the impact of an identical intervention program on multiple-meaning vocabulary across ages 3, 4, and 5 separately, this study employed a gamification-based approach, utilizing the memory game (a card-matching game) that is both familiar and engaging for children in these age groups.

Play, a fundamental educational tool in early childhood, facilitates enjoyable and natural learning experiences. It stimulates children's motivation while fostering the development of critical skills in an informal, free, and creative learning environment (Irvin, 2017). Theorists such as Freud, Erikson, Piaget, and Vygotsky have highlighted various aspects of play, recognizing it as an essential component of a child's personality and developmental growth (Piaget & Inhelder, 1969; Winther-Lindqvist, 2013).

From a developmental perspective, play significantly contributes to cognitive, social, emotional, and sensorimotor abilities, fostering essential skills such as problem-solving, critical thinking, creativity, and interpersonal communication (Winther-Lindqvist, 2013). Cognitively, play enhances imagination, classification, and hypothesis generation, allowing children to explore and understand physical and conceptual properties (Magid et al., 2015). Emotionally, it offers a safe space for self-expression and resilience-building (Savina, 2014). Socially, play promotes cooperation, negotiation, and tolerance, while sensorimotor development is strengthened through activities that refine physical skills (Harris, 2000).

Pedagogically, play is a powerful tool for experiential learning, tailored to the developmental needs of young children. It nurtures their natural curiosity, promotes engagement, and provides a creative outlet for self-expression, fostering skill acquisition in an enjoyable and informal way (Veličković, 2013). Research highlights the vital role of play in learning across all ages, offering authentic learning opportunities through exploration, improvisation, and individuality (Nilsson et al., 2018; Zosh et al., 2018). As an intervention strategy, play creates a structured yet safe environment, encouraging risk-taking and challenges without fear of failure. It stimulates biological rewards, such as dopamine release, enhancing motivation and engagement (Wise, 2004). Additionally, play supports indirect learning by simulating real-world scenarios, while promoting creativity and critical thinking through controlled, competitive elements (Gray, 2013). Play, therefore, functions as both an educational strategy and an intervention tool, offering structured yet flexible opportunities for children to learn, grow, and thrive in a supportive environment.

Building on the limited research on multiple-meaning words, this study has three primary goals: first, to monitor the progress in the acquisition of multiple-meaning words

within the expressive lexicon across age groups (3–5 years); second, to investigate whether this progress differs between polysemous (related meanings) and homonymous (unrelated meanings) words; and third, to evaluate the effectiveness of a gamified intervention program in enhancing multiple-meaning vocabulary, with a focus on its impact on each age group – 3, 4, or 5 – individually.

2. Methods

2.1. Participants

The study involved 92 Hebrew-speaking children between the ages of 3;0 and 6;0, including 48 girls and 44 boys (see [Tables 1](#) and [2](#)). Participants were selected from state kindergartens where college students conducted their teaching practicum. The children came from families with middle to upper-middle socioeconomic status and were distributed across three age groups: nursery class (for 3-year-olds, referred to in the paper as age 3), pre-kindergarten (Pre-K, referred to as age 4), and kindergarten (referred to as age 5). Three children who were not native speakers were excluded and are not included in the count of 92 participants. The study received approval from the Chief Scientist of the Ministry of Education.

2.2. Materials

The Peabody Picture Vocabulary Test (PPVT) – shortened version: PPVT-IV (Dunn & Dunn, 2007) is a widely used standardized assessment tool designed to measure receptive vocabulary and assess verbal ability in both children and adults. In this study, due to limited session time with the children, which did not allow for administering the full test, a shortened version of the PPVT (S-PPVT) was used. This abbreviated version comprised 14 words selected according to the following criteria: first, two representative items were sampled from each of the first seven original sets, ensuring that the final selection preserved the breadth and structure of the source material. Second, the chosen items reflected substantial semantic diversity, encompassing body parts, familiar objects from

Table 1. Participants and group distribution

Class level	Age 3	Age 4	Age 5	All
Male	13	16	15	44
Female	8	20	20	48
All	21	36	35	92

Table 2. Estimated means and standard errors (SEs) of meaning retrieval by age group

Age group	All multiple-meaning words (18 words)	Polysemy (9 words)	Homonymy (9 words)
Age 3	0.58 (0.07)	0.59 (0.10)	0.56 (0.10)
Age 4	0.64 (0.07)	0.74 (0.09)	0.55 (0.09)
Age 5	0.84 (0.06)	0.91 (0.09)	0.77 (0.09)

the immediate environment (such as personal accessories and tools), occupations and work-related actions (which require greater cognitive complexity), social actions (pertinent to socio-emotional development), and cultural artefacts (including musical instruments and toys). Third, all items were judged by an expert to be developmentally appropriate, grounded in concepts familiar and relevant to the children's everyday environments and experiences. Fourth, the internal consistency of the adapted scale was examined, with Cronbach's alpha yielding a reliability coefficient of $\alpha = .72$. The 14 items were as follows: Flower, Mouth, Belt, To paint, To dance, Whistle, Penguin, Gift, Ruler, Arrow, To float, Horseshoe, Violin, Vegetable. The score reflected the raw number of correct responses out of 14.

Multiple-Meaning Retrieval Questionnaire (MMRQ): The questionnaire assesses lexical knowledge of multiple-meaning nouns within the expressive lexicon by prompting the retrieval of various meanings. Adapted from our former studies (Raviv, 2022; Raviv & Avraham, 2024), MMRQ includes a sample of 18 multiple-meaning noun words, demonstrating high reliability ($\alpha = .846$; $\alpha = .851$), and in the current study, Cronbach's alpha was $\alpha = .874$. Each word is presented with a two-part prompt. An example is: "(A) What is the meaning of the word MAP? (B) This word has additional meanings. Can you provide more?" (Anglin et al., 1993; and for preschoolers see: Gavrilidou, 2011; Tuppenhauer et al., 2020). The MMRQ features an equal number of polysemous words (meanings are related) and homonymous words (meanings are unrelated), with nine words in each category (see Appendix A for details and statistical balance). Semantic classification (polysemy/homonymy) was based on the Hebrew dictionary *Rav-Milim*, which also served as the source for validating the different meanings of each word (Table A1). Both categories were balanced for word frequency ($p = .39$) and the number of meanings per word ($p = .39$). Frequencies were obtained from the online archive of the School of Informatics, The University of Edinburgh (accessed from the online dictionary www.doitinhebrew.com). This balanced design allows the researchers to examine multiple-meaning word acquisition in a more comprehensive manner, capturing nuances in how children process words with related versus unrelated meanings.

Multiple-Meaning Word Cards game: As part of the study, a memory game was developed to promote the repeated use and retrieval of multiple-meaning nouns. The words used in this game were selected from the MMRQ. This pedagogical game tool consisted of a set of colourful cards, each displaying a word along with visual representations of its two most common meanings. These meanings were selected based on research findings from pre-tests conducted with multiple-meaning words (Raviv et al., 2024). Each multiple-meaning word was represented by two cards: one card featured the word alongside an image illustrating one meaning, while the second card showed the same word with an image depicting the other meaning. For instance, the word "map" had one card displaying the word "map" along with an image of a road map, and another card showing the word "map" with an image illustrating a tablecloth (Figure 1).

To fit the game within the 25-minute time frame allocated for each intervention session, 11 words (22 cards) – five polysemous (*rainbow, moon, mouse, liquid flow, circumcision*) and six homonymous (*leg, bush, steering wheel, road, map, brother*) – were selected from the 18 words in MMRQ. This number allows for approximately 2 minutes per word, enabling in-depth exposure and learning while maintaining a balance between engagement and educational pace, rather than superficial exposure to all 18 words. The words were selected based on their potential for visual representation – each of the two meanings can be clearly illustrated on the game cards. The remaining seven words (*ball, cup, movie, net, bar, wave, garden*), not included in the intervention game, served as



Figure 1. Example of two matching cards for the multiple-meaning word MAP. One card depicts a table cover, and the other illustrates a road map.

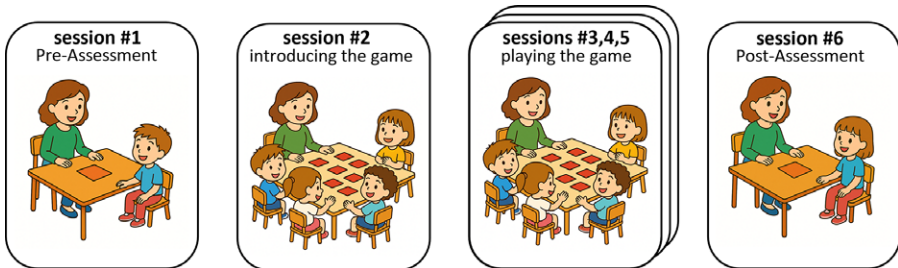


Figure 2. Overview of the six sessions comprising the study; all were spaced one week apart. Sessions 1 and 6 were conducted individually and involved oral pre- and post-assessments, respectively. Session 2, conducted in small groups of four to six children, marked the beginning of the gamified intervention by introducing the game. Sessions 3, 4, and 5, also conducted in groups of four to six children, continued the gamified intervention phase.

control words for post-intervention measurement. The game was identical for all age groups.

The game is structured into two main stages (see details in [Appendix B](#) and [Figure 2](#)). The first stage, the exposure phase, takes place over one session and involves showing the children the cards, providing guidance on the images and their meanings, and teaching them how to match pairs of cards associated with the same word. The second stage, the application phase, may take several sessions and consists of an interactive memory game. In this phase, all the cards are placed face down on the table, and each child takes turns flipping over two cards, aiming to find the matching pairs for each word. This tool is designed to improve children's ability to recognize and understand the various meanings of multiple-meaning words, integrating elements of visual learning and play.

2.3. Procedure

The study consisted of six sessions (see [Figure 2](#) and [Appendix B](#)). The first session was conducted individually with each child and involved administering the S-PPVT and completing the "Multiple-Meaning Retrieval Questionnaire." Both assessments were given orally. The computation of valid retrievals for each word involved recording the number of accurate meanings (see [Appendix A](#)) retrieved by participants, which served as a measure of retrieval proficiency. This count included both literal meanings (e.g. *mouse* as a computer device) and metaphorical meanings (e.g. *wave* as a heat wave). However, associative meanings (e.g. *mouse* as something disgusting) were excluded from the analysis. For each participant, the mean number of retrieved meanings was then

calculated by averaging the total number of valid retrievals across all words, as well as separately for polysemous and homonymous words.

The second session introduced the children to the game, familiarizing them with its rules by showing them the cards, providing guidance on the images and their meanings, and teaching them how to match pairs of cards associated with the same word. Sessions 3 through 5 lasted 25 min each (e.g. Ruston & Schwanenflugel, 2010) and focused on playing the game, where each time a child found a matching pair of cards, they were prompted to recall and verbalize the different meanings of the word, providing repeated retrieval practice throughout the game. These sessions were held in groups of four to six children, with research assistants guiding and facilitating the activities. Attendance and participation were monitored to ensure that all children took part in every session type. The sixth and final session was individual and involved re-administering the “Multiple-Meaning Retrieval Questionnaire” to measure the effectiveness of the intervention program in improving the children’s ability to retrieve multiple meanings. All sessions were spaced one week apart.

2.4. Statistical analysis

Item-level data were analysed using mixed-effects models to account for the fact that responses to the 18 MMRQ items were nested within participants, resulting in multiple observations per participant (see [Appendix A](#)). The data were organized in long format, with each row representing a single word response, along with the number of validated retrievals for that word. Random intercepts were specified for both participants and items to model variability at both levels.

Since the dependent variable comprises count outcomes, a generalized linear mixed-effects model (GLMM) with a Poisson distribution was evaluated for its adequacy. However, the outcome distribution indicated underdispersion: the mean number of retrievals per word was relatively low ($M = 0.69$) and the variance was smaller than the mean ($Var = 0.31$), violating the Poisson assumption of equal mean and variance. Model fit comparison further supported this: a linear mixed-effects model (LMM) yielded substantially lower AIC and BIC values ($AIC = 3685.14$, $BIC = 3745.29$) than the Poisson GLMM ($AIC = 5502.99$, $BIC = 5569.16$), indicating superior fit to the observed data. Given this evidence, final analyses were conducted using LMM. Models included fixed effects for age, gender, and general vocabulary level and were fitted using restricted maximum likelihood (REML) estimation. All analyses were conducted in R using the *lme4* and *lmerTest* packages.

3. Results

3.1. Acquisition of multiple-meaning vocabulary in the expressive lexicon of children aged 3 to 5

Children’s acquisition of multiple-meaning vocabulary in the expressive lexicon was assessed using the MMRQ, administered at baseline. To examine whether retrieval performance varied across the 18 target words – and specifically between polysemous (related meanings) and homonymous (unrelated meanings) items – as a function of age and vocabulary level, an LMM was fitted to the pre-intervention data. The model included semantic category, age (*dummy-coded*; see [Table 1](#)), and their interaction as fixed effects,

with vocabulary level (S-PPVT score; continuous) and gender entered as covariates. Random intercepts for *participant* and *item* were specified to account for repeated measures and item-level variability. The model was specified in R as [retrievalRate ~ semanticCategory * age + vocabulary + gender + (1 | participant) + (1 | item)].

The model revealed a significant effect of age, with age 5 differing significantly ($\beta = 0.331$, $SE = 0.105$, $t(78.9) = 3.14$, $p = .002$) from the reference group (age 3), but not for age 4 ($p = 0.84$). No significant effect of semantic category was demonstrated ($p = 0.81$); however, a significant interaction between semantic category and age group emerged, with children aged 4 retrieved significantly more meanings for polysemous words than for homonymous ones ($\beta = 0.157$, $SE = 0.056$, $t(1477) = 2.76$, $p = .005$) as did 5-year-olds ($\beta = 0.111$, $SE = 0.052$, $t(1477) = 2.13$, $p = .033$), whereas no significant difference was observed for 3-year-olds ($p = 0.813$). These findings suggest increasing sensitivity to semantic relatedness with age. To directly compare performance across age groups within each semantic type, pairwise comparisons with Bonferroni correction were conducted. These showed that children aged 5 outperformed those aged 4 in both polysemous words ($\beta = 0.173$, $SE = 0.055$, $t(128) = 3.09$, $p = .007$) and homonymous words ($\beta = 0.219$, $SE = 0.055$, $t(128) = 3.91$, $p < .001$), while controlling for vocabulary level. No significant difference was found between ages 4 and 3 for homonymous word retrieval ($p = 1.00$), while in polysemous words, a non-significant trend suggested slightly higher performance for age 4 compared with age 3 ($p = .104$) (see Table 2 and Figure 3). Vocabulary level was also a significant positive predictor of retrieval ($\beta = 0.049$, $p < .001$), whereas gender was not significant ($p = 0.88$).

3.2. Assessing the impact of an intervention program on the multiple-meaning vocabulary

To assess the impact of the intervention program on vocabulary knowledge, an LMM was conducted to examine retrieval performance before and after the intervention, comparing experimental words (the 11 words included in the intervention) with control words (the seven words not included in the intervention). The dependent variable was the extent of word retrieval. The fixed effects included time (pre- and post-intervention; within-

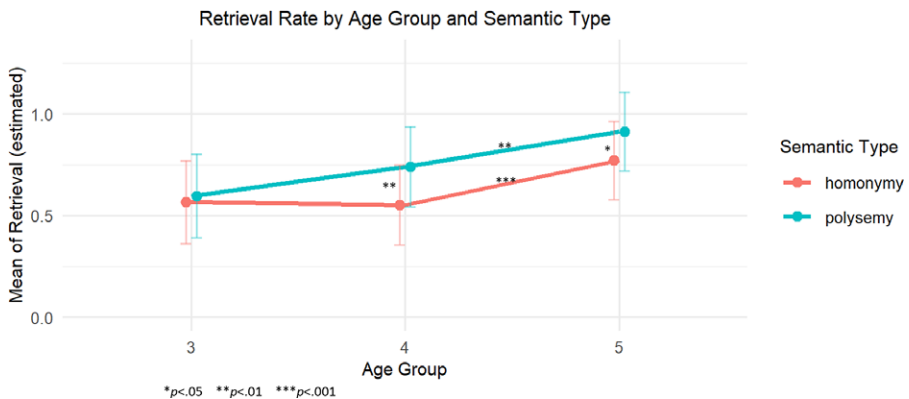


Figure 3. Mean number of retrieved meanings with standard errors (SEs) by age group and semantic category (polysemy versus homonymy).

subject), word group (included versus not-included; within-subject), and age group (dummy variable; see Table 1), along with all two- and three-way interactions. Vocabulary level (S-PPVT scores) was included as a covariate. Random intercepts were included for both participants and items to account for repeated measures and item-level variability. The model formula in R was [retrievalRate ~ time * wordGroup * age + vocabulary + (1 | participant) + (1 | item)].

The analysis revealed a significant effect of time ($\beta = 0.148$, $SE = 0.043$, $t(312509) = 3.44$, $p < .001$), indicating overall improvement in retrieval performance. Importantly, a significant three-way interaction between time, word group, and age was also observed, for both age 4 ($\beta = 0.645$, $SE = 0.092$, $t(3125) = 6.98$, $p < .001$) and age 5 ($\beta = 0.510$, $SE = 0.086$, $t(3125) = 5.92$, $p < .001$) compared with the reference group (age 3), suggesting that the effect of time and word group on retrieval performance differed across age groups, while controlling for vocabulary level. Pairwise comparisons with Bonferroni correction revealed that all age groups benefited from the intervention (included words), although the magnitude of the effect differed. The improvement was highly significant for ages 5 ($\beta = 0.697$, $SE = 0.032$, $t(3125) = 21.81$, $p < .001$) and 4 ($\beta = 0.873$, $SE = 0.038$, $t(3125) = 22.84$, $p < .001$), while for age 3 the effect was also significant, though smaller ($\beta = 0.148$, $SE = 0.043$, $t(3125) = 3.44$, $p = .006$). In contrast, no significant improvement was observed for the

Table 3. Estimated means and standard errors (SEs) of retrieved meanings before and after the intervention program

Group	Included words		Not Included words	
	Before	After	Before	After
Age 3	0.60 (0.09)	0.75 (0.09)	0.63 (0.11)	0.67 (0.11)
Age 4	0.62 (0.08)	1.49 (0.08)	0.63 (0.10)	0.74 (0.10)
Age 5	0.79 (0.08)	1.48 (0.08)	0.85 (0.10)	0.92 (0.10)

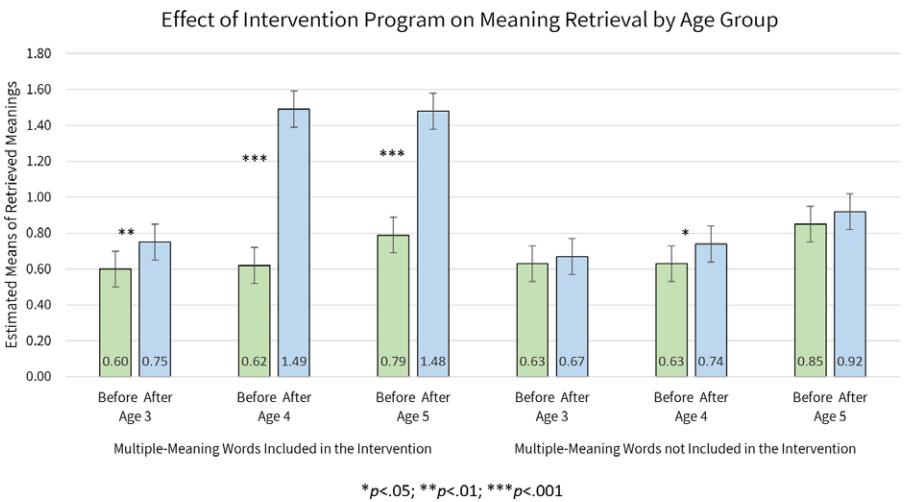


Figure 4. Effect of intervention program on meaning retrieval by age group.

control words (i.e. items not included in the intervention) for age 3 ($p = .54$) and age 5 ($p = .07$), whereas a significant effect was found for age 4 ($p = .02$) (see Table 3 and Figure 4). Importantly, an examination of the post-test responses revealed that 98% of the meanings produced by children corresponded to the meanings explicitly taught during the intervention, suggesting that the observed improvement primarily reflected learning of the trained meanings rather than spontaneous generation of new, untrained meanings (see Supplementary Material).

4. Discussion

Multiple-meaning words represent a unique and complex aspect of language acquisition, particularly during the critical preschool years. This study aimed to investigate the acquisition of multiple-meaning vocabulary within the expressive lexicon, focusing on children aged 3 to 5. Specifically, it examined age-related differences in retrieving meanings for multiple-meaning words overall, as well as separately for polysemous and homonymous words. It also assessed the effectiveness of a gamified intervention program designed to enhance multiple-meaning vocabulary.

Our first goal was to examine the overall progression in the acquisition of multiple-meaning words. The findings reveal that significant development in expressive lexical abilities occurs between ages 3 and 5, while no significant growth occurs in between. This pattern suggests that notable growth in expressive lexical access may emerge primarily during the fifth year of life. These results are consistent with prior research pointing to a marked expansion in the expressive lexicon around this age (Vehkavuori et al., 2021). This developmental leap reflects a shift towards more sophisticated and intentional expressive language use, which appears to accelerate after age 4 (Patrucco-Nanchen et al., 2019; Stolt et al., 2008). The limited gains among 3-year-olds may reflect developmental challenges in retrieving and articulating word meanings at this early stage. At the same time, prior studies have shown that preschoolers, including 3-year-olds, can begin to engage with word-meaning tasks, demonstrating early signs of definitional ability (e.g. Gavrilidou, 2011; Tippenhauer et al., 2020).

The ability to assign and retrieve multiple meanings reflects both linguistic and cognitive advancements, including improved memory, conceptual mapping, and meta-linguistic awareness (Eddington & Tokowicz, 2015; Jalongo & Sobolak, 2011). These findings expand the knowledge about expressive lexicon development, particularly in the context of multiple-meaning words, which demand more advanced semantic processing and retrieval capabilities than single-meaning words (Klepousniotou et al., 2012; MacGregor et al., 2015).

Interestingly, the observed main effect for general vocabulary level further emphasizes the interplay between overall vocabulary knowledge and the ability to retrieve multiple meanings. Children with higher general vocabulary proficiency demonstrated greater retrieval success, suggesting that a robust vocabulary foundation supports more effective semantic processing and retrieval (Denham et al., 2003; Rhoades et al., 2011). Notably, the absence of a main effect for gender indicates that the ability to retrieve multiple meanings is consistent across boys and girls, reinforcing the notion that gender does not influence this specific aspect of lexical development (e.g. Rinaldi et al., 2023).

The second aim was to further explore the progression in the expressive lexicon by distinguishing between polysemous (related meanings) and homonymous words (unrelated meanings), which represent two distinct semantic categories (Murphy, 2010). The findings revealed a significant interaction between semantic category and age group, highlighting distinct developmental patterns for words with related versus unrelated

meanings. For polysemous words, which share conceptual connections among their multiple meanings, a trend of improvement in retrieval was observed between ages 3 and 4, with a significant increase between ages 4 and 5. This pattern supports the notion that semantic relatedness may facilitate word learning by strengthening associative links in the mental lexicon during encoding, consolidation, retention, and retrieval (Klepousniotou et al., 2012; Pykkänen et al., 2006), and aligns with theories that generalization and taxonomic expansion develop incrementally during early childhood (Srinivasan et al., 2017; Srinivasan & Snedeker, 2014). In contrast, homonymous words, which have unrelated meanings, posed greater challenges for children. Significant developmental gains for homonymous word retrieval were found only between ages 4 and 5, with no notable difference between ages 3 and 4. This suggests that acquiring unrelated meanings requires more advanced metalinguistic skills, such as managing lexical ambiguity and dissociating competing meanings (Doherty, 2000), abilities that consolidate around age 4 (Backscheider & Gelman, 1995; Peters & Zaidel, 1980). These results underscore the role of semantic relatedness in shaping how children learn to retrieve multiple meanings during early language development. Future studies should aim to disentangle the relative contributions of encoding, consolidation, retention, and retrieval processes to children's learning and processing of polysemous and homonymous words.

Our third goal was to evaluate the effectiveness of a gamified intervention program in enhancing overall multiple-meaning vocabulary by comparing pre- and post-intervention retrievals for words included in the program versus those that were not. Specifically, this part of the study sought to determine how the intervention impacted retrieval performance across different age groups – 3, 4, and 5 – providing insights into its role in supporting expressive lexicon development at distinct developmental stages. The findings revealed a significant three-way interaction between age group, time, and word group, indicating that the intervention program effectively enhanced retrieval for words included in the program. Significant improvements were observed across all age groups, with greater gains for children aged 4 and 5. These results align with evidence from the literature, which emphasizes the importance of structured, targeted interventions in supporting vocabulary acquisition during early childhood. For instance, Marulis and Neuman's (2010) meta-analysis, which reviewed 67 studies evaluating the impact of language and vocabulary interventions, reported a substantial average effect size of 0.88, emphasizing that well-designed interventions can significantly enhance word learning during this critical developmental period. Specifically for the expressive lexicon, Ruston and Schwanenflugel's (2010) study demonstrated the effectiveness of structured conversational interactions in fostering expressive vocabulary growth among children aged 4 and 5. Rooted in theories of mediated learning and social interaction, the intervention involved intentional and cognitively stimulating conversations facilitated by trained adults. Results indicated significant gains in expressive vocabulary for children in the intervention group compared with controls.

Notably, the group of 3-year-old children, which showed no significant expressive vocabulary gains compared with 4-year-olds in the pre-assessment, demonstrated significant improvement after the intervention, with marked gains in retrieval performance for words included in the program. Previous studies have shown improved language performance in 3-year-old children following interventions that typically used relatively simple tasks (e.g. Fricke et al., 2013, 2017; West et al., 2021). These often included storytelling, picture-based discussions, object naming, and basic phonological awareness activities such as clapping syllables or matching sounds. In contrast, the current intervention involved a somewhat more complex task – an adapted memory game requiring

children to match different visual representations of a word's multiple meanings (e.g. "map" as a road map and as a tablecloth). Despite the increased demands, 3-year-olds showed meaningful gains, suggesting that young children can benefit from more challenging tasks when appropriately supported.

This study has several limitations that should be acknowledged. It focused mainly on retrieval performance, leaving other dimensions of multiple-meaning vocabulary, such as receptive knowledge, unexplored. Additionally, in the MMRQ, one of the balancing measures, word frequency, was based on digital text archives rather than data derived from children. A further limitation concerns the use of the S-PPVT as a covariate. Because this version included only 14 items, it may have provided a less comprehensive estimate of children's vocabulary knowledge compared with the full standardized test. Future research could address these limitations by incorporating broader vocabulary measures and child-based frequency norms.

Supplementary material. The supplementary material for this article can be found at <http://doi.org/10.1017/S030500092610066X>.

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Competing interests. The authors declare none.

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Appendix A. Multiple-meaning retrieval questionnaire (MMRQ): Structure and statistical details

Table A1. List of words included in the multiple-meaning retrieval questionnaire – MMRQ (Raviv, 2022), along with their frequency of use (measured in occurrences per million words) and the number of semantic meanings associated with each word. Statistical analyses confirmed that the words are balanced across semantic categories in terms of frequency ($p = .39$) and number of meanings ($p = .39$)

Multiple-meaning retrieval questionnaire – MMRQ (Raviv, 2022)					
Semantic category	Words (frequency in parentheses)	Meanings (number of meanings in parenthesis)	Average of word frequency $p = .39$	Average of number of meanings $p = .39$	Cronbach's alpha
	עכבר, mouse (5)	little animal, computer clicker (2)			
	זרם, current (19)	liquid flow, electricity, metaphorical use ("easy-going person") (3)			
	לבנה, moon (24)	white-coloured, moon, personal name (3)			
	קשת, rainbow (32)	rainbow, hairband, weapon (bow), violin bow (4)			

(Continued)

Table A1. (Continued)

Multiple-meaning retrieval questionnaire – MMRQ (Raviv, 2022)					
Semantic category	Words (frequency in parentheses)	Meanings (number of meanings in parenthesis)	Average of word frequency $p = .39$	Average of number of meanings $p = .39$	Cronbach's alpha
Polysemy	ברית, circumcision (42)	baby ceremony, promise, agreement with God (3)	71.44	3.11	$\alpha = 0.72$
	כדור, ball (104)	game, pill, metaphorical use ("ice cream scoop," "planet Earth") (4)			
	גביע, cup (111)	something to drink from, shiny prize (2)			
	סרט, movie (121)	a movie to watch, hair ribbon (2)			
	רשת, net (185)	a thing to catch fish, for window, a group of stores, internet, channel (5)			
	הגה, steering wheel (7)	for driving, speaking (2)			
	אח, brother (15)	in family, heater, helper, friend, when something hurts ("ouch!"), when something feels good ("ahh") (6)			
	שיח, bush (17)	bush, talking (2)			
	ציר, hinge (18)	a hinge for a door, birth pain, road, sauce, a line on a graph (5)			
Homonymy	מפה, map (22)	a cloth to cover a table, a map that shows roads (2)	49.44	3.67	$\alpha = 0.76$
	רגל, leg (58)	a leg, a holiday, something to measure things (3)			
	בר, bar (89)	a name, a place to eat, nature or outdoors, son, grain or wheat (5)			
	גל, wave (91)	a wave in the water, a name, metaphorical use ("heat wave") (3)			
	גן, garden (128)	kindergarten, a park, nature garden, zoo, Garden of Eden (heavenly garden) (5)			

Appendix B. Gamified intervention program

This appendix outlines the six study sessions, with a focus on the four gamified intervention sessions. All sessions were spaced one week apart. Sessions 1 and 6 involved individual pre- and post-assessments. Sessions 2 to 5 focused on a gamified activity conducted in groups of 4–6 children. Table B1 shows how the game was introduced and played, highlighting typical interactions and the facilitator’s role in guiding the activity.

Table B1. Overview of the six study sessions with a focus on the gamified intervention

Session 1 – week 1	This session was conducted individually and involved two tasks: • Administration of the S-PPVT. • Completion of the Multiple-Meaning Retrieval Questionnaire as a pre-assessment of multiple-meaning vocabulary knowledge.
Session 2 – week 2: Introducing the game	The dialogue below reflects a typical flow of a 25-min. session: Facilitator: “Who knows how to play Memory?” Children: “We do! We have it in our classroom!” Facilitator: “That’s right! And your teacher told me you’re really good at it. So I brought a special kind of memory game just for you. But this one is a little different from the usual version...” Children: “How is it different?” Facilitator: “In the regular game, you look for two identical cards, right? But in our version, we’re looking for two cards with the <i>same word</i>, but <i>different pictures</i>. Let me show you...” <i>The facilitator presents a pair of cards, both of the word “Map.”</i> Facilitator: “Look at these two pictures. What would you call this one?” (<i>points to the first card</i>) Children: “A map (A road map)!” Facilitator: “And what about this one?” (<i>points to the second card</i>) Children: “A map (A tablecloth)!” Facilitator: “Wow! Same word, but two different pictures. That’s the surprise in our game—some words can mean more than one thing!” Facilitator: “Now let’s move on to another pair...”
Sessions 3,4, and 5 – weeks 3,4, and 5: Playing the game	The dialogue below reflects a typical flow of a 25-min. session: Facilitator: “Child A, you’ll start. Turn over two cards and let’s see what you find...” Child A: (<i>turns over two cards</i>) “Here I got a net and a ball...” Facilitator: “Not the same word this time. Now it’s Child B’s turn!” Child B: (<i>turns over two cards</i>) “Wow! Two cards with a map!” Facilitator: “Great job! You found a pair! Now tell everyone—what do you see on the two cards?” Facilitator instructions to children: • Offered ongoing verbal encouragement (e.g. “Excellent!”, “Well done!”, “Great job!”) • Asked children to clearly explain both meanings before moving on to the next turn • Gave helpful hints when children had trouble identifying a meaning • Kept all children engaged by asking questions to the whole group • Repeated the meanings to help reinforce learning
Session 6 – week 6	This session was conducted individually and involved completing the Multiple-Meaning Retrieval Questionnaire as a post-assessment of multiple-meaning vocabulary knowledge.

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