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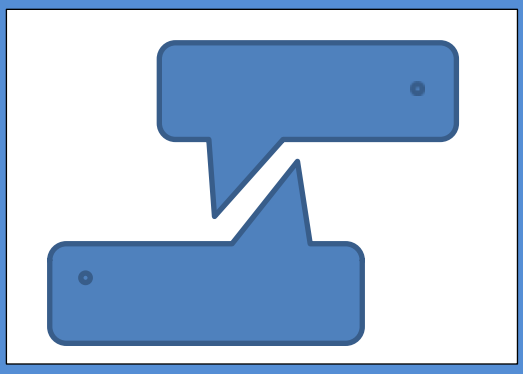

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Addressing the impact of psychosocial factors of parents on home-training: A pre-post comparison

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Abstract

Language learning of children with communication disorders is facilitated in natural situations by parents through the home-training provided by Speech-Language Pathologists (SLPs). Implementation of home-training is highly dependent on the psychosocial factors of parents. Hence, the present study aimed at addressing the impact of psychosocial factors like stress, anxiety, depression and hope levels of parents on home training of their children. The study employed a case study method to examine the impact of psychosocial factors in parents on the home training of their children with communication disorders. Two mothers of children with special needs served as participants. Both were assessed to have high parental stress using Depression Anxiety Stress Scale-21 and lower levels of hope using Adult Trait Hope Scale. Following the assessments, the mothers underwent CBT while their children simultaneously received speech-language therapy. The impact of improvement in maternal mental status post-CBT on the children's target behaviours during clinical therapy was studied and documented. Results revealed that an increase in the mothers' hope levels corresponded with noticeable improvement in the children's target behaviours—progress that had not been observed earlier. The gradual shift in the mothers' perspectives regarding their children's conditions contributed to a more positive approach towards rehabilitation. The study

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emphasizes the importance of SLPs recognizing parents' mental status at an early stage and providing timely referrals, as doing so is crucial for ensuring better and faster prognosis for the child.

Keywords: Home-training, Psychosocial, Speech–Language Intervention, Cognitive Behavioral Therapy

1. Introduction

A communication disorder is an impairment in the ability to receive, send, process and comprehend concepts or verbal, nonverbal and graphic symbol systems (ASHA,1982). Depending on the child's needs and priorities of parents' or caregiver's intervention of communication disorders varies. It typically involves a team approach including professionals, family members and the child. Among the family members, parents play an integral role in deciding goals for the intervention program as well as in implementing and transferring learned behaviours to natural contexts. Literature suggests that parents are the effective facilitators for speech and language development in case of both typically developing children as well as children with communication disorders (Law et al., 2003; Gibbard et al., 2004; Roberts & Kaiser, 2011). Speech-Language Pathologists (SLPs) work closely with parents of pre-school aged children to promote language learning at home (Watts Pappas et al., 2008; Roulstone et al., 2012). As a part of intervention, SLPs provide structured home training for parents to implement the clinically learned behaviors across everyday contexts (Bowen & Cupples, 2004; Watts Pappas et al., 2008).

Several factors influence the success of home training. These factors are broadly classified under child factors (age, gender, complexity of the condition), family factors (income and family functioning), and environmental factors (supports and resources) (Di Marino et al., 2018). Within the factor 'Family', major involvement is of parents, their psychosocial status, financial status and their own physical and mental health (Prata et al., 2019).

Parenthood is a significant responsibility that requires patience, dedication, and effort. In general, parenthood is associated with high level of stress (Crnic & Low, 2002). Further, parenting has been reported to be more stressful when the child has a disability (Watson et al., 2011). Special children would require specialized care in terms of medical or non-medical care, expenses related to the same, uncertainty about the prognosis, sometimes repeated hospitalizations, day-to-day caregiving activities, lack of proper professional support at times have all proven to lead to disruption in familial role distributions, financial stability, overall burden and social networks (Kazak et al., 2006; Cousino & Hazen, 2013; Price et al., 2016; Yassin, 2023). Thus, these challenges and care towards children with special needs in turn have shown to increase the trauma in the family leading to several parental psychosocial factors like stress, depression, and anxiety (Rosenbaum, 2011; Dirks & Hadders-Algra, 2011; Osmančević Katkić et al., 2017; Robinson et al., 2018; Bujnowska et al. 2019; Scherer et al., 2019; Megreya et al., 2020; Kutuk et al., 2021). Further they also exhibit impairments in physical function (Cantwell et al., 2014), social function (Ali et al., 2012), quality of life (Arora et al., 2020).

A large number of studies have reported that parents of children on the Autism experience higher levels of stress (Rodigrue et al., 1992; Yamada et al., 2007; Dabrowska & Pisula, 2010; Hayes & Watson, 2013; Keenan et al., 2016; Porter & Loveland, 2019). Kutuk et al (2021) reported high levels of burnouts and depression in mothers and fathers of children with Autism. Machado Junior et al. (2016) figured out that around 26.7% of parents of children with Autism were diagnosed as having depression. Review also suggests that parents of children with other communication disorders like cerebral palsy (Vijesh & Sukumaran, 2007; Mushtaq et al., 2014; Barreto et al., 2019) and intellectual disability (Singh et al., 2008) face stress, anxiety as well as depression. More than fathers, mothers of children with communication disorders have been reported to experience higher levels of stress and depression (Davis & Carter, 2008; Ang & Loh, 2019; Megreya, 2020). Sharma et al. (2023) reported that 66.3% of mothers and 35.4% of fathers of children with intellectual disabilities exhibited significant depressive symptoms.

Review of literature also indicates that these parental psychosocial factors negatively affect the well-being and development of children with special needs (Rosenbaum, 2011; Dirks & Hadders-Algra, 2011; DeSocio, 2015). Neece et al. (2012) found that these psychosocial issues can have a significant impact on the parent well-being as well as parental practice resulting in poor child, parent/family interaction or outcomes with children with developmental delays because of the presence of bidirectional relationships between parent emotion and child outcomes (Woodman et al., 2015). All these indicate that parental psychosocial factors might have a negative impact on home training. However, there is sparse literature on the same.

All the above background necessitates to address this issue and reduce or eradicate the stress and depression levels of parents of children with special needs. Counselling is one of the ways of achieving this (Jambekar et al., 2018). It helps parents to get an insight into their emotional reactions, face the demands and challenges more positively, understand the strengths and weakness of their child better. Reduction in parental stress levels have proven to be helpful for betterment of their children with special needs (Lebowitz et al., 2020). SLPs as counsellors can address this issue to an extent, however, psychologists' intervention would be essential. As SLPs it is very important to find out parents who would require a psychologists' intervention and provide proper referral.

To improve the overall psychological well-being of parents of children with communication disorders, various types of cognitive-based interventions (CBIs) are implemented. CBIs include cognitive-based therapy (CBT) that employs cognitive methods to modify the behavioral patterns that are leading to stress (Beck & Haigh, 2014); dialectical behavioural therapy (DBT) involves combination of various strategies to resolve the issues; mindfulness-based intervention (MBIs) which includes mindfulness-based stress reduction (MBSR) and mindfulness-based cognitive therapy (MBCT) that would improve the awareness of the present moment and thus help them in coping the life stressors in better way (Chadwick et al., 2016); acceptance and commitment therapy (ACT) focuses on improving the

affective symptoms by promoting psychological flexibility, identifying personal values and by managing commitments to make adjustments (Hayes & Strosahl, 2005); and compassion-focused therapy (CFT) encourages participants to be compassionate towards themselves as well as others and thus assist in mental and emotional recovery (Khoshvaght et al., 2021). All these CBIs have shown promising results in reducing stress, depression, anxiety and related symptoms in parents of children with communication disorders (Bourke-Taylor et al., 2021; Parmar et al., 2021).

Cognitive Behavioural Therapy (CBT) is one of the most evidence-based practice in the field of psychological intervention for the treatment of depression, anxiety and many other psychiatric disorders (Gautam et al., 2020). CBT treatment usually involves efforts to change thinking and behaviour patterns through a collaborative work of psychologist and the client by developing an understanding of the problem and treatment strategy for the same. Majorly CBT has been applied on children with communication disorders, especially children with ASD who are facing anxiety and depression issues (Perihan et al., 2020; Wood et al., 2020; Olsson et al., 2021). CBT has also been documented to show positive effects in reducing parental stress and improve their mental health (Bourke-Taylor et al., 2021). However, study of application of CBT on parents of children with communication disorders is sparse.

In the current study, two children who failed to show improvement in their language outcomes despite providing intensive speech-language therapy were considered. Further, home-training was found to be inadequate which was in-turn affecting the progress of children. Clinical observations indicated that parental psychosocial factors might have been influencing home-training consistency. These observations align with models of family-mediated intervention, particularly ecological systems theory and parent-mediated therapy frameworks, which emphasize the central role of caregiver emotional well-being in enabling effective child rehabilitation (Bronfenbrenner, 1992; Roberts & Kaiser, 2011). Recent research also supports this view: parent-implemented language programs improve child outcomes through changes in parent behaviour and emotional engagement (Heidlage et al., 2020), while parental stress mediates child progress and participation in developmental intervention programs (Guzick et al., 2024; Hayes & Watson, 2013).

Given this context, the current preliminary study aimed to examine the impact of CBT on the psychosocial status of mothers of children with communication disorders and to explore how changes in mothers' mental health influenced home-training and the development of speech-language skills in children, which have been sparsely studied till date.

2. Methodology

A case study method was employed in this study. Generally, case studies are carried out intensive analysis and descriptions of a single unit or a system that is bounded by space and time by studying a single case or more (Campbell, 2015). Campbell (2015) suggests five applications of case studies: one to explain the presumed causal links in real-life interventions, next to describe an intervention, to illustrate certain topics, to explore situations in

which intervention has no clear set of outcomes and to conduct meta-evaluation (pg. 201-202). Sample size for case studies are generally determined by the principle of data saturation and not through statistical power or fixed numbers (Ahmed, 2025). As the current study was a preliminary study of one of its kind in India, only two participants were considered.

1.1. Participants

Two mothers (M1 and M2) of children with special needs where M1 had a child diagnosed with spoken language disorder secondary to multiple disability (C1) and M2 had a child with a diagnosis of at risk for SLI (C2) as per DSM-V served as participants of the present study. Both M1 and M2 were assessed to have parental stress, leading to poor home training which in turn was leading to poor prognosis of the child (C1- had no improvement in spite of attending therapy for 5 years and C2 – no improvement observed post 1 month of therapy initiation). The details of children with special needs are provided in Table1.

Table 1
Children Participant's Details

Parameter	**C1**	**C2**
Age / Gender	8 years 5 months / Female	2 years 4 months / Male
Provisional Diagnosis	Spoken language disorder secondary to multiple disability (hearing loss, repaired cleft palate, ASD features, sensory issues, intellectual disability)	Risk for Specific Language Impairment
Earlier Speech-Language Intervention Duration	5 years	1 month
Home-Training Status	Inadequate	Inadequate
Improvement Before Study	Poor	Poor

Purposive and convenience sampling was carried out to select the participants. The study adhered to the ethical committee guidelines for Bio-behavioural Sciences for human subjects (Venkatesan & Basavaraj, 2009). All moral standards were met for participant selection and participation. A written consent was obtained from the participants after explaining the purpose of the study.

1.2. Data collection and processing

The two mothers, M1 and M2 underwent Cognitive Behavioral Therapy (CBT). On the other hand, children (C1 and C2) underwent speech-language therapy.

1.2.1. Cognitive Behavioral Therapy (CBT) for Mothers M1 and M2

Information on parental psychosocial factors was gathered during the counselling session of speech-language intervention on home training. Post counselling mothers were recommended to undergo clinical psychological assessment to check the levels of stress, depression and anxiety. An experienced clinical psychologist administered The Depression Anxiety Stress Scales – 21 (DASS-21) (Synder, 1991) and Adult Trait Hope Scale (Synder, 1992) to test the levels of stress, anxiety, depression and hope. The Adult Trait Hope Scale (Synder, 1992) is a 12-item self-report measure that assesses a person's level of hope as a cognitive trait, based on Snyder's theory that hope is a positive motivational state. It has two subscales Agency (goal-directed energy) and Pathways (planning to meet goals) with four items for each subscale and the total score is the sum of the scores from the Agency and Pathways subscales. Thus, the psychosocial indicators of assessment used in the study included Depression score (DASS-21), Anxiety score (DASS-21), Stress score (DASS-21) and Hope score (Adult Trait Hope Scale: Agency and Pathway subscales). These pre-therapy measurements were considered baseline scores for the CBT intervention.

Post this preliminary assessment, a structured CBT session plan was implemented to address parental stress, anxiety, depression, and low hope that were affecting home-training. The 5 structured CBT sessions spanned 3 weeks, with a 3 to 4-day gap, and were accompanied by home assignments implemented as follows. **Session 1** focused on building rapport and understanding psychosocial difficulties using DASS-21 and Hope Scale findings. Unhelpful thoughts, such as “my child will never improve,” were identified, and goals were set to reduce stress and increase confidence in supporting the child. **Session 2** involved cognitive restructuring, where cognitive distortions, such as catastrophizing and self-blame, were identified and reframed into more balanced and realistic thoughts to strengthen motivation toward home training. **Session 3** emphasized behavioral activation and stress management, introducing relaxation techniques, activity scheduling, and problem-solving strategies to help parents balance self-care with structured child interaction. **Session 4** focused on enhancing hope and self-efficacy by recognizing parental strengths, reinforcing successful attempts in home-training, and applying the goal–pathway–agency model to build confidence in the child’s progress. **Session 5** involved relapse-prevention planning, reviewing overall gains, creating coping strategies for future stressors, and reinforcing continued collaboration with SLPs to ensure that improved psychological well-being translated into consistent home training and better developmental outcomes for the child. At the end of five sessions, both were reassessed using the same tools and were compared to the pre-test scores.

1.2.2. Speech-Language Therapy for Children C1 and C2

While the mothers were undergoing CBT, simultaneously children were undergoing speech-language therapy (SLT). This was because the current

study aimed to check the effect of reduction of parental stress, anxiety, and depression levels on the home training of their children which in turn would show improvement in children's language skills.

Baseline assessment of the children's target behaviours (Table 3) was conducted through parent interviews and direct observation. Based on this, individualized goals were selected. Post this assessment SLT sessions were initiated.

A total of 8 SLT sessions of 45 minutes duration each were taken up over a period of two weeks. During these 8 sessions, the child's target behaviours (Table 3) were quantified by documenting the child's response for 5 trials. A correct independent response of the child was scored '1' and prompted response/incorrect/no response was scored '0'. The same method of documentation was asked to followed by the parents at home by using the learnt behaviour in a natural setting at home. This was monitored through video recordings as well as maintenance of documentation on child's response at home.

Child behaviour indicators included:

– Percentage of correct responses in 5-trial probes per session

– Level of prompting required (independent → visual → verbal → physical)

– Home-training performance at three points: first, mid, and last sessions

1.3. Data Analysis

A descriptive qualitative analysis was carried out. Mothers' pre-post CBT scores of stress, anxiety, depression and hope levels from DASS-21 and Adult Trait Hope Scale were compared by tabulating the same. On the other hand, pre-post SLT scores of children's target behaviors were compared and represented in table as well as graphically. Further, children's improvement in target behaviors during home training were also tabulated as well as graphically represented for the first, mid and last sessions. Lastly, comparison of mothers' improvement in the mental status with improvement of children in SLT as well as home training was carried out.

3. Findings

Objective 1 was to compare the pre- and post-CBT scores of stress, anxiety, depression and hope levels from DASS-21 and Adult Trait Hope Scale. This comparison aimed to determine whether maternal psychosocial indicators improved following the CBT intervention. Table 2 presents the pre- and post-therapy scores for both mothers.

Table 2

Pre and post test results of the psychosocial measures of both the mothers (M1 and M2)

	DASS 21			ADULT TRAIT HOPE SCALE		
	Depression	Anxiety	Stress	Agency	Pathway	Hope Total
Pre- therapy (M1)	42 Extreme	42 Extreme	42 Extreme	16 Moderate	18 Moderate	34 Moderate

Post- therapy (M1)	12 Mild	22 Extreme	22 Moderate	26 High	25 High	51 High
Pre- therapy (M2)	24 Severe	20 Extreme	30 Severe	25 High	12 Low	27 Moderate
Post- therapy (M2)	8 Normal	10 Moderate	14 Normal	27 High	28 High	55 High

The results in Table 2 show a clear reduction in depression, anxiety, and stress levels for both mothers following the CBT intervention. For M1, depression, anxiety, and stress scores decreased from 42, 42, and 42 to 12, 22, and 22 respectively. For M2, the respective scores reduced from 24, 20, and 30 to 8, 10, and 14. Additionally, both mothers demonstrated substantial increases in hope scores. M1's hope score increased from 34 to 51, while M2's increased from 27 to 55, indicating improved psychological resilience and a more positive outlook following therapy.

Objective 2 was to check the progress of children C1 and C2 in the target behaviors during speech-language therapy sessions as well as during home-training. Table 3 outlines the pre-therapy baseline status and post-therapy outcomes for each target behaviour.

Table 3
Status of Target Behaviors (G) Pre- and Post- Speech-language Intervention for C1 and C2

Participants	**Target Behaviors (G)**	**Pre-therapy (Baseline)**	**Post-therapy**	**Remarks**
C1	G - Indicating basic needs (Food, water, and toilet) through gestures	For food and water: Drags mother to the kitchen	Has started using gestures to indicate food and water with visual stimuli in her visual field	There has been a transition from full physcial prompt to visual prompt over 8 sessions of speech-language intervention and home-training
C2	G1- Improve comprehension of common objects (Towel, brush, glass, and plate)	0% - unable to comprehend the common objects	Brush – 80% Towel – 60% Glass – 80% Plate – 80%	The child is able to comprehend the target common objects based on their functions
	G2 - Improve functional communication (/ta/ for asking; /ba/ for calling; /ba:j/ for bye) (Note that /ta/ and /ba/ are the	With prompts uses /ta/ for asking, /ba/ for calling and /ba:j/ for bye, however, highly inconsistent.	With verbal prompts she has started using /ta/, /ba/, and /ba:j/ meaningfully	Only on prompts and not independently

	monosyllables used meaningfully in Kannada, a Dravidian Language) G3 - Matching picture to object (Brush and Glass)	Sometimes even non-meaningful. 0% - Unable to match	Able to match with 40% accuracy	Without prompts

Table 3 demonstrates that both children showed meaningful gains in their respective target behaviours during clinical intervention. C1, who initially relied on full physical prompts, began using gestures to indicate basic needs (food, water, toilet) with only visual prompts by the end of therapy, reflecting increased communicative independence.

C2 exhibited substantial improvement across all three target behaviours. Comprehension of common objects improved from 0% to between 60% and 80% accuracy. Functional communication (/ta/, /ba/, /ba:j/) progressed from inconsistent, prompted production to more meaningful use with verbal prompts. Furthermore, matching picture-to-object accuracy improved from 0% to 40%. These changes illustrate significant developmental gains in both receptive and expressive communication.

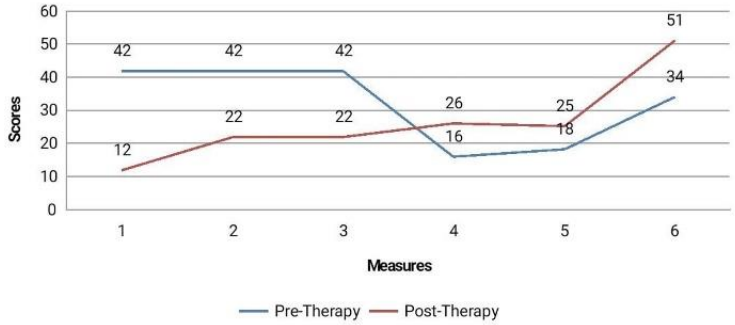
Table 4 provides information on performance of the child before initiating the home-training and after initiating the home-training. As shown in Table 4, improvements observed in clinical settings were also reflected in home-training. C1 progressed from providing no gestural indications (full physical prompts) to independently responding with visual stimuli presented within her field of vision. C2 demonstrated progressive improvement across all goals: comprehension of common objects improved from 1/5 to 3/5 correct responses, functional communication increased from 1/5 to 3/5, and matching picture to object improved from 0/5 to 2/5. While these findings indicate progress during home-training, it cannot be conclusively determined whether the behaviours were generalized to natural contexts or performed solely within structured tasks similar to those used in the clinical setting. This is because, home training was not monitored closely by the researcher rather, mothers' scoring sheets were considered.

Table 4
Children's performance on target behaviors (G) at first, mid and last sessions of home-training

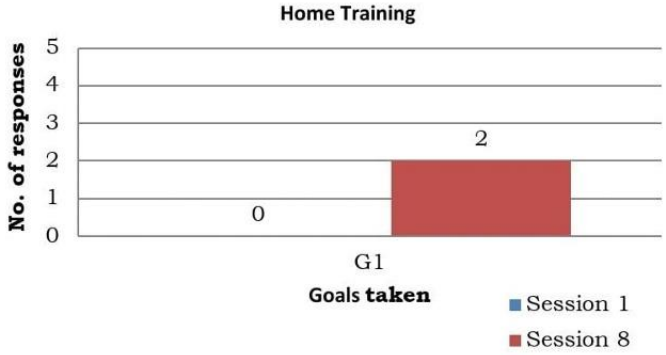
	First	**Mid**	**Last**
C1			
- **G** Use of Gestures to indicate her basic needs at home (Food and water)	No indication using gestures (Full physical prompts)	Responded twice with visual stimulus within her eye field	Responded thrice with visual stimulus within her eye field

C2			
- **G1** Improve the comprehension of common objects (Towel, Brush, Glass, Plate)	1/5	2/5	3/5
- **G2** Improve the functional communication (asking /ta/, calling /ba/, bye)	1/5	1/5	3/5
- **G3** Matching picture to object (Brush, Glass)	0/5	0/5	2/5

Objective 3 was to check the impact of improvement in mothers' mental status on children's target behaviors especially based on home-training. Figures 1 and 2 illustrate the relationship between parental psychosocial change and child progress.

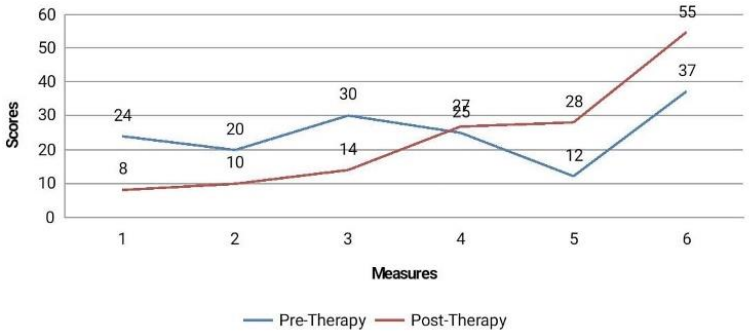


1(a) Pre-post CBT levels of stress, anxiety, depression and hope of M1

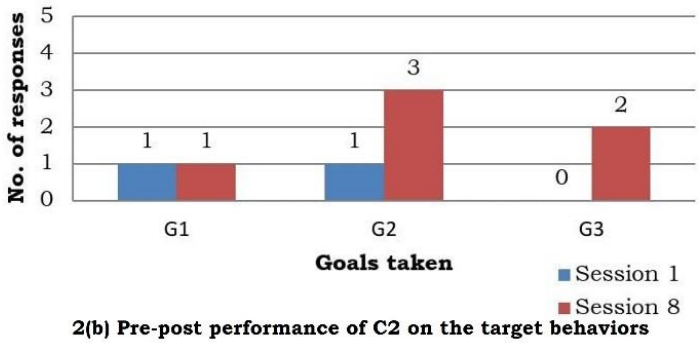


1(b) Pre-post performance of C1 on the target behavior

Figure 1. 1(a) Pre-post CBT levels of stress, anxiety, depression and hope of M1 and 1(b) Pre-post performances of C1 on the target behavior



2(a) Pre-post CBT levels of stress, anxiety, depression and hope of M2 Home Training



2(b) Pre-post performance of C2 on the target behaviors

Figure 2. 2(a) Pre-post CBT levels of stress, anxiety, depression and hope of M2 and 2(b) Pre-post performances of C2 on the target behaviors.

Figures 1 and 2 show that as maternal stress, anxiety, and depression levels decreased and hope levels increased, both children demonstrated better performance in their respective home-training tasks. This pattern suggests a positive association between improved parental mental health and enhanced child engagement and progress in home-based implementation of therapy goals. The improvement appears to be gradual and consistent, indicating that parental psychological well-being plays a crucial role in facilitating effective home-training.

4. Discussion (or Discussion and conclusion)

The findings of this study reveal that stress, anxiety and depression levels declined in both mothers while their hope levels increased following CBT. Especially, M2 had normal levels of stress and depression post CBT. This variation between the two mothers can be linked to the intensity of psychosocial distress, which was more pronounced for M1 probably due to the increased complexity of her child's condition—an insight aligned with studies showing that greater severity of a child's disability corresponds, to elevated parental stress and emotional strain (Watson et al., 2011; Kazak et al., 2006; Kutuk et al. 2021). These results confirm the recognized efficacy of CBT in enhancing emotional health and diminishing harmful cognitive patterns (Beck & Haigh 2014; Gautam et al. 2020) emphasizing the need to direct parents to psychological treatment when required as recommended by earlier research and clinical protocols (Jambekar et al., 2018; Bourke-Taylor et al., 2021). Further, these findings align with Cognitive Behavioral Theory,

which posits that altering negative thoughts can improve emotions and behavior (Beck, 1976). The results also reflect Bandura's Self-Efficacy Theory, indicating that when parents gained confidence in their ability to support their child, their motivation and involvement increased (Bandura, 1997). Furthermore, the outcomes support Bronfenbrenner's Ecological Systems Theory, which emphasizes that an improved emotional climate in the home has a positive influence on child development (Bronfenbrenner, 1979).

In addition, the noted enhancement in maternal psychosocial functioning corresponds with family-systems and ecological-system models, which suggest that understanding child development requires considering the family unit and that the well-being of parents is crucial for intervention results (Bronfenbrenner, 1992; Rosenbaum, 2011). The emotional condition of parents directly affects the nature of parent–child interactions, involvement in therapy sessions and a child's involvement, in treatment (Keenan et al., 2016; Dirks & Hadders-Algra 2011). Aligned with this framework the current study observed that decrease in stress levels and boosts in hope levels coincided with betterment, in children's targeted behaviours during clinical sessions.

The findings of the current study also align closely with a body of research on language interventions led by parents. Evidence shows that the involvement of caregivers and their emotional preparedness play a role in the effectiveness of methods like Enhanced Milieu Teaching and various naturalistic developmental strategies (Roberts & Kaiser 2011; Heidlage et al., 2020). Enhanced parental optimism and diminished stress probably facilitated regular application of home-based training thus fostering improvements, in the child's communication. This is consistent, with research indicating that parents serve as successful facilitators of speech and language growth when they receive emotional support and sufficient training (Law et al., 2003; Gibbard et al., 2004; Watts Pappas et al., 2008).

Recent research offers evidence for this connection. For instance, Guzick et al. (2024) demonstrated that parent-led CBT boosted self-assurance and involvement in therapy leading to improved results for children, with communication and behavioral challenges. Likewise, Megreya et al. (2020). Kutuk et al. (2021) noted that decreases in anxiety and depression improve the parent's capacity to engage effectively in child-centered interventions. These results support the study's observation that enhancements, in mothers' outlooks and mental resilience led to better home-training quality. The behavioural improvements noted after the intervention in both children— regarding gesture use, understanding of everyday items and effective communication—indicate that enhanced parental mental health might have supported increased consistency, responsiveness and focus during home practice sessions. This trend aligns with research showing that parental mental health is positively linked to improved child developmental outcomes and greater engagement, in interventions (Lebowitz et al., 2020; Neece et al., 2012).

Taken together, the findings of the present study provide preliminary evidence that enhancing parental psychosocial well-being through CBT may indirectly promote children's speech-language development by strengthening

the quality of home-training. This highlights the importance of a holistic, family-centered approach in speech-language intervention—an approach strongly supported in previous literature (Watts Pappas et al., 2008; Hayes & Watson, 2013; Roberts & Kaiser, 2011).

5. Conclusion

The study highlights on the fact that SLPs not only have to look into the child's condition but also give importance to the parents/caregivers' condition/mental status that is impacting the child's development. The findings reiterate that not only mothers of children with severe disabilities experience heightened levels of stress, anxiety, and depression, but mothers of children with mild or minimal disabilities may also undergo similar psychosocial challenges. Therefore, recognizing parents' mental status at an early stage by a SLP and providing proper referrals becomes very important to have better and faster prognosis of the child. Hence, by following a protocol that includes rapport building sessions followed by counselling and parent educating sessions regarding the home training and their role in home training would be beneficial. This study thus underscores the importance of a comprehensive team approach to child rehabilitation.

The novelty of this study lies in examining the effect of Cognitive Behavioural Therapy administered to parents—rather than the children—on the children's progress in speech-language intervention and home-training. While CBT is widely recognized for reducing anxiety and depression, its application as a means to enhance parental capacity for consistent and effective home-training in speech-language intervention remains largely unexplored in the Indian context. This study provides preliminary evidence that improvements in parental mental health can directly influence and enhance child communication outcomes, highlighting an innovative pathway for supporting therapeutic gains through parent-focused intervention.

However, these results are preliminary and cannot be overgeneralized, as they are based on only two participants; larger studies are required to validate and extend these findings. Further, the current study needs to be carried out on a larger population to validate the results. Also, the current study investigated the mental status of only mothers. Further research should focus on fathers as well as other family members' mental status as they too play a major role in the child's rehabilitation. A large number of studies report that the parents of children with ASD experience a higher level of stress compared to typically developing children. The identification and understanding of the factors that contribute to parent stress is necessary to effectively address the psychological needs of parents as part of any intervention program. If parents feel supported, educated and more confident in their ability to help their child, they will become better advocates for their child's needs and a better foundational support.

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Agreement groups circuits for a unified account of syntactic priming: Theory and applications

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Abstract

The present paper seeks to highlight qualitative congruencies between empirical data from behavioural experiments on linguistic structural priming and insights obtained from the Agreement Groups (AG) approach, a cognitive, usage-based, distributional framework for modelling linguistic processing. Specifically, we demonstrate that a wide variety of experimental observations can be given theoretically consistent interpretation when the AG model is situated in a cognitive circuitry-architecture of nodes and connections. With the AG method, structural priming naturally emerges as a consequence of structural similarity via repeated activation of basic structural units, i.e. AGs. The analysed phenomena include structural priming of particular linguistic constructions, lexical/semantic facilitation (boost), cross-linguistic priming, anomalous utterances, and developmental aspects of structural priming. We also point out experimentally testable issues that come up along the hypothetical discussions.

Keywords: cognitive modelling, linguistics, syntax, structural priming, language acquisition

1. Introduction

Syntactic or structural priming became an important notion of psycholinguistic research after the classic experiments of Bock (1986) demonstrated that participants were more likely to use passive sentences in a picture description task if they had been repeating passive sentences previously. Abstract structural priming has been shown to be at work behind a wide variety of linguistic phenomena ever since (see e.g. Pickering and Ferreira, 2008, or Branigan and Pickering, 2017, for an overview). Scrutinising findings on syntactic priming in production and comprehension, and on bidirectional priming between comprehension and production, Branigan, Pickering, Liversedge, Stewart, and Urbach (1995) emphasise that results from priming experiments may tap into linguistic knowledge, specifically, into mental representations of linguistic structures. This point is taken further in Branigan and Pickering (2017) where the authors argue that structural priming experiments provide a behavioural measure for the direct examination of cognitive representations underlying language use.

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The existing mainstream approaches to priming phenomena differ widely with respect to representational assumptions. In activation-based models (e.g. Pickering and Branigan, 1999) priming is a consequence of residual activation of network nodes. Syntactic structures are retrieved by spreading activation, and repeated retrieval of syntactic structures is facilitated by residual activation. Error-driven models (e.g. Chang et al., 2006) interpret syntactic priming as a result of violated expectations. If an encountered syntactic structure violates the listener's expectation, the error is corrected by adjusting neural weights so that the unexpected structure will have higher probability. In an exemplar-based approach (e.g. Ambridge, 2020) priming occurs because the exemplars previously activated for a given utterance will facilitate the retrieval of a similar utterance with a similar structure. Although all models offer explanations for repetitive usage of linguistic structure, problematic issues remain. Jacobs et al.'s (2019) experiments, for instance, reveal that while activation models are consistent with self-priming, they cannot account for the inverse frequency effect, and that while error-driven models are consistent with the inverse frequency effect, they cannot account for self-priming. Messenger et al. (2020) claim that the inverse frequency effect and short-lived lexical boost vs. long-lived abstract priming cannot be fully explained by a radical exemplar-based model. The basic assumptions of the model we propose here may be reminiscent of the favourable properties of the abovementioned approaches. *Agreement Groups* (AGs) are, by definition, exemplar-based. The circuitry architecture representation of AGs allows for activation-based argumentation as in the activation-based models and also allows for employing notions like connections between nodes and connection strength, ultimately enabling representational adjustments for error-driven approaches.

The idea of *agreement groups* and *agreement groups coverage* was presented in a series of works as a distributional approach to modelling linguistic processing. Drienkó (2014) showed that AGs, i.e. groups of 2-5 word long utterances differing from a base utterance in only one word, can account for a certain percent of novel utterances of English mother-child speech, may facilitate categorisation (lexical/syntactic, semantic), and might serve as a basis for "real" agreement relations. The findings were confirmed cross-linguistically by Hungarian and Spanish data in Drienkó (2013a). For the processing of longer utterances the notion of *coverage* was introduced in Drienkó (2013b, 2013c, 2015, 2016b). The coverage apparatus seeks to identify 2-5 word long fragments of an input utterance and map them onto AGs. By applying the AG coverage method to mother-child speech (Anne sessions, Manchester corpus: Theakston et al., 2001) from the CHILDES corpora (MacWhinney, 2000), it was found that the continuous and the discontinuous cases yielded, respectively, 78% and 83% average coverage values.

The AG model assumes two basic levels of linguistic processing. The first level corresponds to direct mappings onto AGs for processing holophrases, shorter utterances, or "formulaic" expressions. The second level requires more computational effort since firstly AG-compatible fragments have to be found (Level 1 mappings), then an optimal combination of fragments must be selected in order to assign a grammatical *coverage structure* (CS) to the

utterance being processed. The inherent dualistic properties of the AG framework are discussed in Drienkó (2020b) along with contact points for research on cognitive linguistic processing including generalisation, categorisation, a semantic/syntactic categorical interpretation of the *less-is-more* principle of Newport (1990) and its relationship to U-shaped learning (Strauss, 1982) and vocabulary spurt (e.g. Ganger and Brent, 2004), parallelisms with the dual-process model of Van Lancker Sidtis (2009), lateralization of formulaic and analytical speech (e.g. Sidtis, Sidtis, Dhawan, and Eidelberg, 2018), neurolinguistic processing (Bahlmann and Friederici, 2006), and the processing of complex linguistic structures such as long-distance dependencies, crossing dependencies, or embeddings (cf. also Drienkó, 2016b). For a more comprehensive model, Drienkó (2020c, 2024b) combined the AG framework with the Largest Chunk algorithm (Drienkó, 2016a, 2018) to produce AG systems with groups consisting of text fragments obtained from automatically segmented word sequences.

The present study seeks to demonstrate that experimental results are congruent with a model where the cognitive representation of linguistic knowledge is based on appropriate groupings of similar linguistic material. In particular, we propose the AG model, especially as situated in a network of nodes and connections, as a theoretical framework wherein a wide variety of structural (even semantic) priming phenomena can be interpreted straightforwardly.[2]

The discussion will be hypothetical in nature since we will assume the existence of possible AGs underlying the processing of particular linguistic phenomena without, naturally, there being any direct evidence that such, or exactly those, AGs exist. However, by assuming them we can provide a "constructive" account of the cognitive underpinnings of the mechanisms potentially responsible for linguistic processing. Congruency with experimental data, then, can justify our claim that for any experimental phenomenon discussed here, in principle, there can exist a corresponding configuration of AGs on which a theoretical account can be grounded. Furthermore, no any two learners of any language can be exposed to exactly the same linguistic input, which means that no two AG-bases for any two speakers can be expected to be identical. Then, arguably, even if the exact collection of AGs were known for one speaker, it could not automatically yield valid conclusions for the linguistic behaviour of another speaker. Incorporating this fact into our expectations, we will wish to demonstrate that for any average, healthy speaker there can exist some AG configurations that can account for the experimental data. In other words, our results will be immediately valid for only a subset of English. However, this subset, we intuit,

[2]Some confluence of structural priming findings and the AG model was reported as:
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Drienkó, L. (2024a). Exemplar-based Agreement Groups for linguistic abstractions: the emergence of syntactic priming effects. Talk presented at the *Linguistics Beyond and Within (LingBaW) Conference*, KUL Lublin, Poland, 17-18 October, 2024.

might grow arbitrarily large and approach the English language itself. Thus, although we do not report numerical results directly, the empirical aspects of our approach stem from the experimental foundations of the AG framework, on the one hand, and of structural priming research, on the other.

The layout of this study adopts the following order. The rest of this introduction is dedicated to a brief familiarisation with the basic components of the AG framework. Section 2 illustrates how structural priming phenomena can be analysed within this framework relying on the notion of structural similarity. Section 3 presents a circuitry interpretation of the AG model and discusses general priming-related issues whose analyses specifically favour such an AG-circuit setting (viz. semantic/lexical boost, cross-linguistic priming, and temporal characteristics of priming effects: short-lived lexical facilitation vs. long-lived structural priming). Section 4 provides AG analyses for some "classic" findings in structural priming research concerning particular linguistic constructions. Section 5 shows how anomalous utterances can be processed with the help of a reconstruction component of the AG model. Section 6 relates the U-shaped developmental dynamics of the AG space to observations in developmental studies. Section 7 draws some conclusions, points to experimentally testable issues, and outlines some future research directions.

1.1. Overview of the Agreement Groups model

1.1.1. Agreement Groups

The basic cognitive underpinning of the AG model lies in forming groups of utterances differing in only one word from a given "base" utterance. Actually, each utterance of a training corpus has its own group and, consequently, is a base utterance of its own group. For instance, the training corpus (1) yields the AGs under (2).

(1)

mommy drinks	daddy drinks	baby drinks	mommy wants
drinks tea	drinks milk	wants tea	by baby
tea is drunk	milk is drunk	tea is wanted	
goat milk	cow milk	by daddy	

(2)

AG1	AG2	AG3	AG4
<u>mommy drinks</u>	<u>daddy drinks</u>	<u>baby drinks</u>	<u>mommy wants</u>
daddy drinks	mommy drinks	mommy drinks	mommy drinks
baby drinks	baby drinks	daddy drinks	
mommy wants			
AG5	AG6	AG7	
<u>drinks tea</u>	<u>drinks milk</u>	<u>wants tea</u>	
drinks milk	drinks tea	drinks tea	
wants tea			
AG8	AG9	AG10	
<u>tea is drunk</u>	<u>milk is drunk</u>	<u>tea is wanted</u>	
milk is drunk	tea is drunk	tea is drunk	
tea is wanted			
AG11	AG12	AG13	AG14
<u>goat milk</u>	<u>cow milk</u>	<u>by daddy</u>	<u>by baby</u>
cow milk	goat milk	by baby	by daddy

Formally, an AG can be represented as a hypothetical table for concatenating linguistic units, where columns in the table symbolise (agreement) categories, and any element (word) in a column can be concatenated with any other in the next column, cf. Table 1. We say that an utterance is compatible with an AG, i.e. can be mapped onto that AG, if it can be obtained by choosing words from the subsequent columns of the corresponding hypothetical table and the number of words in the utterance equals the number of columns (i.e. utterance positions) in the AG. In fact, AGs are basic processing units for both familiar (viz. utterances in the training corpus) and novel linguistic sequences. For instance, AG1 licenses novel utterances *daddy wants* and *baby wants* besides the group member utterances *mommy drinks, daddy drinks, baby drinks,* and *mommy wants*.

Table 1
Tabular representation for AG1

hypothetical table for AG1	
mommy	drinks
daddy	wants
baby	

1.1.2. Combination of groups, coverage structure

Recall that utterance length is arbitrarily restricted to five words in AGs. For utterances longer than five words the model activates a *coverage* mechanism for building the *coverage structure* (CS) of any utterance. The coverage structure of an utterance is a tabular visualisation of a configuration of AGs onto which fragments of the utterance in question can be mapped. For instance, Table 2 shows the possible fragments that can cover sentence *daddy wants milk*. Fragment *daddy wants* can be mapped onto AG1 while *wants milk* onto AG5.

Table 2
CS for 'daddy wants milk'

daddy	*wants*	*milk*	
daddy	wants		AG1
	wants	milk	AG5

Numerically, coverage can be less than 100% when not all positions in a target utterance can be covered by appropriate (i.e. AG-mappable) fragments. For example, *mommy wants soup* would result in a 2/3≈67% coverage value since the third utterance position could not be covered because fragment *wants soup* cannot be mapped onto any AG in (2), cf. Table 3.

Table 3
Incomplete coverage (<100%)

mommy	*wants*	*soup*	
mommy	wants		AG1, AG4
	wants	?	AG ?

AGs can be represented discontinuously in CSs. For instance, AG5 corresponding to fragment *wants milk* in utterance *daddy wants goat milk* is represented discontinuously in Table 4 owing to the word *goat* as inserted between *wants* and *milk*. Discontinuous mapping in the AG framework is computationally more complex. The extra complexity in the discontinuous case is due to the fact that the mapping algorithm considers the collection of all possible discontinuous fragments in the input utterance as opposed to the collection of all possible continuous fragments in the continuous case. Generally, the latter collection is much smaller.[3]

Table 4
Discontinuous coverage: AG5 covers fragment 'wants milk' discontinuously

daddy	*wants*	*goat*	*milk*	
daddy	wants			AG1
	wants		**milk**	AG5
		goat	milk	AG11/AG12

An important question concerning the grammaticality of utterances is which AGs can be combined with which others in a given CS for a grammatically correct utterance. In order to be able to explicitly model the combinability of AGs, we can employ the notion of *Combinability Constraints* (CC). CCs are "atomistic" CSs constituting elementary patterns of how words in, basically, two AGs can be combined. The CS, e.g., for *daddy wants milk* in Table 2 can also be regarded as CC(1,5), i.e. a combinability constraint prescribing how AG1 and AG5 can be combined, namely, that the word mapped onto the second word position of AG1 must be mapped onto the first position in AG5. A combinability pattern for more than two AGs can more conveniently be interpreted as a memorised CS, or *schema***,** in the AG framework.

Note that fragments represented by AGs in CSs do not necessarily coincide with phrase-structure constituents. However, in the event of a suitable constellation of AGs in a particular CS, it can be possible to extract or derive a quasi "constituent structure" for the utterance in question. This structure will be void of mother-daughter relations, though, since CSs per se do not intrinsically impose hierarchies on AGs. We sketch a possible derivation for *daddy wants goat milk* as (3).

(3)
goat milk → (goat milk $_{AG11/AG12}$) →
wants (goat milk $_{AG11/AG12}$) →
(wants (goat milk $_{AG11/AG12}$) $_{AG5+AG11/AG12}$) →
daddy (wants (goat milk $_{AG11/AG12}$) $_{AG5+AG11/AG12}$) →
(daddy (wants (goat milk $_{AG11/AG12}$) $_{AG5+AG11/AG12}$) $_{AG1+AG5+AG11/AG12}$)

[3] In the circuitry setting to be discussed later, the larger mapping complexity for discontinuous fragments might be ascribed to memory processes: e.g. it may be necessary to suspend mapping onto one AG when an intervening fragment requires starting mapping onto another. Then the processing status of the first AG should be allocated some extra memory while the processing of the second is going on. Cf. Section 3.

1.1.3. Developmental aspects of AGs: Homogenisation of groups

Depending on the distribution of linguistic elements in the training corpus, AGs can be rather "inhomogeneous". In (4), for example, the *the boy* group includes the adjective '*big'* along with the definite article '*the'* and the indefinite '*a'*. Although the AG yields grammatically correct novel utterances (viz. *a girl, big girl, a car* and *big car*) it can be desirable to have groups with grammatically more coherent or homogeneous utterances. Therefore, the AG framework assumes an error-correcting or *homogenising* mechanism that can reorganise groups by, primarily, removing utterances. By removing e.g. *big boy* from (4) the resultant AG represents a determiner-noun word combination. Thus, integrating information on lexical-syntactic categories into the mapping-system results in modifications of the AG space (Drienkó, 2017). Semantic information can likewise affect the shaping of AGs (Drienkó, 2020a). Removing *the car* from the example in (4) results in a group with only animate nouns.

(4)

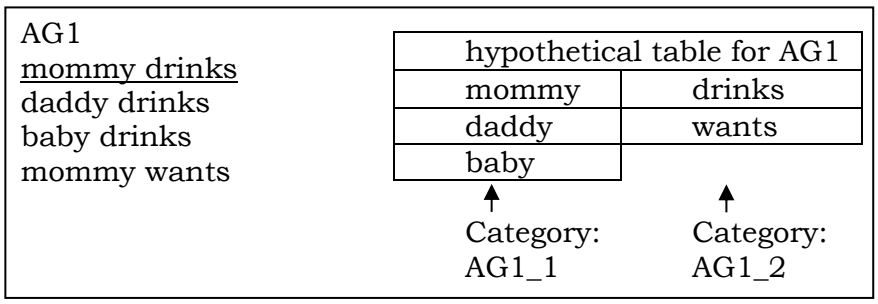
the boy
a boy
big boy
the girl
the car

Developmentally, the *homogenisation* process dictates a U-shaped trajectory (e.g. Strauss, 1982) since the appearance of either syntactic or semantic category information at some point during the formation of the processing system causes an initial drop in syntactic processing capacities (due to a reduction in average group size). However, with increasing training corpus size, i.e. with a growing body of memorised utterances, processing capacities improve (cf. also Drienkó, 2020b, Section 4.5).

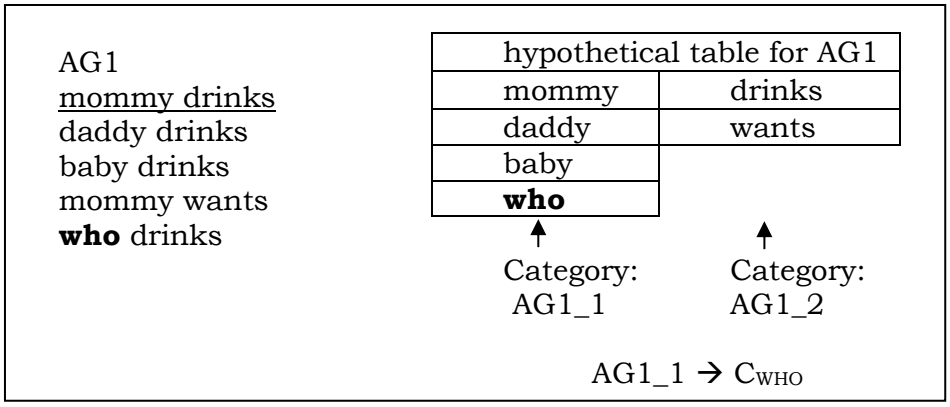
1.1.4. Category assignment

Columns in the hypothetical table representations of AGs are regarded as *agreement categories* in our model. For instance, the first words in the utterances of AG1 are assigned agreement category AG1_1, or the words in the second column belong to category AG1_2, cf. (5). Agreement categories may facilitate the development of higher-level categories, or "metacategories". Having already realised that certain words of an agreement category belong to a particular higher-level category, the language learner may infer that other words in the same agreement category also belong to that higher-level category. Knowing that e.g. '*mommy*' refers to a human being, a learner might extend this humanness feature to the other members of AG1__1, viz. *daddy* and *baby*. Category assignment may also be facilitated by characteristic or prototypical words. Including e.g. *who drinks* in AG1 could prompt the language learner to realise that category AG1_1 might actually represent words referring to human entities belonging to a higher-level category, say C_{WHO}, symbolised by the question word '*who'*, cf. (6). (cf. also Drienkó 2020b, Sections 4.1, 4.2).

(5)



(6)



1.1.5. Concepts over AGs

It is possible to add an explicit semantic component to the AG framework by defining semantic concepts over AGs. Agreement categories, i.e. columns in the tabular representations of AGs can be interpreted as positional attributes and the actual words in an agreement category as the possible values for the positional attribute in question. The most generic concept is the one with all possible attribute values permitted. Amongst the examples of (7), the most generic concept is *'What all do or can/could do',* symbolised as (MOMMY ∨ DADDY ∨ BABY) ∧ (DRINKS ∨ WANTS), subsuming all the six utterances that are mappable onto AG1. The least generic, or most specific, concepts are those with only one legal value for each attribute, corresponding to individual utterances that can be mapped onto AGs. Utterance *daddy drinks*, for example, can be understood as representing the concept *'What daddy does'* in the context of AG1 describable formally as DADDY ∧ DRINKS. The concept MOMMY ∧ (DRINKS ∨ WANTS), *'What mommy does',* represents the two utterances of AG1 *mommy drinks* and *mommy wants* whereas DADDY ∧ (DRINKS ∨ WANTS) should rather be understood as *'What daddy does or can/could do'* since while *daddy drinks* is explicitly stated in the group, *daddy wants* requires a kind of "analogical inference" (cf. also Drienkó, 2020b, Sections 5.2 and 5.3).

(7)

AG1	Positional attribute values
mommy drinks	AG_1: MOMMY, DADDY, BABY
daddy drinks	AG_2: DRINKS, WANTS
baby drinks	
mommy wants	

Example concepts
'What all do or can/could do': (MOMMY ∨ DADDY ∨ BABY) ∧ (DRINKS ∨ WANTS)
'What daddy does': DADDY ∧ DRINKS
'What mommy does': MOMMY ∧ (DRINKS ∨ WANTS)
'What daddy does or can/could do': DADDY ∧ (DRINKS ∨ WANTS)

2. Priming in the AG model

The AG model was primarily designed for modelling linguistic processing of individual utterances. Also, it intrinsically had a developmental aspect due to the temporal dynamics of the expansion of the AG space ("learning"). However, no specific attention was paid to how the processing of one utterance can affect the processing of another. AGs were supposed to be available on demand, whenever needed. Nevertheless, AGs can also be regarded as abstract mapping units or patterns that can be activated repeatedly, and whose activation on one occasion can affect their repeated activation. It could make sense both computationally and cognitively, for instance, that recently activated AGs can be found faster for a matching utterance. In modelling priming, we will adopt this picture of repeatedly usable AGs whose previous activation affects the processing of subsequent utterances.

As a first example, consider the sentence *mommy drinks tea*. Since the utterance involves mapping onto groups AG1–AG7, i.e. "activates" these groups, they readily offer themselves for mapping for subsequent utterances. On encountering e.g. *daddy wants milk,* it may become easier for the mapping system to select the previously activated AGs that are compatible with the current utterance. Indeed, the coverage structure (CS) of *daddy wants milk* consists of a subset (AG1 and AG5) of the AGs compatible with *mommy drinks tea*, cf. Table 5 and Table 2 repeated as Table 6. Thus we might say that utterance *mommy drinks tea* can "prime" the subsequent *daddy wants milk*.

Table 5
Coverage structure for 'mommy drinks tea'

mommy	*drinks*	*tea*	
mommy	drinks		AG1,AG2,AG3,AG4
	drinks	tea	AG5,AG6,AG7

Table 6 (Table 2)
Coverage structure for 'daddy wants milk'

daddy	*wants*	*milk*	
daddy	wants		AG1
	wants	milk	AG5

On the other hand, a passive utterance is likely to involve different AGs. For instance, *milk is wanted by daddy*, instead of *daddy wants milk*, requires AG8, and AG13 or AG14, none of which is included in Table 5. Thus the CS for *milk is wanted by daddy* is not facilitated, or primed, by *mommy drinks tea*, cf. Table 7.

Table 7
Coverage structure for 'milk is wanted by daddy '

milk	*is*	*wanted*	*by*	*daddy*	
milk	is	wanted			AG8
			by	daddy	AG13/AG14

Such kind of dissociation between the processing of active versus passive sentences in priming experiments was famously reported in Bock (1986). For another introductory example let us consider findings from Chang, Bock, and Goldberg (2003) who report priming effects for sentences with the same syntactic constituent order (viz. NP V NP PP) but different thematic role order. Sentences with theme-location order primed theme-location targets, e.g. *The man sprayed water on the wall*, whereas location-theme primes facilitated location-theme targets, e.g. *The man sprayed the wall with water*. One possible AG account of the experimental findings can be based on properly homogenised groups (cf. 1.1.3). The formation of AGs with verbs whose meaning may be connected to '*transferring some (soft/ liquid) substance (theme) onto the surface of some object (location)*' and nouns denoting either substances or objects in their proper categories (positions) along with concomitant prepositions can facilitate the observed dissociation in thematic role mapping. For instance, the utterance *smeared paint on door* from the theme-location AG_{TL1} under (8) could prime *sprayed water on wall* whilst *cleaned car with water* from the location-theme AG_{LT} can facilitate *sprayed wall with water*. Note that an utterance/fragment can be mapped onto several AGs so it could also be possible that priming is collectively affected by all the AGs that a given utterance is compatible with. As *smeared paint on door* can also be mapped onto AG_{TL2} under (8) it could also prime theme-location targets that are not mappable onto AG_{TL1} but are mappable onto AG_{TL2}, e.g. *splattered oil on table*.

(8)

AG_{TL1}	AG_{TL2}	AG_{LT}
<u>sprayed water on wall</u>	<u>smeared oil on paper</u>	<u>sprayed wall with water</u>
sprayed paint on wall	smeared oil on table	sprayed wall with paint
sprayed water on door	smeared paint on paper	sprayed car with water
sprinkled water on wall	splattered oil on paper	sprinkled wall with water
smeared water on wall	smeared oil on door	cleaned wall with water
…	…	…

Note that for structural priming to occur it is not absolutely necessary that prime and target share exactly the same structure, or even the same number of words. Accordingly, we see structural priming to reflect the degree of

structural similarity between the utterances involved. Utterance *mommy drinks tea*, for instance could also prime *daddy wants goat milk*, along with *daddy wants milk*, because the respective CSs all include AG1 and AG5, cf. Tables 2 (6), 4, and 5. In a sense, however, the CS for *daddy wants milk* is more similar to the CS for *mommy drinks tea* since both utterances involve the same number of words, three, and neither requires discontinuous mapping onto AG5 while *daddy wants goat milk* does.

3. AGs in a circuitry architecture

In this section we outline how AG processing could be performed in the neural circuitry system of human cognition by situating the AG model in a network-like architecture of excitable nodes with connections. Such a picture of cognitive processing may be reminiscent of spread-activation models like, e.g., Levelt, Roelofs, and Meyer (1999) or, more specifically for structural priming, Pickering and Branigan (1998).

3.1. AG circuits

Figure 1 shows how an AG can be visualised as a circuit of nodes. Memorised utterances are represented as circled words (nodes) connected with black horizontal arrows. Upward blue arrows point to AG categories. Category C1, for instance, corresponds to AG1_1, the first utterance position in AG1. Category nodes are also connected with black horizontal arrows. AG nodes and connections are assumed to constitute the *AG stratum* or *layer*. Nodes in the AG layer receive connections from nodes in the *Lexical layer* (brown arrows in Figure 1). These latter nodes may be thought of as representing base forms or stems of words ("lemmas") besides morphologically complete word forms and also morphemes embodying features of grammar like e.g. *–s* for 3rd person singular, symbolised as *–s(V)* in Figure 1. Additionally, we possibly allow word combinations i.e. utterance fragments or holophrases to be represented in the Lexical layer. Lexical nodes may be connected to other lexical nodes as the lines and arrows indicate. Finally, lexical nodes receive input from nodes of the *Concept/ Semantic layer* representing conceptual units/objects.

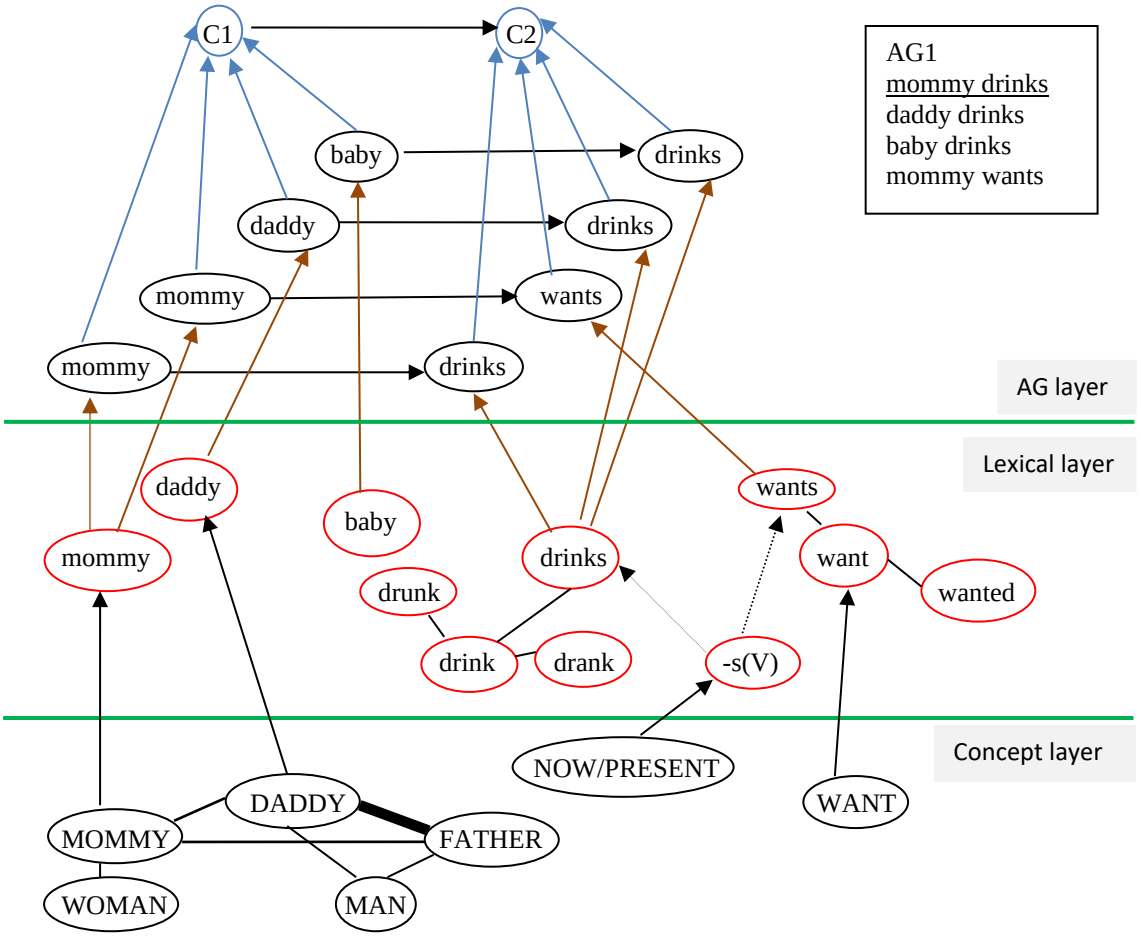


Figure 1. AG1 as circuit of nodes. See explanation in text.

Naturally, the picture we outline here should be regarded as approximate and it can be refined in many ways. First of all, we do not exclude the possibility of other types of connections across or within layers. For instance, there might be a single node representing a particular AG receiving input from the category nodes (C1 and C2 in Figure 1) and/or directly from the lower nodes of the AG. Memorised utterances could likewise be represented by corresponding unique nodes, even potentially in the Lexical and/or Concept layers. These utterance nodes could then be activated directly from other cognitive modules or layers for providing faster access (i.e. without the need to follow the pathways within AGs) for more automatic or "formulaic" language. Also, connections between nodes may somewhere be bidirectional or undirected, most dominantly, perhaps, in the "semantic network" of the concept layer. Furthermore, the strength of links between nodes may be graded. Clearly, there is a semantic connection between DADDY and MOMMY – both are parents – but the connection between DADDY and FATHER should somehow be stronger, as indicated with a thicker line, since both refer to the more specific concept MALE PARENT. Similarly, the dotted arrows in the Lexical layer refer to weaker connections. Undirected lines may alternatively be understood as bidirectional. As there is no sharp distinction between AGs and CSs (a single AG can cover a simple utterance), we shall explicitly use the notion *Coverage layer* only when a distinction between AGs and CSs is

relevant. Also, we tacitly assume that further cognitive layers exist and can interact with those introduced here.

Through the example of *daddy wants*, Figure 2 demonstrates how an utterance can be processed by mapping it onto AG1 via activating the relevant nodes.

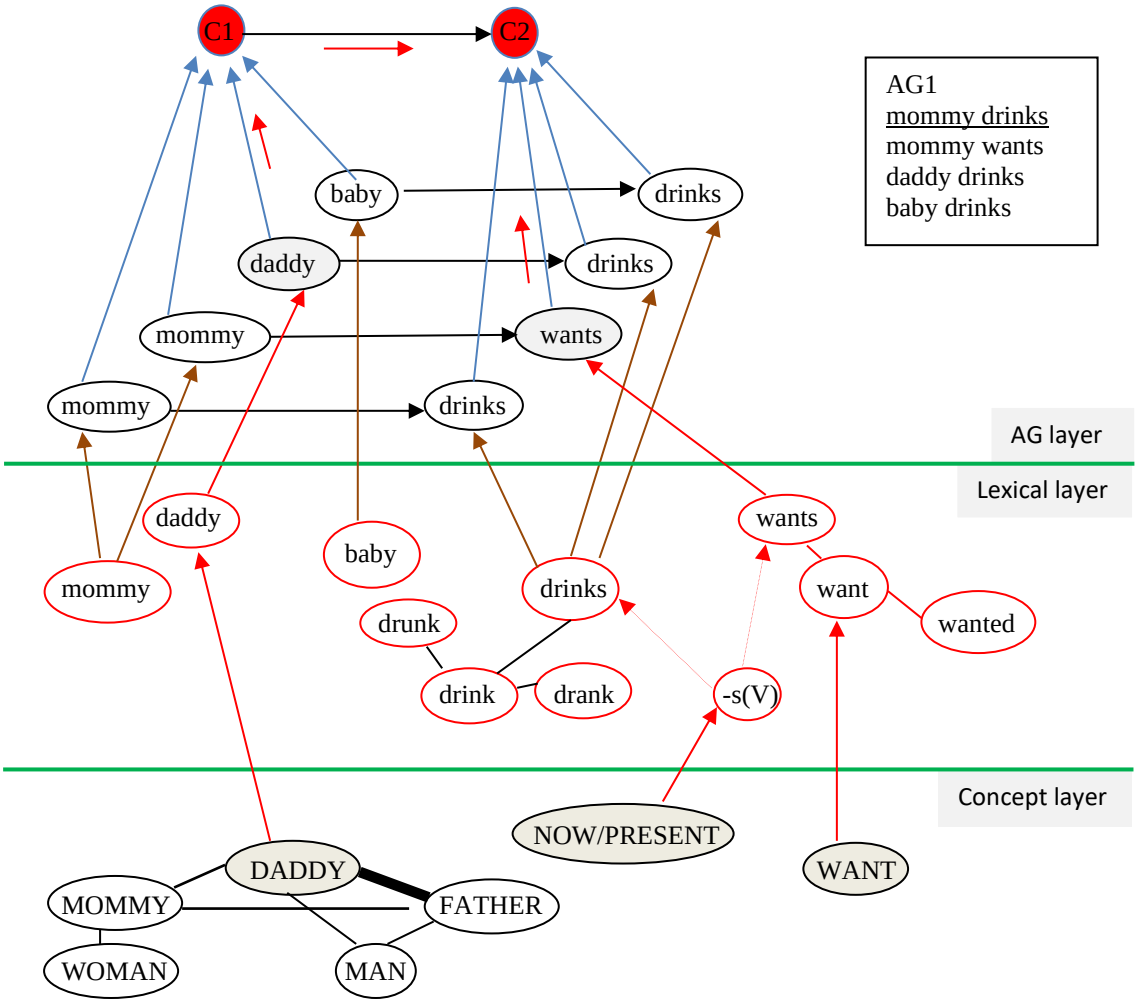


Figure 2. Mapping *'daddy wants'* onto AG1. Activation propagates as shown by red arrows

The "core" mapping process concerns the Lexical and the AG layers. The activation of nodes in the Lexical layer spreads along the corresponding connections and reaches the lower nodes of the AG, as the solid red arrows indicate. From the activated *'daddy'* node and *'wants'* node of AG1, activation spreads further to the category nodes (blue arrows) and the connection between them. As a general requirement for mapping to be complete, we can prescribe the possible activation of all category nodes in the AG (red filled circles). However, in the case of memorised group member utterances, e.g. *mommy drinks*, activation can spread along the horizontal black arrows for enabling faster processing which may or may not concern category nodes. Note the *'drinks'* nodes can also get activation from the morphological *-s(V)* node representing 3rd-person-singular but they do not become active. One possible

explanation is that connections from morphological nodes are weaker, as indicated with the dotted arrows, and, alone, are not capable of activating the corresponding verb nodes of the Lexical (and thus ultimately the AG) layer. Another possibility would be that the verb stem and the *-s* suffix are represented as separate nodes (columns) in the AG so that both the verb stem and the suffix require their separate activating connections from the Lexical layer. The present figures incorporate the former explanation for easier visualisation. However, the latter, more refined picture could be invoked for discussing why lexical boost seems to be unaffected by word form variation (Pickering and Branigan, 1998). See also the remarks concerning the viability of morphological CSs, illustrated in (20) and Table 31 in Section 4.7

We assume this basic mapping process, associated primarily with the Lexical and the AG layers, to be shared by both production and comprehension mechanisms of language. Fundamentally, we ascribe the difference between the two processing modes to the additional cognitive domains involved. For instance, in comprehension, initial auditory stimuli may activate both lexical and conceptual nodes, either simultaneously or in a serial manner with lexical nodes activated first. In this latter case bidirectional links between lexical and conceptual nodes could support the "backward" propagation of activation from the Lexical to the Concept layer. The production process may or may not be triggered by external (visual, auditory, etc.) stimuli. In the absence of external stimulation, the AG mapping process might roughly be depicted as in Figure 2 but with connections to articulatory circuits responsible for the physical production of speech sounds.

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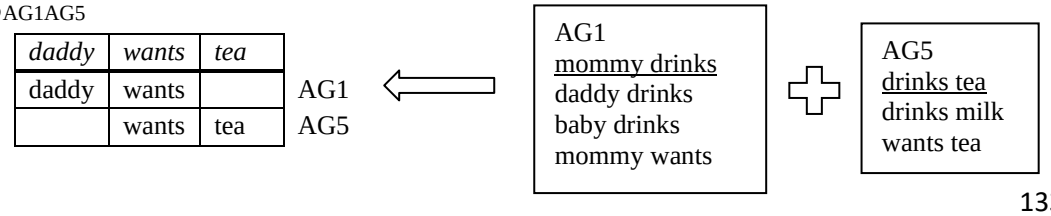
The combination of AGs into representations for CSs may also be pictured as realised by dedicated circuits. The nodes and connections that form such CS circuits might be collectively referred to as the Coverage layer. Figure 3 illustrates how AG1 and AG5 can be combined to yield $CS_{AG1AG5,}$ as shown in (9), for *daddy wants tea*.

(9) CS_{AG1AG5}



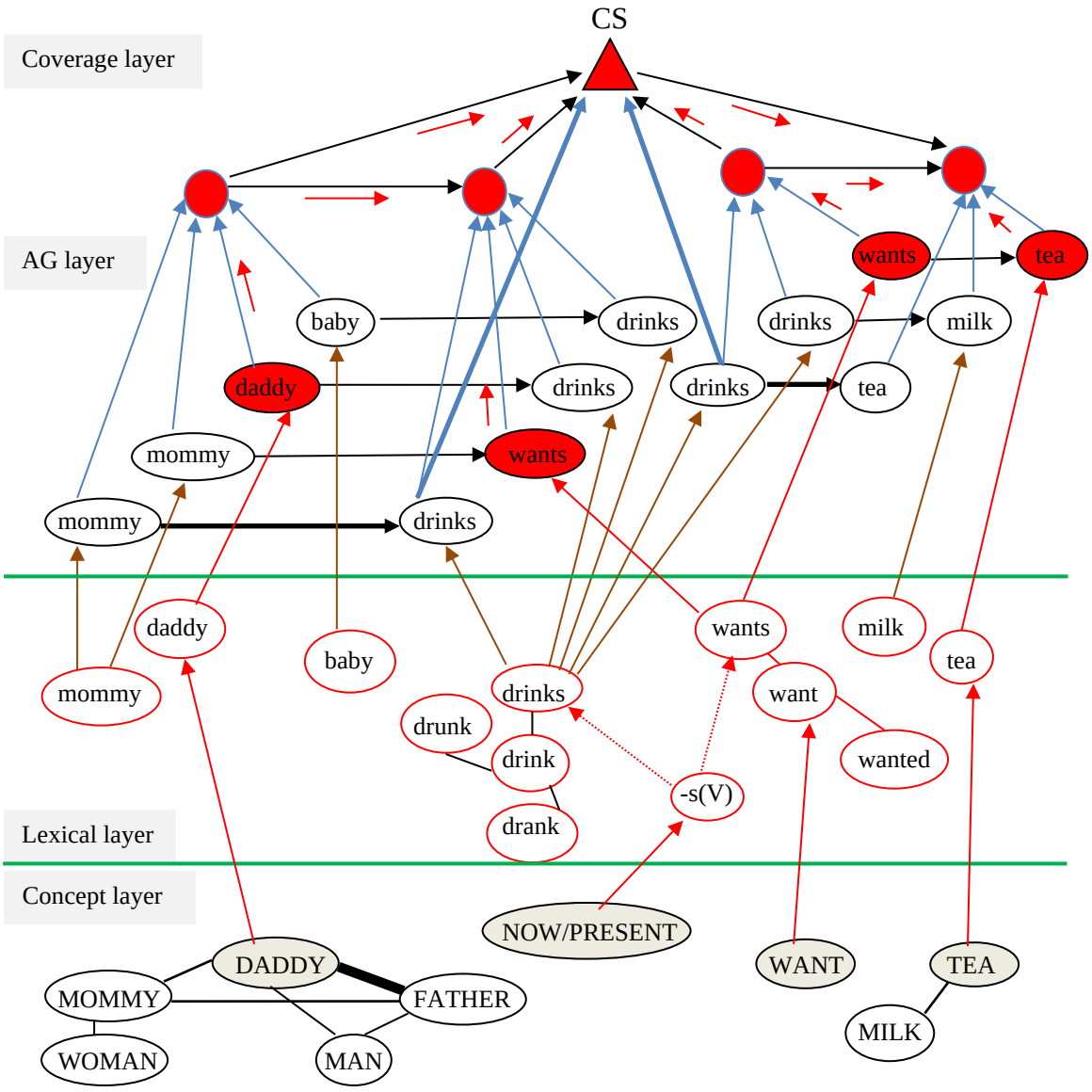


Figure 3. Coverage structure for '*daddy wants tea*'

Suppose utterances *mommy drinks* and *drinks tea*, as well as the utterances in their AGs, are stored in memory. A later utterance e.g. *mommy drinks tea* may inform the language learner that *mommy drinks* and *drinks tea* can be conjoined to form a novel utterance. This information can further be generalised to the AGs involved and can become hardwired into the cognitive circuitry. In our example, the conjunction of *mommy drinks* and *drinks tea,* and the respective AGs, is symbolised by the emergence of a new node, denoted by a triangle, receiving connections from the nodes representing the shared word '*drinks'* as well as from the category nodes in AG1 and AG5. This new mapping circuit can now be mobilised for processing novel utterances like *daddy wants tea* consisting of speech fragments that can be mapped onto the AGs in the circuit. Figure 3 shows that *daddy wants* can be mapped onto AG1,

while *wants tea* onto AG5, and all category nodes plus the newly created structural node (triangle) become activated signalling the compatibility of *daddy wants tea* with CS_{AG1AG5}.

As every node can be connected to many others, it is not surprising that activation from lexical and conceptual nodes can fully activate alternative AGs for the same intended message. For instance, the concept DADDY WANTING TEA can be expressed by the active sentence *daddy wants tea* or by the passive *tea is wanted by daddy*. Figure 4 illustrates – given AG1, AG5, AG8, and AG13, as in (10) – how activation can spread across layers to reach a particular CS alternative. The solid red arrows indicate the choice for active, CS_{ACT}. The nodes and connections along the arrows can retain a certain degree of activation after the CS in question is accessed (especially the category and CS nodes in the circuits of the AG and Coverage layers) which can give rise to structural priming owing to easier access to the same CS for a subsequent utterance. Thus, *daddy wants tea* can prime e.g. *baby drinks milk*. Note that in Figure 4, the network representation is abandoned at the AG and Coverage layers for simplicity.

(10)

AG1	AG5	AG8	AG13
mommy drinks	drinks tea	tea is drunk	by daddy
daddy drinks	drinks milk	milk is drunk	by baby
baby drinks	wants tea	tea is wanted	
mommy wants			

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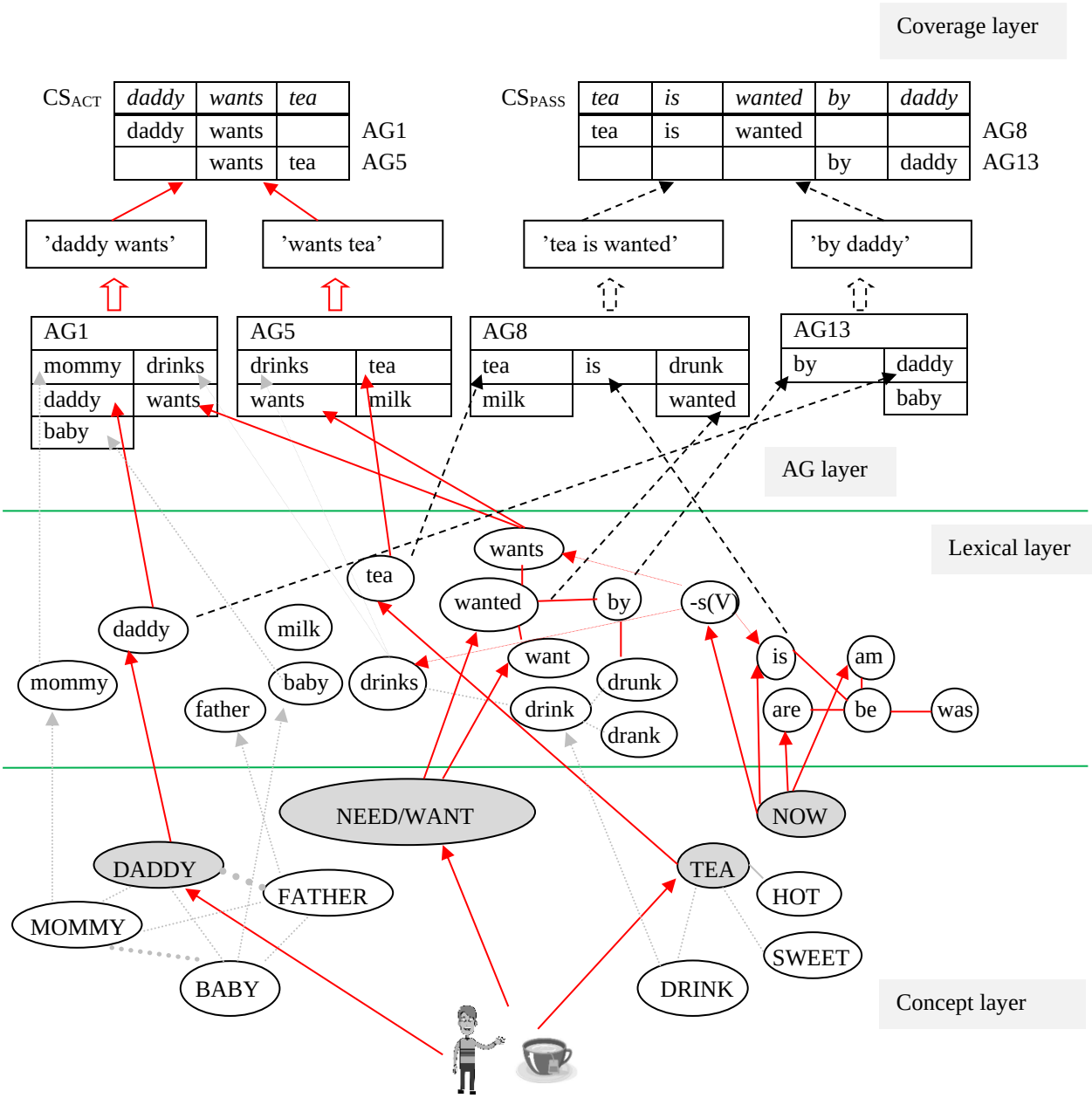

Figure 4. Alternative structures for expressing concept DADDY WANTING TEA: active and passive. When e.g. CS_{ACT}, the active construction, is chosen, following the solid red arrows, the corresponding nodes and connections retaining (some) activation can effect priming by constituting a subsequent bias for active. Dashed arrows lead to the alternative passive construction CS_{PASS}. Dotted (red or grey) arrows or lines denote weaker activation.

3.2. Semantic/lexical boost

The AG circuitry model allows the connectivity structure of the Concept layer to have an influence on the activation level of the AG nodes and connections. In other words, conceptual or semantic relations have the potential to affect syntactic processing. In Figure 4, for instance, the '*drink*' node in the Lexical layer may receive activation from the conceptual DRINK

node because it is contained in the same semantic circuit as concept TEA. However, since the TEA concept is activated "directly" whereas DRINK is activated indirectly, via semantic connections, the lexical '*drink'* node receives less activation which is insufficient to properly activate lexical '*drinks*' even though '*drinks'* is also (weakly) stimulated by the '*-s'* suffix node, cf. the grey dotted lines in Figure 4. Ultimately, the realisation of '*drink*' forms in the AGs is not supported by appropriate activation level, so *daddy wants tea* wins out over *daddy drinks tea*. However, if we assume, following Pickering and Branigan (1998), that previous activation can facilitate subsequent processing, and additionally assume that this is also true for "weakly" activated nodes and connections, we can expect a semantic facilitative effect for conceptually similar linguistic elements. Indeed, semantic boost to structural priming is a well-established notion in psycholinguistics. For instance, Cleland and Pickering (2003) observed that utterance *the sheep that is red* (as opposed to *the red sheep*) is primed more by *the goat that is red* than by *the knife that is red*. This means that there is a semantic relatedness/similarity factor influencing the magnitude of structural priming. In the AG model, semantic priming effects can be ascribed to an interplay between AGs and the semantic circuits of the Concept layer. On the one hand, semantically similar words may tend to belong to similar AGs and/or AG categories. On the other hand, in the semantic circuitry of the Concept layer, related words belong to the same circuit. Supposing, for instance, that AG55 exists, besides AG1 and AG5, we would expect that *mommy wants knife* primes *daddy wants fork* more than it primes *daddy wants tea*, cf. (11). This is because *mommy wants knife* and *daddy wants fork* are covered by the same AGs, AG1 and AG55, while *daddy wants tea* requires AG5 instead of AG55, i.e. it only shares AG1 with *mommy wants knife*. The respective CSs are shown as Tables 8, 9, and 10. Note that *'fork'* and *'knife'* belong to category AG55_2 whereas *'tea'* has category AG5_2. Conceptually, the nodes for AG55_2 words might be accessed from a NECESSARY THINGS or a CUTLERY circuit of the Concept layer whilst AG5_2 nodes should rather be connected to concept DRINK. Speculating a bit further, we might also expect that *mommy wants knife* primes *daddy wants fork* more than it primes *daddy wants money* since knife and fork must be more strongly connected to each other in the Concept layer than either of them to MONEY, even though *'money'* is also an AG55_2 word. Naturally, the argumentation here presupposes a capacity of conceptual connection strengths to have an influence on the activation level of AG nodes. Additionally, the capacity of semantic connections and connection strengths in the Concept layer to affect the activation of AG nodes could play a role in establishing sub-categories or concepts within AGs (see Section 1.1.5). For instance, pathways originating from conceptual circuit nodes (with about the same connection strength) could point to assemblies of AG nodes representing the realisation of the corresponding concept within a particular AG. Pathways from the appropriate nodes of a CUTLERY circuit (viz. KNIFE and FORK) to the *'knife'* and *'fork'* nodes of AG55 could define a KNIFE ∨ FORK realisation of the CUTLERY concept for AG55.

(11)

AG1	AG5	AG55
mommy drinks	drinks tea	needs money
daddy drinks	drinks milk	needs knife
baby drinks	wants tea	wants money
mommy wants		needs fork

Table 8
CS for 'mommy wants knife'

mommy	*wants*	*knife*	
mommy	wants		AG1
	wants	knife	AG55

Table 9
CS for 'daddy wants fork'

daddy	*wants*	*fork*	
daddy	wants		AG1
	wants	fork	AG55

Table 10
CS for 'daddy wants tea'

daddy	*wants*	*tea*	
daddy	wants		AG1
	wants	tea	AG5

Note that a special case of semantic priming is when not a semantically related word is repeated in a subsequent utterance but the very same word. Alternatively speaking, the semantically most similar word is repeated, i.e. the original word itself. In such cases a stronger priming effect, the "lexical boost", is observed (e.g. Pickering and Branigan, 1998). The stronger priming effect in the case of lexical repetition is in line with our AG circuitry model since a previously activated lexical node might be easier to access for a subsequent utterance. While lexically independent structural priming may mostly be driven by the residual activation of category and CS nodes and connections in the AG/Coverage layer, the additional pre-activation of lexical (plus conceptual) nodes and connections can result in the pre-activation of a larger segment of a relevant pathway, which suggests a larger priming effect.

Pickering and Branigan (1998) provide a "one-locus" explanation of structural priming and lexical boost which is based on the lexical access model of Levelt et al. (1999) where lemmas (ca. base forms of words) constitute a cognitive stratum and are associated with grammatical features. Pickering and Branigan (1998) further propose that lemmas be linked to combinatorial nodes responsible for particular constructions. Priming, then, is due to residual activation of combinatorial and lemma nodes, as well as the corresponding connections. In particular, lexically independent structural priming occurs as a result of the residual activation of the combinatorial nodes, whereas lexical boost is the consequence of the additional residual activation of lemma nodes and their links to combinatorial nodes. Furthermore, since the same lemma is activated for different morphological forms of the same verb, it is not necessary for prime and target to share the same form of the given verb for a lexical boost effect to come about, in accordance with the authors' (P. and B.) observations.

The AG circuitry approach offers a more fine-grained picture of the residual activation model. The category and/or CS nodes belonging to the AG

and the Coverage layers – responsible for lexically more independent syntactic processing and priming – could collectively be termed "combinatorial nodes", whereas lexical nodes represent "lemmas", whose residual activation, possibly reinforced by concept nodes, boosts structural priming lexically. The AG model suggests that semantic priming is additionally a manifestation of interaction with conceptual circuits.

3.3. Cross-linguistic priming

Bernolet, Hartsuiker, and Pickering (2007) extend Pickering and Branigan's model in order to account for bi- or multilingual findings. In this integrated network, lemma nodes of a shared lexicon are tagged according to which language they belong to and lemmas representing the same meaning in different languages are connected to a shared node at the conceptual level, as well as to a shared syntactic category node (e.g. 'noun'). Each lemma node is linked to the combinatorial nodes representing the linguistic constructions in which the given lemma/word can participate in the language the lemma is tagged to. The AG model can, likewise, accommodate multilingual phenomena. Figure 5 and the AGs in (12) shows how the concept DADDY WANTING TEA can be realised either in English as *daddy wants tea* or in Hungarian as *apa akar teát.* Note that in Hungarian, other word order variants, e.g. *apa teát akar* are also possible.[4] The English lemmas are connected to their Hungarian equivalents (blue lines) and lemmas of both languages are also linked to the corresponding (shared) concept nodes in the Concept layer (black and green arrows). An arrow connecting a grey box to a language concept (ENGLISH or HUNGARIAN) means that all the lemmas within the box are connected to that language concept. Activation can propagate in parallel from conceptual nodes to alternative AGs and CSs in both languages. Suppose, for example, that CS1 gets activated for processing utterance *daddy wants tea*. Then, consequently, pathways for alternative English constructions (e.g. for passive) become deactivated or suppressed. After processing the utterance, the CS1 pathways retain some activation, a certain amount of which can be shared with the corresponding Hungarian nodes via the lexical connections (blue lines) and/or the conceptual connections (green arrows) to result in priming for Hungarian AGs and CSs. Note that in our example, *daddy wants tea* would prime both Hungarian word-order variants, CS2 (e.g. *baba iszik tejet 'baby drinks milk')* and CS3 (e.g. *baba tejet iszik 'baby milk drinks'*).

(12)

AG1	AG5	$AG_{HU}1$	$AG_{HU}5_{VN}$	$AG_{HU}5_{NV}$
<u>mommy drinks</u>	<u>drinks tea</u>	<u>anya iszik</u>	<u>iszik teát</u>	<u>teát iszik</u>
daddy drinks	drinks milk	apa iszik	iszik tejet	tejet iszik
baby drinks	wants tea	baba iszik	akar teát	teát akar
mommy wants		anya akar		

[4] There are topic-focus issues concerning word order, whose details are irrelevant with respect to our arguments here, so they are not included in our discussion.

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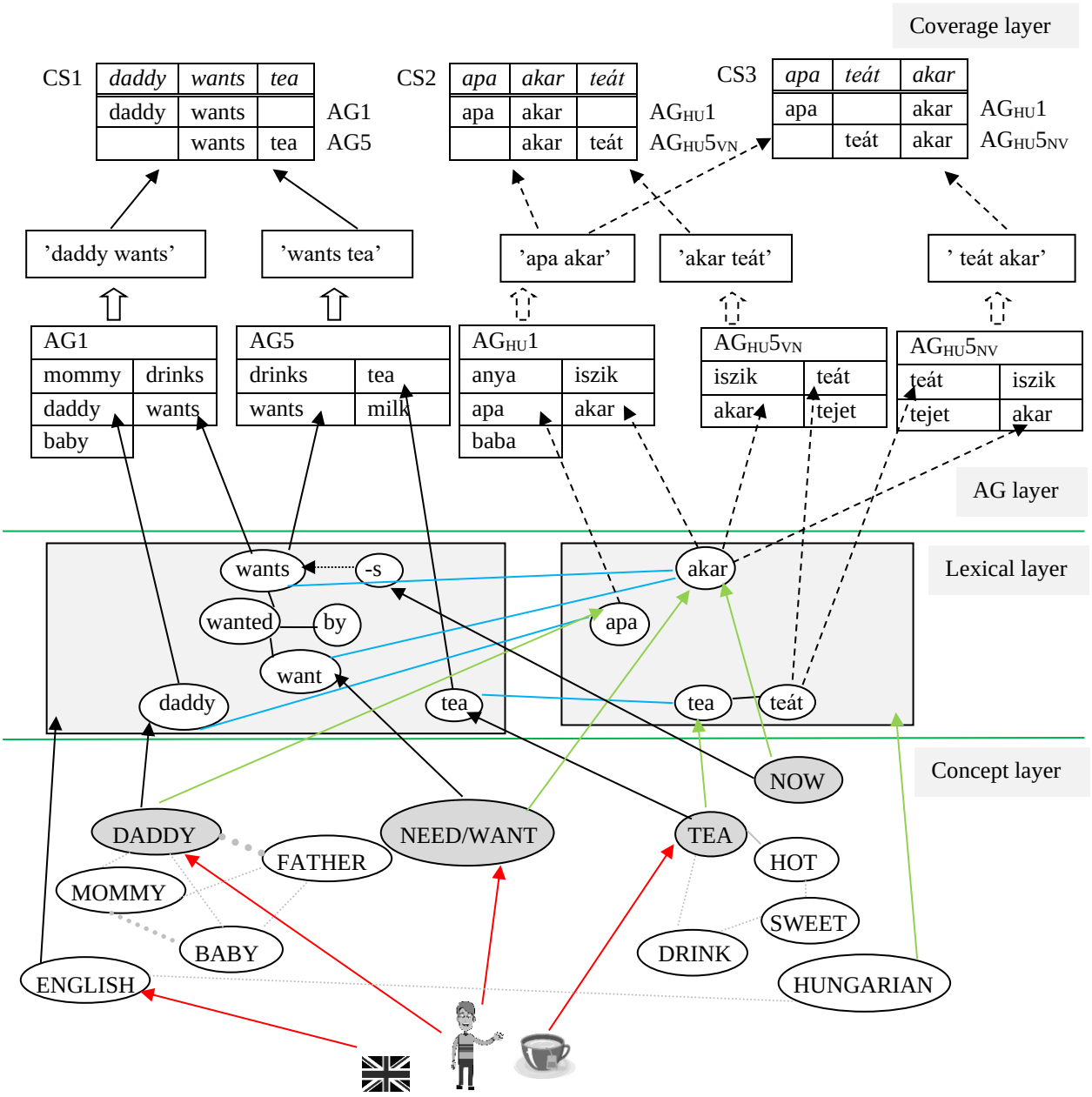

Figure 5. Cross-linguistic mapping alternatives. Concept DADDY WANTING TEA can ultimately activate CS1 for the English utterance *daddy wants tea* as well as CS2 and CS3 for the Hungarian equivalents. Black arrows from concepts point to English lemmas, and green arrows to Hungarian ones. Blue lines indicate direct links between English and Hungarian nodes. An arrow from a language concept (ENGLISH or HUNGARIAN) to a grey box means that all the lemmas within the box are connected to that language concept. Concepts are labelled with capitalised English words.

Research findings from behavioural experiments do not seem to be unequivocal with regards to cross-linguistic structural choice. Loebell and Bock (2003), for instance, reported cross-linguistic priming between German (L1) and English (L2) in a picture description task for datives. Bernolet et al. (2007) found no priming of complex noun phrases between Dutch (L1) and

English (L2) where word order for the noun phrases in question is different in the two languages (e.g. "*The sheep that red is"* vs. *The sheep that is red*). On the other hand, Bernolet, Hartsuiker, and Pickering (2009) did observe priming, in spite of the word order difference, between verb-final passives in Dutch and verb-medial passives in English (e.g. "*The diver was by the pirate lifted*" vs. *The diver was lifted by the pirate).* The AG model would suggest that complex noun phrases are less similar cross-linguistically (cf. the lack of priming effect) as they reflect AG-level differences: speech fragments *red is* and *is red* are not likely to be in cross-linguistically equivalent AGs. On the other hand, the Dutch and the corresponding English passives share cross-linguistically equivalent fragments, with the difference that the Dutch '*by the pirate'* phrase is embedded in the discontinuous *was lifted* fragment whereas in English the fragments do not require discontinuity. Consequently, we might conclude that the AG-level word order difference for complex noun phrases distorts structural similarity more than does the CS-level word order difference for passive.

Alternative explanations[5] may include reference to memory processes. Arguably, a previously processed utterance can be represented in short-term memory (STM) as an ordered sequence of words. In that case, lexical nodes could be linked to, and receive activation from, memory nodes corresponding to the items in STM. Besides residual activation of the previously operative pathways, then, memory nodes could also contribute to priming. As we assume that word-order would be sustained in STM, the cross-linguistic data could be explained by a conflict between sequential word order and AG-mapping order. Since *The sheep that is red* sequence in STM would require an AG where *'is'* is represented before the adjective (activation propagating towards '*red'*) its memory trace could not sufficiently support mapping onto a Dutch AG prescribing mapping *'is'* after an adjective. On the other hand, the memory trace of *The diver was lifted by the pirate* could provide more priming for the Dutch verb-final passive since word order within either of the corresponding Dutch AGs (for '*was lifted*' and '*by the pirate*') could be in line with the word order imposed by the memory trace of the English sentence, i.e. every word within a Dutch AG would be followed by a word that comes later in the memory trace.

As for the Hungarian examples, in the absence of extra-syntactic factors, the AG model might consider CS2 (for *apa akar teát*) as a more probable target to be primed by the English sentence than CS3 (for *apa teát akar*) because CS2 requires the same activation sequence of words as CS1. Consequently, *daddy wants tea* would prime e.g. *apa akar teát*. Alternatively, we could say that CS2 is more similar to CS1 than CS3 is because CS3 involves a discontinuous fragment, $AG_{HU}1$, and there is an AG-level word-order difference between AG5 and $AG_{HU}5_{NV}$.

Kootstra, van Hell, and Dijkstra (2010) demonstrate that code-switching between languages in Dutch-English bilinguals can occur during sentence processing and it can influence word order choice with a preference for constructions where the word order is identical in the two languages. The

[5] Note that alternative explanations are provided in order to be confirmed or falsified by future research. They are not necessarily mutually exclusive, as they may have overlapping details. In the present example, for instance, AG reactivation may depend on memory processes.

findings are in concert with the AG circuit framework enabling code-switching at any utterance position. Suppose that, in our example, an English-Hungarian bilingual speaker starts processing *daddy wants tea* but after activating the lexical '*daddy'* node and reaching the corresponding AG1 node this speaker is cued to switch to Hungarian. Since the corresponding Hungarian lexical nodes also receive some activation, either directly from the English lemmas or through conceptual links, the Hungarian groups $AG_{HU}1$, $AG_{HU}5_{VN}$ and $AG_{HU}5_{NV}$, also become available licensing both CS2 (*apa akar teát*) and CS3 (*apa teát akar*). Thus, in principle, both hybrid sentences, *daddy akar teát* and *daddy teát akar* could be produced. However, AG1 has already been activated by the '*daddy*' pathway and anticipates a verb (*drinks* or *wants*). This requirement can be fulfilled by activation from the lexical '*wants*' if we assume, logically, that all the relevant concepts become active before lexical and AG mappings begin and therefore the lexical '*wants'* node has also been activated by a corresponding concept. As AG1 is now fully active, it can have an influence on the choice of the corresponding Hungarian CS. $AG_{HU}1$ also prescribes a noun-verb temporal sequence but in CS2 it is employed continuously while in CS3 it needs discontinuous mapping. Consequently, CS2 is more similar to the English CS1, and we would expect the mapping process to be guided in the direction of *daddy akar teát*.[6] The similarity of CSs, again, plays a role in explaining experimental findings, namely, findings on code-switching and a bias for constructions with shared word-order.

3.4. Short-lived versus long-lived structural priming

Branigan, Pickering, and Cleland (1999) revealed that priming effects are short-lived when prime and target share a verb, i.e. the effect was diminished when prime and target was separated by a neutral sentence and completely disappeared with four intervening sentences (see also Levelt and Kelter, 1982, where one intervening sentence cancelled the effect). However, experiments where verbs are not repeated find long-lived priming, undiminished and detectable after 10 intervening neutral sentences (e.g. Bock and Griffin 2000), or even for weeks (Kaschak, Kutta, and Coyle, 2014). The AG circuitry model offers the following explanation. AGs are represented as node configurations and, additionally, a particular construction can be represented by multiple AGs. This means that the processing of a given utterance can involve fairly large node populations of the AG layer. Activation in such circuits may be much more likely to be maintained for longer time periods than the activation of individual nodes or smaller circuits in the Lexical layer, where we do not expect large populations of interconnected nodes.[7] Thus, AG circuits can intrinsically support long-lasting structural priming. In contrast, lexical facilitation, as effected by the repetition of individual words, may span a shorter time interval due to intrinsically shorter activation maintenance in less densely interconnected lexical pathways. However, this explanation, alone, would mean that when short-lived lexical facilitation disappears, after some

[6] Recall that we ignore topic-focus issues.

[7] Our intuition about longer-lived memories for larger neuronal populations with larger connectivity may be confirmed by empirical data. Benna and Fusi (2016), for instance, report a linear relationship between memory lifetime and number of neurons (synapses) in a computational experiment with a class of synaptic models.

intervening sentences, structural priming should be the same as without lexical facilitation, it should not disappear. A more precise characterisation of the phenomenon may relate to memory processes besides just differences in connectivity. A key observation in memory research is that repeated stimuli in primates can result in two types of neuronal activation: neuronal responses can be *suppressed* or they can be *enhanced* (e.g. Miller and Desimone, 1994). In our context, suppression may mean that when content-words are repeated – i.e. their lexical nodes are re-accessed through connections from conceptual nodes (production) or by oral/written stimuli (comprehension) – the activation level of the corresponding lexical nodes will be diminished compared with the first activation.[8] The low activation of suppressed lexical nodes (and connections) then might not be enough to facilitate, or might inhibit, re-access to the relevant AGs. Therefore, we expect a reduced (short-lived) structural priming effect for repeated words, in general. On the other hand, enhanced responses may reflect a more active involvement of STM (Miller and Desimone, 1994) for repetitions closer in time. Repeated words in consecutive utterances may be temporally close enough to trigger an active memory search for repetitions (versus a more automatic repetition detection mechanism associated with response suppression). Repeated elements detected by this more active search mechanism, in turn, may raise the activation level of the corresponding lexical nodes thereby possibly adding to their residual activation facilitating easier access to previously operative AGs, i.e. contribute to lexical boost. Thus, the AG circuitry model is compatible with an interpretation of priming phenomena where structural priming is long-lived because large AG populations might maintain more long-lasting activation, whilst lexical priming is primarily short-lived as a result of suppressed activation of lexical nodes for distant repetitions, with a boost for only temporally close word repetitions resulting from enhanced lexical activation effected by more intensive STM involvement.

Note that our assumption about possibly more prolonged activation in AG circuits is in line with a view that structural priming relates to adaptation mechanisms underlying implicit learning (e.g. Bock and Griffin, 2000; Chang et al., 2006). Sustained activation may entail Hebbian strengthening and weakening of connections between AG nodes and therefore can have a long-lasting effect on the structure of the AG and Coverage layers. For one thing, AGs representing certain construction types can gain priority over others responsible for alternative constructions due to possibly easier accessibility through stronger links. Furthermore, by assuming that "neglected" or suboptimal connections get weaker we obtain a mechanism for explaining how AG circuits can be homogenised (see Section 1.1.3). Connections along pathways representing suboptimal utterances in AGs can become weak enough to be prohibitive, i.e. unwanted utterances can get excluded from AGs. Thus, since we relate homogenisation to error correction, AG circuits can be seen as also having an error-driven developmental feature.

[8] Note that we only expect priming effects for content-words, i.e. not for function-words (cf. e. g. Pickering and Branigan, 1998). However, the same argumentation may hold for function-words, too, with the difference that priming effects stay unobservable since suppressed or enhanced activation might dissipate along the weaker and/or more diverse connections that we suppose for lexical nodes representing grammar-related information.

4. AG account of structural priming phenomena

In this section we illustrate via a "classic" blend of examples how the fundamental notions of the AG model can be employed in explaining findings from experiments investigating particular structural priming phenomena. In our discussion we shall deploy hypothetical AGs for a subset of English containing the phenomena to be examined. We shall attempt to use the simplest or most instructive analyses. Example sentences will be short, determiners, adjectives, or phrasal sentence constituents of no direct importance with regards to the particular construction will be omitted. AGs will be represented by just a small number of member utterances. Our analyses, especially the composition of CSs, should not be understood as exclusive. Appropriate alternative AG combinations could generally yield similar results. Recall that speech fragments represented by AGs do not necessarily coincide with phrase-structure constituents, which is a consequence of our usage-based attitude.

4.1. Double Object Dative versus Prepositional Object Dative

Besides active versus passive sentences, Bock (1986) also reported structural priming for the dative constructions Double-object Dative (DOD), and Prepositional Object Dative (POD). Furthermore, POD sentences with prepositions '*to*' or '*for*' equally primed the production of '*to*' in target POD sentences. Suppose a hypothetical speaker's AG collection includes groups AG15, AG16 and AG17 as shown in (13). Table 11 demonstrates how two groups, here AG15 and AG16, can be combined into CS_{POD} licensing a POD sentence, e.g. *baby brings tea to mommy*. In contrast, CS_{DOD} given as Table 12 symbolises the discontinuous combination of AG15 with AG17 for DOD utterances, say *baby brings mommy tea*. In the examples, priming means that a previously activated CS constitutes a bias for subsequent processing. After mapping *baby brings mommy tea* onto CS_{DOD}, for instance, the DOD sentence *mommy gives daddy juice* will be more probable than the POD alternative *mommy gives juice to daddy*. Similarly, CS_{POD} will prime POD utterances. Note that AG16 allows several prepositions which entails that both *baby brings tea* ***to*** *mommy* and *baby brings tea* ***for*** *mommy* are mappable onto CS_{POD}, i.e. both sentences could prime *mommy gives juice to daddy*, in accordance with the experimental findings. As other prepositions might also be possible in AGs, they could also contribute to the POD priming effect. *Baby brings tea* ***with*** *mommy*, for instance, could prime POD utterances, supposing that AG16 is not homogenised further. This might be a research question to investigate in more detail.

(13)

AG15	AG16	AG17	AG18
<u>baby brings tea</u>	<u>to mommy</u>	<u>gives mommy tea</u>	<u>John said that</u>
baby gives tea	to daddy	brings mommy tea	Jack said that
baby brings bread	for mommy	gives mommy juice	John says that
mommy brings tea	with mommy	gives daddy tea	
baby brings juice	to baby		

Table 11
Coverage structure CS_{POD} for processing 'baby brings tea to mommy'

baby	*brings*	*tea*	*to*	*mommy*	
baby	brings	tea			AG15
			to	mommy	AG16

Table 12
Coverage structure CS_{DOD} for processing 'baby brings mommy tea'

baby	*brings*	*mommy*	*tea*	
baby	brings		tea	AG15(discontinuous)
	brings	mommy	tea	AG17

Our claim that discontinuous mapping spoils CS similarity is also confirmed by experiments with shifted-object constructions. Pickering, Branigan, and McLean (2002), e.g., found no priming of shifted-object target sentences from the POD construction. As Table 13 illustrates, the object shifting CS_{ShO} may employ the same AGs as CS_{POD}, viz. AG15 and AG16, but it requires discontinuous mapping onto AG15. Consequently, we do not expect the POD *baby brings tea to mommy* to significantly prime the shifted-object *mommy gives to daddy juice*.

Table 13
Coverage structure CS_{ShO} for processing 'baby brings to mommy tea'

baby	*brings*	*to*	*mommy*	*tea*	
baby	brings			tea	AG15(discontinuous)
		to	mommy		AG16

4.2. Subordinated clause versus main clause

Branigan, Pickering, McLean, and Stewart (2006) suggest that priming is a consequence of reusing particular "phrase-structure rules", regardless of the global structure of the sentences in question. They observed priming irrespective of whether the prime and/or the target involved a subordinate clause or not. For instance, *the girl gave the puppy to the boy* and *John said that the girl gave the puppy to the boy* behaved similarly with regard to priming. The priming effect was greater when prime and target shared the same sentence type, though. The results are in concert with our intuitive claim that the larger portions of the CSs for prime and target overlap, the larger priming effect may be observed. For instance, both *'baby brings mommy tea'* and '*John said that baby brings mommy tea'* can prime '*mommy gives daddy juice'*. However, whereas '*baby brings mommy tea'* and '*mommy gives daddy juice'* share the same CS_{DOD}, CS_{THAT} for '*John said that baby brings mommy tea'* contains the extra group AG18 from (13) which reduces the similarity of the CSs in question. A lesser degree of structural similarity for prime and target utterance, in turn, may result in a smaller priming effect, cf. Table 14 and Table 12.

Table 14
Coverage structure CS_{THAT} for processing 'John said that baby brings mommy tea'

John	*said*	*that*	*baby*	*brings*	*mommy*	*tea*	
			baby	brings		tea	AG15(discontinuous)
				brings	mommy	tea	AG17
John	said	that					AG18

4.3. Locative versus agentive by-phrase

Bock and Loebell (1990) observe that sentences containing a locative by-phrase, e.g. *The foreigner was loitering by the broken traffic light* can prime passive sentences with agentive by-phrase, e.g. *The referee was punched by one of the fans*. We propose that, due to the ambiguity of preposition *'by'*, AGs containing it cannot dissociate fully with respect to locative or agentive function, cf. e.g. *he stood by the wall*, and *he was stopped by the wall*. Thus, AG19 in (14) need to be used for both $CS_{locative}$ and $CS_{agentive}$, given as Table 15 and Table 16, respectively. Cf. also AG20 and AG21 in (14).

(14)

AG19	AG20	AG21
by the wall	he stood	he was stopped
by the light	he waited	he was seen
by a wall	we stood	I was stopped
by the fan	you stood	

Table 15
Coverage structure $CS_{locative}$ for processing 'he stood by the wall'

he	*stood*	*by*	*the*	*wall*	
		by	**the**	**wall**	**AG19**
he	stood				AG20

Table 16
Coverage structure $CS_{agentive}$ for processing 'he was stopped by the wall'

he	*was*	*stopped*	*by*	*the*	*wall*	
			by	**the**	**wall**	**AG19**
he	was	stopped				AG21

The fact that *he stood by the wall* could prime e.g. *I was seen by a fan* suggests that priming effects might not require a full structural alignment of subsequent utterances (of prime and target). The presence of AG19 in $CS_{locative}$ for an active sentence, *he stood by the wall,* may suffice to bias the selection of the passive structure $CS_{agentive}$ also containing AG19, like for *I was seen by a fan*, instead of the active *a fan saw me*. In terms of similarity, we could say that the passive utterance *I was seen by a fan* is "coverage-structurally" more similar to the active *he stood by the wall* than is the active sentence *a fan saw me*.

4.4. Relative clause attachment

Scheepers (2003) reports a priming effect concerning relative clause attachment. Sentences like *The assistant announced the score of the candidate that...* are structurally ambiguous since they allow for two interpretations. In e.g. *The assistant announced the score of the candidate that was very good* the relative clause *that was very good* can be interpreted as either modifying noun-phrase *the candidate* ("low attachment") or *the score of the candidate* ("high attachment"). Assuming groups AG22, AG23, and AG24 in (15), there can be two distinct CSs for the two cases. In CS_{low}, the *candidate that was good* fragment of the sentence is mapped onto AG23 (low attachment), whereas in CS_{high} the *score that was good* fragment is mapped onto AG23 discontinuously (high attachment). Depending on which CS is activated by the prime, CS_{low} or CS_{high}, the corresponding interpretation will be more easily available for a subsequent utterance, say *The author of the book that was bad*, cf. Tables 17 and 18.

(15)

AG22	AG23	AG24
<u>the score</u>	<u>score that was good</u>	<u>of the</u>
the candidate	score that is good	for the
a score	score that was bad	of a
the author	candidate that was good	
the book	book that was good	
	author that was good	

Table 17
Coverage structure CS_{low} for processing 'the score of the candidate that was good'

the	*score*	*of*	*the*	*candidate*	*that*	*was*	*good*	
the	score							AG22
			the	candidate				AG22
				candidate	**that**	**was**	**good**	**AG23**
		of	the					AG24

Table 18
Coverage structure CS_{high} for processing 'the score of the candidate that was good'

the	*score*	*of*	*the*	*candidate*	*that*	*was*	*good*	
the	score							AG22
			the	candidate				AG22
	score				**that**	**was**	**good**	**AG23(discontinuous)**
		of	the					AG24

4.5. Object-raising versus object-control

Griffin and Weinstein-Tull (2003) claim that speakers are more likely to produce a noun phrase and infinitive clause (e.g. *John believed Mary to be nice*) after prime utterances with object-raising (OR) verbs (e.g. *A teaching assistant reported the exam to be too difficult*) than after sentences with object-control (OC) verbs (e.g. *Allen encouraged his roommate to be more studious).* In the sentence-recall experiments, speakers were expected to paraphrase finite complement clauses as infinitive clauses after producing an OR or OC sentence. The authors report i) a general infinitive priming effect resulting from the presence of an infinitive complement in the priming sentence, and ii) a specific infinitive priming effect due to the differential processing of OR and OC clauses. Additionally, iii) passive versions of the object-raising primes elicited fewer paraphrases than the active versions did. The first words of the given target sentence, including the OR verb, were used as the recall cue (e.g. *John believed...*). We sketch the relevant fragmentations in the CSs for a possible target (i.e. to be recalled) finite complement utterance and its possible primes as Tables 19 - 22. A first glance reveals that all primes contain shared infinitival fragments, *to be nice* or *Mary to be nice*, which can account for the observed general infinitive priming effect. As for the specific infinitive effect, it seems to reflect a more intricate interplay of priming from the target (sentence to be recalled) and priming from the prime (actually following the target), besides just CS similarity: the more similar the CS of the target to the CS of the prime, the more probable that the target becomes paraphrased into an infinitival sentence, i.e. the dominant priming effect comes from the prime. Conversely, if the prime is not similar "enough", the priming effect of the prime will be suppressed by the priming effect from the target. This might imply that repetition suppression/enhancement, as discussed in Section 3.4 concerning long-lived versus short-lived priming, may also pertain to repeated structural components, e.g. AGs, not only to words. Similarity, understood as correlating with structural repetitions across CSs, can affect priming in such a way that temporally distant repeated AGs may inhibit the re-activation of the CSs that previously deployed them and the word sequence of the to-be-recalled sentence is reassigned a new CS whose structural components may be facilitated by repetition enhancement and residual activation from the more recent prime. On the other hand, when the intervening sentence (prime) is not similar (enough) to the target, structural repetition effects do not interfere (so much) with sentence recall, so the original structure of the target can be maintained more efficiently.

To visualise the degree of similarity between the target and the various primes consider Tables 19 - 22. The initial part of the target CS_{targFC}, Table 19, and of the CS for the OR sentence CS_{OR} in Table 20, are fairly similar in that they both symbolise a group with OR verbs, say AG_{OR}. This similarity is somewhat reduced for the OC sentence, since (*John persuaded) (Mary to be nice)* is a less sensible segmentation than *(John persuaded Mary)(to be nice)*, cf. Table 21. Thus CS_{targFC} seems to have more in common with CS_{OR} than with CS_{OC}, hence CS_{OR} may be responsible for a larger priming effect. Note that the recall cue (e.g. *John believed*) can also be mapped onto AG_{OR}, equally biasing CS_{targFC} and CS_{OR} so its contribution to priming might be negligible. In terms of structural similarity, the passive version of the OR sentence, viz. *Mary*

was believed to be nice by John, might be more reminiscent of an OC sentence than of the active OR sentence itself since the initial AGs of CS_{targFC} for mapping *Anne reported (that)* cannot be used for mapping *Mary was believed*, cf. CS_{ORpass} in Table 22. Consequently, as the passive OR structure is less similar to the target CS than the active OR structure is, the priming effect from the target is more dominant, i.e. fewer paraphrases can be expected from passive primes.

Table 19
Coverage structure $CS_{targ\ FC}$ for processing target 'Anne reported that Jill was good'

Anne	*reported*	*that*	*Jill*	*was*	*good*	
Anne	**reported**					**AG_{OR}**
		that	Jill	was	good	
Anne	reported	that				
			Jill	was	good	

Table 20
Coverage structure CS_{OR} for processing prime 'John believed Mary to be nice'

John	*believed*	*Mary*	*to*	*be*	*nice*	
John	**believed**					**AG_{OR}**
		Mary	to	be	nice	
John	believed	Mary				?
			to	be	nice	

Table 21
Coverage structure CS_{OC} for processing prime 'John persuaded Mary to be nice'

John	*persuaded*	*Mary*	*to*	*be*	*nice*	
John	persuaded					AG_{OR}?
		Mary	to	be	nice	?
John	**persuaded**	**Mary**				AG_{OC}
			to	be	nice	

Table 22
Coverage structure CS_{ORpass} for processing prime 'Mary was believed to be nice by John'

Mary	*was*	*believed*	*to*	*be*	*nice*	*by*	*John*	
Mary	was	believed						AG_{ORpass}
Mary			to	be	nice			
			to	be	nice			
						by	John	

4.6. Coerced expressions

Experimenting with coerced sentences Raffray, Pickering, Zhenguang, and Branigan (2014) observed that participants were less likely to produce coerced expressions (e.g. *the bricklayer began the wall*) after VP primes (e.g. *the author began writing the book*) than following either coerced (e.g. *the*

author began the book) or event-NP primes (e.g. *the author began the lecture*). Assuming the AGs in (16), the corresponding CSs, are sketched as CS_{CO1} of Table 23 and CS_{CO2} of Table 24. While CS_{CO2} can be used for processing coerced sentences, CS_{CO1} is more complex as it has more groups (cf. AG_{CO3}), and involves AG_{CO2} discontinuously. Since the two CSs are quite different, we cannot expect CS_{CO1} to prime coerced targets as much as CS_{CO2} can prime them.

(16)

AG_{CO1}	AG_{CO2}	AG_{CO3}
the author	began the book	began writing
the book	began the article	began building
the article	began the wall	started writing
the wall	began the lecture	
the bricklayer	wrote the book	
the lecture	bought the book	
the speech		

Table 23
Coverage structure CS_{CO1} for processing 'the author began writing the book/lecture'

the	*author*	*began*	*writing*	*the*	*book/lecture*	
the	author					AG_{CO1}
		began	writing			AG_{CO3}
		began		**the**	**book/lecture**	**AG_{CO2}**
				the	book/lecture	AG_{CO1}

Table 24
Coverage structure CS_{CO2} for processing 'the author began the book/lecture'

the	*author*	*began*	*the*	*book/lecture*	
the	author				AG_{CO1}
		began	**the**	**book/lecture**	**AG_{CO2}**
			the	book/lecture	AG_{CO1}

Raffray et al. (2014) additionally observed that participants were more likely to produce coerced responses (*the bricklayer began the wall*) after coerced primes (*the author began the book*) than after event-NP primes (*the author began the lecture*). Syntactically, the constituent structures of the sentences in question are exactly the same. However, the respective CSs will be different if we, for instance, allow sub-AGs on the basis of concepts definable over AGs, and suppose that these AG sub-domains can have specific properties with respect to combinability. By assuming the concepts in (17) over AG_{CO1} along with the corresponding sub-AGs – AG_{CO1}/ANIMATE, AG_{CO1}/OBJECT, and AG_{CO1}/EVENT – we can have two different CSs. One for coerced utterances, e.g. CS_{OBJ} in Table 25, and another one for sentences with event-NP objects, e.g. CS_{EVENT} in Table 26. Obviously, CS_{OBJ} is a more suitable CS for *the bricklayer began the wall* to be mapped onto than CS_{EVENT} and can result in a larger priming effect.

(17)

"Animate": THE ∧ (AUTHOR ∨ BRICKLAYER)
"Object": THE ∧ (BOOK ∨ WALL ∨ ARTICLE)
"Event": THE ∧ (LECTURE ∨ SPEECH)

Table 25
Coverage structure CS_{OBJ} for processing 'the author began the book'

the	*author*	*began*	*the*	*book*	
the	*author*				AG_{CO1}/*ANIMATE*
		began	***the***	***book***	$\mathbf{AG_{CO2}}$
			the	*book*	AG_{CO1}/*OBJECT*

Table 26
Coverage structure CS_{EVENT} for processing 'the author began the book/lecture'

the	*author*	*began*	*the*	*lecture*	
the	*author*				AG_{CO1}/*ANIMATE*
		began	***the***	***lecture***	$\mathbf{AG_{CO2}}$
			the	*lecture*	AG_{CO1}/*EVENT*

Thus, the degree of similarity of the CSs of the primes to the CS of a coerced target – $CS_{OBJ} > CS_{EVENT} > CS_{CO1}$, where CS_{OBJ} is the most similar – mirrors their suitability for priming coerced utterances, in concert with the experimental results.

Raffray et al. (2014) found a boost to priming when prime and target shared the coerced, but overtly unexpressed, verb. For instance, *The celebrity began the champagne* constituted a stronger prime for *The banker began the tea* than *The caretaker began the stairs* did, which suggests that the underlying coerced verb '*drink*' establishes a stronger connection between '*champagne*' and '*tea*' than the connection between '*stairs*' and '*tea*'. Assuming more fine-grained concepts than in (17), we could also classify objects according to the verbs they can be associated with. For example, concept "*Object to be written*", basically definable for AG_{CO1} as THE ∧ (BOOK ∨ ARTICLE), could specify those utterances, that are most closely related to the verb '*write*'.

The circuitry interpretation of the AG model additionally allows an account of semantic differences where CSs need not be explicitly differentiated conceptually. In Section 3.2 we related semantic priming effects to an interaction between AGs and conceptual circuits. A similar line of reasoning might be valid here, too. Just as *the sheep that is red* is primed more by *the goat that is red* than by *the knife that is red* (Cleland and Pickering, 2003), it can be possible that *began the wall* is primed more by *began the book* than by *began the lecture* because of shared underlying conceptual circuits. Supposing that BOOK and WALL are both part of a, say, OBJECT circuit would imply that activation from the BOOK concept could reach not only the *'book'* node of AG_{CO1} (and/or AG_{CO2}) through the lexical *'book'* node but also the *'wall'* node of AG_{CO1} since some activation from the Concept layer BOOK node can spread to the WALL node as they are conceptually connected within the OBJECT circuit, and this (weaker) activation can ultimately propagate to the

AG_{CO1} *'wall'* node. Although such incidental activation of *'wall'* can be backgrounded by the winner *'book'*, the residual activation of the corresponding *'wall'* pathway (alongside with the residual activation of the AG_{CO1} category nodes) facilitates easier accessibility of AG_{CO1} for a subsequent utterance fragment containing the word *'wall'*. Similarly, *began the tea* can be primed more strongly by *began the champagne* than by *began the stairs* if we assume that CHAMPAGNE and TEA belong to a shared conceptual circuit (DRINK) whilst they have no relevant conceptual links in common with concept STAIRS.

4.7. Closed-class elements

Investigating the role of closed-class morphemes, Pickering and Branigan (1998) found no effect on priming. Sentences (18) all primed *the doctor gave the medicine to the patient.*

(18)

the *teacher gave* the homework to the children
the *teacher gives* the homework to the children
the *teacher was giving* the homework to the children
the *teachers give* the homework to the children

It can be seen immediately that whereas the initial part of the utterances can differ with regards to grammatical features, the final sequences are fairly homogeneous. This suggests a partial matching of the respective CSs and a similar priming potential for all the primes in (18). For a particular analysis, consider the AGs in (19) and the CSs in Tables 27 – 30.

(19)

AG25	AG26	AG27	AG28
<u>gives homework</u>	<u>medicine to children</u>	<u>teacher gives</u>	<u>teachers give</u>
gives money	homework to children	doctor gives	doctors give
gives medicine	medicine to patients	teacher **gave**	teachers **gave**
gave homework	medicine to **patient**		

AG29
<u>teacher was giving</u>
doctor was giving

Indeed, all prime CSs share group AG26 with the target CS. Furthermore, CS_{PRIME1} is identical with the target CS. CS_{PRIME2} has AG26 and the same number of words as the target. CS_{PRIME3} still has AG26 but it requires the extra word '*was*'. Assuming, again, that the degree of similarity of the CSs of the primes to the target CS mirrors the intensity of the priming effect, we would predict the following ordering: $CS_{PRIME1} > CS_{PRIME2} > CS_{PRIME3}$, where CS_{PRIME1} primes most. It might be insightful to experimentally investigate whether there really are such fine-grained quantitative differences between the CSs in questions. Specifically, as CS_{PRIME3} may coverage-structurally be reminiscent of the passive construction, some subtle priming effect might be expected from

e.g. *the doctor was giving medicine (to the patient)* for e.g. *the teacher was given access (to the children)*. Cf. also the discussion on reconstruction in Section 5.

Table 27
Coverage structure CS_{TARGET} for target 'doctor gave medicine to patient'

doctor	*gave*	*medicine*	*to*	*patient*	
doctor	gave				AG27
	gave	medicine			AG25
		medicine	to	patient	AG26

Table 28
Coverage structure CS_{PRIME1} for prime 'teacher gives homework to children'

teacher	*gives*	*homework*	*to*	*children*	
teacher	gives				AG27
	gives	homework			AG25
		homework	to	children	AG26

Table 29
Coverage structure CS_{PRIME2} for prime 'teachers give homework to children'

teachers	*give*	*homework*	*to*	*children*	
teachers	give				AG28
		homework	to	children	AG26

Table 30
Coverage structure CS_{PRIME3} for prime 'teacher was giving homework to children'

teacher	*was*	*giving*	*homework*	*to*	*children*	
teacher	was	giving				AG29
			homework	to	children	AG26

Note, that the example AGs in (19) are morphologically rather heterogeneous. For instance, *gives* and *gave* in AG25 conflate tense features (present vs. past). By employing more homogeneous AGs or, alternatively, sub-AGs representing "morphological/grammatical concepts", we could obtain different analyses, possibly with different CS. Nevertheless, all CS alternatives would result in some degree of priming since all of them should be suitable for mapping similarly the final part of the sentence, represented by AG26 in the present example.

Here we make the additional claim that further explanatory horizons can open up if we consider possible parallelisms between morphological and syntactic mapping. AGs could consist of combinations of sublexical components (viz. word stems and affixes) that could, in turn, be combined into CSs. For a very simplified English example consider the AGs in (20) and CS_M in Table 31 for the morphological processing of 3rd–singular verb form *'reuses'*.[9] In principle, repeated use of morphological AGs and CSs might also contribute to priming.

[9] See Section 5.1 in Drienkó (2020b) for some Hungarian examples.

(20)

AG_{M1}		AG_{M2}	
dis	close	close	d
dis	use	use	d
re	close	move	d
		close	s

Table 31
Morphological coverage structure CS_M for mapping the word 'reuses'

re	*use*	*s*	
re	use		AG_{M1}
	use	s	AG_{M2}

5. Anomalous sentences and reconstruction

5.1. AG-level reconstruction

In experiments on the comprehension of anomalous sentences Ivanova, Pickering, Branigan, McLean, and Costa (2012) found that morphologically anomalous sentences like (21a), sentences with novel verbs like (21b), and inappropriately used intransitive verbs like (21c) all primed target picture descriptions.

(21)
a) The waitress *gived the book to the monk
b) The waitress brunks the book to the monk
c) The waitress exists the book to the monk

It was demonstrated in Drienkó (2014) how an extended mapping mechanism can enhance the processing capacity of AGs by "guessing" the AG-category of unknown words, i.e. by allowing mapping of novel word w_i of utterance u_k onto a suitable position in AG_n if all the other words of u_k can be mapped onto their proper positions in AG_n. For instance, *baby brunks tea* can be mapped onto AG15 by assuming the same agreement category (position in the AG) for *'brunks'* as for *'brings'* and *'gives'*. Thus, e.g. *baby brunks tea to mommy* can prime *mommy gives bread to baby,* cf. Tables 11, 32 and (22).[10]

[10] In a circuitry setting, extended mapping (reconstruction) might be realised explicitly via a "?" lexical node connected to all AG nodes. When no appropriate concept-lemma-AG route can be found between conceptual, lexical, and AG nodes, an "UNKNOWN/NOISE" concept could activate the "?" lemma, which in turn could raise the activation level of all the AG nodes by sending activation, thereby enabling full activation of otherwise incompletely evoked AGs. This alone means more extensive activation for mapping. Furthermore, since some AG nodes have already been activated by their proper lemmas, these nodes may receive even stronger activation producing a more enhanced priming potential for the reconstruction mechanism. Cf. the discussion of inverse frequency effect in Section 5.4.

Table 32
CS$_{POD}$ for 'baby brunks tea to mommy'

baby	*brunks*	*tea*	*to*	*mommy*	
baby	?brunks	tea			?AG15
			to	mommy	AG16

(22)

AG15	AG16	AG17
<u>baby brings tea</u>	<u>to mommy</u>	<u>gives mommy tea</u>
baby gives tea	to daddy	brings mommy tea
baby brings bread	for mommy	gives mommy juice
mommy brings tea	with mommy	gives daddy tea
baby brings juice	to baby	
AG48	AG49	
<u>we give tea</u>	<u>give mommy milk</u>	
you give tea	give mommy tea	
I give tea	bring mommy milk	
we bring tea		
they give tea		
we give bread		

Note that due to CS-similarity, some priming effect from anomalous sentences can be expected even without reconstruction. Since all the ill-formed sentences in (21a)-(21c) share a well-formed prepositional end fragment, they can be expected to prime POD targets even if no "correct" CS can be constructed or found for such anomalous utterances. This is supported by research on garden-path sentences, e.g. by Van Gompel, Pickering, Pearson, and Jacob (2006) who found that incorrect analyses can retain activation and, thus, produce priming effects.

The "guessing" mechanism can also be activated for sentences like (21c) if incorrectly used words are interpreted as novel i.e. as having a novel meaning. By extended mapping of *'exists'* onto AG15, for instance, the word can be understood as meaning something like *'brings'* or *'gives*' and utterance *baby exists tea to mommy* would be mappable. Similar arguments may hold for *baby *gived tea to mommy* containing the incorrect verb form **gived,* also contained in (21a), with the difference that, in AG15, *'gives'* could have priority over *'brings'* due to some activation from the lexical *'give'* node. Furthermore, if AG15 contained the past-tense verb form *'gave'*, the reconstruction of *'gave'* for **gived* could receive additional support (i.e. more than *'gives*') from the past-tense lexical node *'gave'* possibly activated by concept PAST as a result of detecting suffix '-ed' in **gived*.

When the guessing mechanism is activated, it is practically irrelevant what particular phonological form a nonce word has: substituting e.g. *x, zagsg*, or ##### for *brunks* in (21b) could similarly licence mapping onto AG15. In the ultimate case, the nonce word has no phonological form at all, like in sentence **The waitress the book to the monk* containing no verb. Since this sentence still retains the prepositional ending *to the monk,* it suggests a priming bias for POD. With additional help from the AG guessing mechanism, the mapping

system might ultimately "reconstruct" an optimal CS for such an utterance by selecting or activating, among possibly many others, the most suitable AGs. Figure 6 sketches the situation where groups AG15 and AG16 have been activated for **baby tea to mommy* and the two groups can be combined into CS_{POD} with the proviso that something is missing between the first two words. Our analysis also accords with the results in Ivanova, Branigan, McLean, Costa and Pickering (2017) who claim that comprehenders can reconstruct the constituent structure of anomalous sentences since anomalous sentences with missing verbs primed participants' picture description utterances as much as well-formed sentences did.

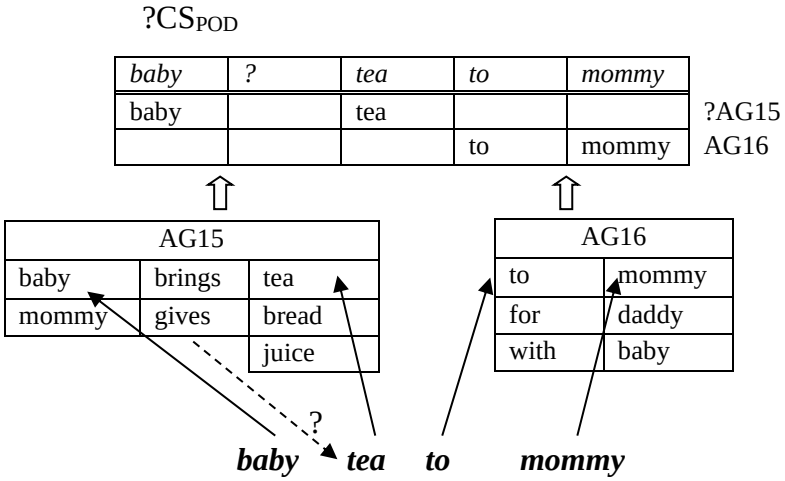

Figure 6. Reconstructing CS_{POD} for **baby tea to mommy*

5.2. CS-level reconstruction

Besides the AG-level guessing mechanism invoked above for identifying AG member candidates in order to handle the anomalous utterances in the examples (21a-c), there might be a CS-level guessing component responsible for providing the missing AGs for underspecified CSs. On hearing, for instance, the utterance pair *we give mommy tea, he doesn't*, speakers of English will trivially understand the second utterance as *he doesn't give mommy tea* which suggests the interpretation that speakers may use AGs activated for the CS of a previous utterance (fragment) – together with the actual words mapped onto them – to guess the missing AG(s) for the current utterance (fragment). Tables 33 and 34 show how AG49, as reconstructed from CS_1, the CS for *we give mommy tea*, can be combined with an AG for *he doesn't*, e.g. AG30, to yield the reconstructed CS_2 where the deleted part should be understood as having no explicit phonological manifestation in the utterance. Cf. AGs (22).

Table 33
CS_1 for 'we give mommy tea'

we	*give*	*mommy*	*tea*	
we	give		*tea*	AG48
	give	mommy	tea	AG49

Table 34
CS_2 for 'he doesn't give mommy tea'

he	*doesn't*	~~*give*~~	~~*mommy*~~	~~*tea*~~	
he	doesn't				AG30
		~~give~~	~~mommy~~	~~tea~~	~~(AG49)~~

With *she gives mommy tea, he doesn't*, the situation is a bit more complex since *gives mommy tea* requires AG17, so this fragment could only be mapped onto AG49 via reconstruction, assuming that '*gives'* is something like '*give',* which assumption could be supported by activation from the lexical '*give'* node. Here we see an example of reconstruction on two levels: the CS-level reconstruction of AG49 for CS_2 is dependent on the AG-level reconstruction of the appropriate verb form '*give'* for '*gives'* as prescribed by AG49.

5.3. Activation intensity and reconstruction levels

Experimental research seems to suggest that the reconstruction of missing components requires varying degrees of activation, depending on the level of structural inference. AGs involved in the extended mapping of unfamiliar words (e.g. AG15 for *baby ? tea*) seem to be more strongly activated (stay longer in memory) than reconstructed AGs for CSs (e.g. AG49 for CS_2). Cai, Pickering, Wang, and Branigan (2015) showed that, in Mandarin, both full DOD utterances and DOD utterances with elided (missing) Theme NPs primed full DOD sentences, i.e. both (23a) and (23b) produced priming.

(23)

a) *Niuzai mai-le yiben shu hou* ***song-gei-le shuishou na ben shu***
(The cowboy bought a book and later **gave the sailor the book**)

b) *Niuzai mai-le yi ben shu hou* ***song-gei-le shuishou***
(The cowboy bought a book and later **gave the sailor** [that book])

It is logical to assume that the *gave (the) sailor (the) book* (*song-gei-le shuishou shu*) fragment of the sentence in (23a) can be mapped onto a single AG representing the DOD construction in question. By extended mapping, the *gave sailor* (*song-gei-le shuishou*) fragment of (23b) can likewise be mapped onto that AG, presuming a missing noun at the end. This missing noun, then, can be identified with the word *book (shu)* – as supported by previous activation of the corresponding lexical node for use in the first part of the sentence – and the AG in question can take part in the priming of subsequent utterances.[11]

On the other hand, Cai, Pickering, and Sturt (2013) found no priming with elided VPs. For instance, neither the DOD fragment *jie-gei shuishou na ba qiang* in (24a) nor the POD fragment *jie na ba qiang gei shuishou* in (24b), as assumed to be reconstructed for the *bu xiang* (*would not like to*) fragments in the corresponding target sentences, primed the respective dative constructions.

[11] Recall that the same utterance can be mapped onto several AGs, so, in general, the priming effect may rather be ascribed to the set of AGs that a given fragment is compatible with than just to a single AG.

(24)

a) *Fuwuyuan xiang **jie-gei shuishou na ba qiang**.*
(The waitress would like **to lend the sailor the gun**)
*Yinwei haipa reshi chushi que bu xiang [**jie-gei shuishou na ba qiang**].*
(Because of fear of trouble, the chef would not like to [lend the sailor the gun])

b) *Fuwuyuan xiang **jie na ba qiang gei shuishou**.*
(The waitress would like **to lend the gun to the sailor**)
*Yinwei haipa reshi chushi que bu xiang [**jie na ba qiang gei shuishou**].*
(Because of fear of trouble, the chef would not like to [lend the gun to the sailor])

The results suggest that the AG activated for the mapping of the '*lend sailor gun'* DOD sentence fragment in order to be combined with the AG for the '*would not like (bu xiang)'* fragment in the CS for the whole utterance is either not activated to a sufficient degree or is not kept in memory long enough to cause DOD priming effects with subsequent utterances. Similar arguments may hold for POD sentences (cf. *lend gun to sailor).* Thus, experimental findings suggest that AGs involved in the within-AG inference of missing words (e.g. '*book'* for '*gave sailor book')* may get stronger activation (persist longer in memory) than AGs reconstructed for missing AGs in CSs (e.g. than the AG for mapping '*lend sailor gun'* as in the case of '*would not like to [lend sailor gun]'*). This discrepancy is also mirrored in the coverage properties of the phenomenon: the reconstructed AG (for '*lend sailor gun'*) does not explicitly appear in the CS of the priming sentence (*Because of fear of trouble, the chef would not like to)* whilst the AG for '*gave sailor book'* is actually represented in the CS of the prime *(The cowboy bought a book and later gave the sailor)* even though the object noun (*book*) is not expressed overtly. Tables 35–38 contrast the various priming conditions visually. Table 35 sketches the relevant structure, CS_{CH1}, for the Chinese DOD construction. Table 36 shows that CS_{CH1R} can similarly facilitate priming subsequent DOD utterances because AG_{CHDOD} is explicitly activated and the missing noun (*shu*) is reconstructed. Table 37 outlines CS_{CH2}, the Chinese DOD construction for the missing VP case. As Table 38 demonstrates, CS_{CH2R} cannot result in priming because AG_{CHDOD} is not explicitly contained (is not activated strongly enough) in CS_{CH2R}.[12]

[12] Arguably, it might not be necessary to distinguish between the two options, DOD or POD, for the missing VP to process the same message when the message is not fully articulated. Indeed, the two constructions are conceptually equivalent and they activate exactly the same lexical nodes (with different word-order). When the speaker is forced to process, i.e. to choose, one particular construction, it can naturally be biased by previous use and it can bias subsequent use. However, when no choice is necessary, i.e. an utterance component is not represented explicitly in the CS, due to this uncertainty, no priming should be expected from the utterance component in question.

Table 35
CS_{CH1} for Chinese DOD construction (NP ellipsis experiment)

Niuzai	*mai-le*	*shu*	*hou*	*gei-le*	*shuishou*	*shu*	
Niuzai	mai-le	shu					
	mai-le	shu	hou				
				gei-le	shuishou	shu	**AG_{CHDOD}**

Table 36
CS_{CH1R} with reconstructed word 'shu'

Niuzai	*mai-le*	*shu*	*hou*	*gei-le*	*shuishou*	~~*shu*~~	
Niuzai	mai-le	shu					
	mai-le	shu	hou				
				gei-le	shuishou	~~shu~~	**AG_{CHDOD}**

Table 37
CS_{CH2} for Chinese DOD construction (VP ellipsis experiment)

Fuwuyuan	*xiang*	*jie-gei*	*shuishou*	*qiang*	
Fuwuyuan	xiang				
		jie-gei	shuishou	qiang	**AG_{CHDOD}**

Table 38
CS_{CH2R} with reconstructed AG_{CHDOD}

chushi	*bu*	*xiang*	~~*jie-gei*~~	~~*shuishou*~~	~~*-qiang*~~	
chushi		xiang				
	bu	xiang				
			~~jie-gei~~	~~shuishou~~	~~-qiang~~	**~~AG_{CHDOD}~~**

5.4. Reconstruction and the inverse frequency effect

The extended mapping mechanism (reconstruction) might also underlie the "inverse frequency/preference" effect, i.e. the observation that longer-term priming is stronger when the prime construction is less frequent (e.g. Pickering and Ferreira, 2008). "Less frequent" constructions are synonymous with "represented by fewer and/or smaller AGs" in our model. This increases the probability that a given rare-construction utterance (fragment) cannot be mapped onto an appropriate AG directly. Reconstruction can be useful here, too. Suppose, for example, that the English passive voice is less frequent than the active construction and we have AGs like in (25). On attempting to process e.g. '*milk is drunk*', the mapping system detects the lack of any suitable AGs and can call on the reconstruction mechanism. Checking all (the two) candidate AGs, the system can conclude that mapping '*milk? is drunk*' onto AG_{P1} is viable if '*milk*' belongs to AG-category {*water, tea*} or, alternatively, '*milk is? drunk*' can be mapped onto AG_{P2} if '*is*' is something similar to '*was*'. The decision as to which AG to choose may be based on semantic information from the Concept layer. As '*is*' is typically associated with concept PRESENT while '*was*' with PAST, AG_{P2} does not seem to be a fair option. In contrast, MILK can be strongly linked to other beverages, inter alia to WATER and TEA, in a semantic circuit of the Concept layer which biases AG_{P1} as the right option.

(25)

AG_{P1}	AG_{P2}
water is drunk	coffee was drunk
tea is drunk	milk was drunk
	beer was drunk

Since the reconstruction process requires an extensive search (activation) of pathways, it can ultimately involve large node populations, possibly larger than for mapping without reconstruction for the more common and larger AGs. Recall that we associate a higher probability of long-lasting activation with larger node populations, hence we expect a higher priming potential for less frequent constructions requiring reconstruction via extended mapping (cf. footnotes 5 and 8).

Stronger activation for novel utterances may additionally have a within-AG dimension. Whereas memorised AG-member utterances can be accessed more directly, possibly bypassing category nodes, novel utterances require the category nodes for previously unconnected words to be connected, cf. Figures 1 – 3. Consequently, the mapping of novel utterances requires longer pathways, involving more nodes and connections which, again, can entail longer and/or stronger activation and priming potential. Since rare constructions can reasonably be supposed to require more novel word combinations than frequent ones, within-AG variability is an additional source of enhanced priming for less frequent constructions. Note that within-AG variability is graded in proportion to how many category nodes can be bypassed. Thus, for instance, '*mommy brings tea'* is a member utterance of AG15 in (13) and can be mapped without intervening category nodes, '*mommy gives tea'* can bypass one category node (between '*gives*' and '*tea*', i.e. activation can propagate directly from '*gives'* to '*tea'* since the '*gives tea*' fragment is a part of the member utterance '*baby gives tea*'), and finally, *mommy gives juice* requires all the category nodes of AG15, i.e. the longest pathway. Further degrees of novelty, as with e.g. '*mommy gives brunk'* will be handled by the reconstruction mechanism.

5.5. Code-switching and reconstruction

In speakers of English with no knowledge of Hungarian, sentences '*baby brunks tea to mommy* 'and '*baby hoz tea to mommy'* would be processed similarly. However, for English-Hungarian bilinguals, this could be an instance of code-switching since '*hoz*' means '*brings*' in Hungarian. Consequently, code-switching seems to be related to reconstruction. Indeed, fragment '*baby hoz tea'* can be mapped onto AG15 only by inference, i.e. assigning AG-category {*gives, bring*} to '*hoz*'. This category assignment and a strong bias for AG node '*brings*' can be supported by activation either via direct English-Hungarian connections between nodes '*bring/brings*' and '*hoz*' in the Lexical layer and/or via concept BRING as connected to both the English '*bring*' and the Hungarian '*hoz*' lemmas. Mapping '*hoz*' onto AG15, in turn, enables the activation (and possible re-activation for priming subsequent utterances) of CS_{POD}, shown as CS_{PODR} by Table 39. Cf. also Figure 5.

Table 39
Reconstructed CS_{PODR} for 'baby hoz tea to mommy'

baby	*hoz*	*tea*	*to*	*mommy*	
baby	?hoz	tea			?AG15
			to	mommy	AG16

Note that this account agrees with what was said about code-switching in Section 3.3. From a reconstruction aspect, however, it can be a question whether the reconstruction apparatus is needed in its entirety (searching through all possible AGs as required by an "UNKNOWN/NOISE" concept) with support from cross-linguistic connections, or supporting activation via cross-linguistic connections alone could suffice to identify the needed word/AG. The answer could arise from experiments with anomalous utterances containing both true nonce words and nonce words that are actually meaningful in another language. We may expect a difference in priming effects for bilinguals. Priming should be smaller for meaningful nonce words if they can be identified through cross-linguistic connections. On the other hand, if priming is the same or larger than for true nonce words, it could mean that the whole reconstruction apparatus is deployed possibly involving a much larger node population. Additionally, measuring bilinguals' processing times in experiments with the two types of anomaly might also be informative about the degree of reconstruction involved.[13]

6. Developmental aspects of priming

The present section aims to highlight the developmental aspects of the AG framework against the backdrop of a representative selection of observations from experiments with various age groups. First we list the major findings then demonstrate how they are compatible with the AG model.

6.1. Developmental findings

Rowland, Chang, Ambridge, Pine, and Lieven (2012) investigated the developmental aspects of linguistic priming by conducting experiments with 3-4 year olds, 5-6 year olds, and adults. The participants were primed with double object dative (DOD) and prepositional dative (POD) sentences. The authors found i) that structural priming occurred in all age groups: 3-4 year olds, 5-6 year olds, and adults; ii) some evidence that structural priming was larger in the younger child group than with older children and adults; iii) that children, especially 3-4 year olds, produced fewer DODs than adults; iv) a significant increase in priming effect when prime and target sentence shared the same verb (lexical boost) in adults, a small increase with older children, and no increase in the youngest child group. Buckle, Lieven, and Theakston (2017) examined to what extent animacy-semantic role mappings in POD and DOD prime and target sentences influenced the choice of syntactic structure and post-verbal noun order in children (3- and 5-year-olds) and adults. They

[13] An even more intriguing question could be the case of anomalous words having different meanings in different languages. In e.g. *Baby ad tea to mommy*, '*ad*' can either be interpreted (in various ways) as an anomalously used English word or as the Hungarian word for '*gives*'. The interpretation may depend on the previously/simultaneously activated lexical, semantic or AG nodes.

found that v) structural priming occurred in all age groups; vi) animacy could moderate the magnitude of structural priming in only 3-year-olds; vii) 5-year-olds and adults produced more DODs for prototypical (animate goal, inanimate theme) targets; viii) noun animacy primed the ordering of nouns in children (3- and 5-year-olds); ix) noun animacy did not prime the ordering of nouns in adults. Table 40 summarises the observations.

Table 40
Observations in developmental research

i)	Structural priming in all age groups: 3-4 year olds, 5-6 year olds, and adults	Rowland et al. (2012): 3-4 year olds, 5-6 year olds, and adults, DOD, POD
ii)	Structural priming larger in the younger child group than with older children and adults	
iii)	Children, especially 3-4 year olds, produce fewer DODs than adults	
iv)	A significant lexical boost in adults, a small boost with older children, and no boost in the youngest children	
v)	Structural priming in all age groups	Buckle et al. (2017): 3-year-olds, 5-year-olds, adults, DOD, POD, animacy-semantic role mappings
vi)	Animacy moderates structural priming in 3-year-olds	
vii)	5-year-olds and adults produce more DODs for prototypical (animate goal, inanimate theme) targets	
viii)	Noun animacy ordering priming effect in children (3- and 5-year-olds)	
ix)	No noun animacy ordering priming effect in adults	

Overall, the results seem to accord with the U-shaped AG homogenisation trajectory observed in Drienkó (2017; 2020a; 2020b, Section 4.5) We assume that, initially, there is a general expansion of the AG space, with AGs rather mixed with regards to various linguistic categories. Then at some point of development, they begin to become more specific (homogeneous), corresponding more closely to some particular aspects of language. At this point a reduction might be observed in some processing capacities. Then, the AG space, with its homogenised groups, starts to expand again and processing improves. Note that re-expanding AGs, homogenised in terms of a particular linguistic category (e.g. verb types) may become increasingly more heterogeneous in terms of other aspects of language (e.g. the type of nouns that may co-occur with a particular verb type). What follows is a discussion of how specific details of the experimental findings can be integrated into this more general picture of linguistic development envisaged by the AG framework. Roman numbers refer to the observations in Table 40.

6.2. Structural priming is larger in (younger) children: i), ii), v)

The observed structural priming in 3-4-olds reveals that repeated usage of AGs is possible from a very early age (i, v). Besides, at the early stages of development, AGs are less homogenised – giving rise to various possible speech errors – so the same AG can be accessed through a larger variety of words which means a greater probability for subsequent utterances to be mapped onto the same AG, i.e. a greater likelihood of structural priming (ii).

Additionally, AGs are not only inhomogeneous but there are fewer of them at the earlier developmental stages which also increases the probability of repeated usage (ii). Arguably, with less developed linguistic capacity, children may need to resort to reconstruction mechanisms to a larger extent than adults. Reconstruction, as we proposed earlier, can potentiate larger AG populations entailing an enhancement of priming (ii).

6.3. Lexical boost in adults: iv)

The above claim that the fewer and less homogeneous AGs in early development can be accessed through a larger variety of words, in general, also suggests that a greater number of more homogeneous AGs at later stages increase the probability that the same AG will be accessible through a possibly smaller variety of words, compatible with some specific linguistic category, e.g. GIVE/TRANSFER. On the other hand, once this category has been identified (by a compatible word in a previous sentence) in a concrete AG, there will be a greater chance for other words (e.g. nouns as direct or indirect object candidates for '*give*') in a subsequent utterance to be included in (i.e. to be mappable onto) the same AG (out of possibly several alternative AGs) because adult AGs integrate a more heterogeneous collection of nouns compatible with GIVE. For example, while '*give mommy tea'* may boost '*give employee salary'* lexically via a shared underlying AG in adults, it is less likely in the case of young children. In other words, a child's AG32 in (26), e.g., may not include the words *'employee'* or *'salary'* but later on they can appear in their appropriate AGs. In the circuitry interpretation, the lexical node (*give*) together with the corresponding AG nodes, as well as the concomitant links between the nodes, constitute a more robust processing bias, lexical boost, for subsequent utterances in mature speakers, cf. Sections 3.2. and 6.4.

6.4. Children produce fewer DODs than adults: iii)

The results may reflect the evolution of alternative linguistic constructions via the maturation process of the AG mapping system. Initially, (two-word) AGs are mixed with respect to semantic roles, allowing both goals and themes to be mapped onto them. For example, utterances *give tea(theme),* and *give baby(goal)* can be mapped onto AG32 in (26). There are no/few AG combinations at this stage. Later on, as group combinations for CSs begin to emerge, it becomes possible to express the difference between goal and theme syntactically. The key component in doing so must be the formation of appropriate AGs. By homogenising AG32 into AG33 to comprise prototypical theme nouns and forming prepositional AGs like AG34 for prototypical goals, the mapping system can combine them into CSs to represent (prototypical) prepositional dative constructions like *give milk to mommy*, cf. (26) and CS_{POD} in Table 41.

(26)

AG32	AG33(theme)	AG34(goal)
give tea	give tea	to mommy
give milk	give milk	to baby
give mommy	~~give mommy~~	to daddy
give baby	~~give baby~~	
take tea	take tea	
bring tea	bring tea	
provide tea	provide tea	

Table 41
CS_{POD} for POD constructions

give	*milk*	*to*	*mommy*	
give	milk			AG33
		to	mommy	AG34

Another way to assign semantic roles, without the intervention of prepositions, is via word- order. Combining AG32 with itself yields a verb-noun-noun sequence. If learners realise that the first noun is always the goal and the second is the theme (e.g. *give mommy milk)* they can use this information to encode the thematic roles into the corresponding CS. As the DOD structure CS_{DOD} in Table 42 reveals, the noun in the continuous fragment mapped onto AG32 corresponds to the goal, whereas the noun of the discontinuously used AG32 represents the theme. Alternatively, the verb-goal-theme order can be encoded into AGs in the first place. After the developmental stage of two-word combinations, the DOD construction can be represented by memorised three-word-long utterances, and their corresponding AGs, cf. AG_{DOD1} in (27). The finding that children produce fewer DODs than adults suggests that CS_{POD} emerges sooner than CS_{DOD} or DOD AGs.[14]

Table 42
CS_{DOD} for DOD constructions

give	*mommy*	*milk*	
give	mommy		AG32(continuous)
give		milk	AG32(discontinuous)

(27)

AG_{DOD1}
give mommy tea
give mommy milk
give mommy dolly
give baby tea
give daddy tea
bring mommy tea

The assumption that both the POD and the DOD construction derive from a "common ancestor" (e.g. like AG32) is supported by the observation in Goldwater, Tomlinson, Echols, and Love (2011) who found that in scene description tasks the prime in one type of dative (DOD or POD) increased the likelihood of using both dative types in 4-year-olds This suggests that although children can already combine AGs to build CSs for both dative types, the two types do not fully differentiate by the age of 4 (e.g. because AG32 is not homogeneous enough, so it can be employed for both CS_{POD} and CS_{DOD}).

[14] The POD construction can also be represented by dedicated AGs. However, they should minimally consist of four words (verb, theme, preposition, goal) so they can emerge (similarly to DOD AGs) after the two-word combination stage.

The common ancestor idea is also in line with findings in Hare and Goldberg (1999) who report that *provide-with* sentences (e.g. *The officers provided the soldiers with guns*) behaved like double-object (DOD) primes. As Table 43 illustrates, *provide-with* sentences are structurally fairly similar to DOD constructions. Both CS4 in Table 43 and CS_{DOD} in Table 42 employ AG32 in the same way (i.e. continuously for the goal noun and discontinuously for the theme), with the difference that CS4 additionally involves AG35 that prescribes preposition *'with'* for *provide*-type verbs, cf. (28).

Table 43
CS4 for provide-with type constructions

provide	*mommy*	*with*	*milk*	
provide	mommy			AG32(continuous)
provide			milk	AG32(discontinuous)
provide		with	milk	AG35

(28)

AG35
provide with food
provide with milk
supply with food

6.5. Animacy moderates structural priming in only 3-year-olds, not in 5-year-olds and adults: vi)

At a very early age, when there are rudimentary, prototypical POD CSs – e.g. CS_{POD} in Table 41 – and there are even less developed or no AGs for the DOD construction – e.g. AG_{DOD1} in (27) with animate goal and inanimate theme – the processing of non-prototypical utterances may be more difficult. This processing difficulty can be reflected in priming. When a non-prototypical utterance is processed, the failure to identify a suitable (unequivocal) CS for it naturally results in a lack of priming for a subsequent utterance, since priming would require the repeated use of the previously identified CS. Quantitatively, this could imply that structural priming in young children would decrease in proportion to the number of non-prototypical primes. Reconstruction success or, rather, failure may also contribute to the modulatory effect of animacy as younger children, with less developed linguistic capacity, may need to rely on the reconstruction mechanisms more than older speakers do. Since reconstruction activates larger AG populations, it facilitates structural priming (cf. ii). However, when even reconstruction fails to find tentative AG/CS candidates for non-prototypical constructions due to the rudimentary stage of the AG system, no priming should be expected.

6.6. Noun animacy ordering priming effect in children (3- and 5-year-olds): viii)

Why animacy can prime the ordering of nouns irrespective of the dative type (POD or DOD) might be explained with the existence of more heterogeneous or general AGs at early developmental stages plus concepts that can mark out sub-domains within AGs. For example, the animate-inanimate dichotomy in the unhomogenised AG32 is mirrored by concepts

"Transfer animate" and "Transfer inanimate", as (29) shows. Thus the same, conceptually differentiated, group, AG32, can be activated for both the POD and the DOD construction. Tables 44 and 45 illustrate how the respective CSs are similar owing to the conceptually specified shared sub-AG that is needed for the first part of the utterances. As a result, the POD sentence '*give baby to tea'*, with the animate theme '*baby'*, can cause some priming for the DOD '*give mommy milk'* containing the animate goal '*mommy'*. In both sentences an animate noun is followed by an inanimate one, whereas the semantic role orders are reversed (theme-goal vs. goal-theme). Essentially, our argumentation would be the same for '*give tea to baby'*, with the inanimate theme '*tea'*, and '*give milk mommy'*, with the inanimate goal '*milk'*. However, in this case, priming would come from the conceptual domain AG32/INANIMATE rather than AG32/ANIMATE in the corresponding CSs. The present analysis suggests animacy priming for the first post-verbal nouns. Whether or not there is priming between the second nouns, as well, could be determined experimentally. Under our present interpretation, no priming between the second nouns would be anticipated.

Note, that without conceptual sub-domains, AG32 could be used more freely, for both POD and DOD, irrespective of animacy features. Such a situation would be reminiscent of the observation in Goldwater et al. (2011), that the two dative types can prime each other, since AG32 would be comprised both in Table 44 and in Table 45 without conceptual restrictions. Again, we conclude that at around the age of 4, the two types of dative are not yet fully differentiated, cf. Section 6.4.

(29)

AG32	
give tea	CONCEPT "Transfer Animate":
give milk	(GIVE ∨ TAKE ∨ BRING ∨ PROVIDE) ∧ (MOMMY ∨ BABY))
give mommy	
give baby	
take tea	CONCEPT "Transfer Inanimate":
bring tea	(GIVE ∨ TAKE ∨ BRING ∨ PROVIDE) ∧ (TEA ∨ MILK))
provide tea	

Table 44
Conceptually differentiated CS for POD constructions

give	*baby*	*to*	*tea*	
give	*baby*			*AG32/ANIMATE*
		to	*tea*	

Table 45
Conceptually differentiated CS for DOD constructions

give	*mommy*	*milk*	
give	mommy		AG32/ANIMATE
give		milk	AG32/INANIMATE

6.7. No noun animacy ordering priming effect in adults: ix)

The reason why adult processing is less conceptually-driven might be that the restructured (homogenised) and re-expanded AG space offers specific DOD AGs for processing DOD utterances rather than more general (heterogeneous) AGs for combining them into DOD CSs. The POD construction can likewise be supported by specific POD AGs in adults. Such a dissociation of grammatical construction types, in turn, is less likely to allow specific AGs for one construction type to be usable for another. Consequently, no such AG can be found that it is contained both in a DOD CS and a POD CS and its conceptual sub-domains (e.g. with respect to animacy) can facilitate cross-constructional conceptual priming. In other words, the emergence of more specialised AGs in older speakers reduces the structural overlap between POD and DOD.

6.8. 5-year-olds and adults produce more DODs for prototypical (animate goal, inanimate theme) targets: vii)

The explanation may reflect the way words are distributed across utterances or, for that matter, how words and/or utterances are distributed across AGs. The distribution of post-verbal nouns in DOD AGs can be such that AGs with prototypical word-order (i.e. animate goal, inanimate theme) are larger, providing a greater chance for animate-inanimate DOD AGs to be used for processing. This difference is specifically pronounced in older speakers because young children have fewer (and smaller) DOD AGs, or fewer (and smaller) AGs in general. How the distribution of post-verbal noun order across AGs can influence their processing potential is illustrated by the simplified example of (30). The largest group AG_{AI}, with prototypical animate-inanimate word-order, licenses 1×4×4=16 DOD utterances. The non-prototypical inanimate-animate utterances are distributed across two distinct smaller AGs, AG_{IA1} and AG_{IA2} that yield (1×2×2) + (1×2×2) = 8 non-prototypical DOD utterances altogether. Thus the 16 possible prototypical animate-inanimate utterances, as opposed to the 8 inanimate-animate possibilities, implies a greater chance for a message with animate goal and inanimate theme to be processed by a DOD AG than a message with inanimate goal and animate theme. Since each utterance has its own group, supposing that the AG system is based on the 13 memorised utterances given in (30) would entail the existence of 7 prototypical, and larger, AGs (cf. the utterances in AG_{AI}), as well as 6 non-prototypical, and smaller, AGs (cf. the utterances in AG_{IA1} and AG_{IA2}), in accordance with the assumption that the prototypical DOD construction is represented by more and larger AGs.

(30)

AG_{AI} (prototypical)	AG_{IA1} (non-prototypical)	AG_{IA2} (non-prototypical)
<u>give mommy water</u>	<u>give zoo tiger</u>	<u>give house puppy</u>
give mommy milk	give zoo monkey	give car puppy
give mommy dolly	give garden tiger	give house kitten
give baby water		
give daddy water		
give mommy biscuit		
give granny water		

The influence of across-AG word-type distribution on structural processing bias further seems to be highlighted by findings in Bidgood, Pine, Rowland, and Ambridge (2020), who emphasise that syntax is abstract and semantically constrained at the same time. Specifically, they find that the processing of the passive construction is semantically constrained both in 4-6 year olds and adults since participants in either age group produced significantly fewer passives for experiencer-theme verbs (ET, e.g. '*see*') than for agent-patient (AP, e.g. '*hit*') and theme-experiencer (TE, e.g. '*frighten*') verbs. The rank order of passive production (TE>AP>ET) may reflect the composition of AGs with respect to verb types. For instance, verbs belonging to various semantic categories (e.g. TE, AP, ET) may be represented in groups according to their proportions across vocabulary/lexicon. There may be more and larger TE groups than AP and ET groups, and more and larger AP groups than ET groups (e.g. adjectival TE verbs can mingle with adjectives in AGs, cf. '*was frightened*' and '*was sad*'). More and larger groups, as we pointed out above, means a greater chance for an utterance (and also for a similar subsequent one) to be mapped onto. This idea that the data reflect an overall distribution of semantic categories is, additionally, supported by the fact that the rank order of the verb type categories with respect to passive production – viz. TE>AP> ET – is the same for active primes as for passive primes in both age groups (cf. e.g. Figure 3 in Bidgood et al., 2020). In other words, the relative proportion of passive sentences with respect to thematic category is the same in the primed and unprimed (i.e. primed for active) conditions, which, in turn, may be indicative of the underlying AG substrate with regards to the distribution of verb types across AGs, i.e. across AGs responsible for the processing of passive utterances, in particular. Here, again, the distributional difference might be more pronounced in older speakers because young children must have fewer (and smaller) AGs for passive.

6.9. Summary of AG accounts for developmental findings

Table 46 juxtaposes observations i)-ix) with their possible interpretation in the AG framework.

Table 46
Developmental observations explained

	Observation	AG interpretation
i) and v)	Structural priming in all age groups: 3-4 year olds, 5-6 year olds, and adults	Repeated usage of AGs is possible from a very early age
ii)	Structural priming is larger in younger children than in older children and adults	Fewer and more heterogeneous (unhomogenised) AGs in children, accessible through a larger variety of words, larger need for reconstruction
iii)	Children, especially 3-4 year olds, produce fewer DODs than adults	AGs/CSs supporting DOD emerge later in development

iv)	Lexical boost in adults, a small boost with older children, and no boost in young children	Re-expanded larger AGs in adults, homogenised with respect to some category or lexical item increase likelihood of repeated use of an AG (CS) triggered by the corresponding category/lexical item
vi)	Animacy moderates structural priming in 3-year-olds	Prototypical (animate goal, inanimate theme) AGs/CSs in 3-year olds plus reconstruction failure to find unequivocal CSs result in difficulty with non-prototypical utterances (reduced priming)
vii)	5-year-olds and adults produce more DODs for prototypical (animate goal, inanimate theme) targets	Distribution of word types across DOD AGs in older speakers supports animate goal, inanimate theme (no full-fledged DOD in young children, cf. iii)
viii)	Noun-animacy ordering priming effect in children (3- and 5-year-olds)	Heterogeneous/unhomogenised early AGs, plus conceptual domains defined over them
ix)	No noun-animacy ordering priming effect in adults	Specific (DOD) AGs in adults, less structural overlap between POD and DOD

7. Conclusions and future work

It was demonstrated that an AG circuitry approach to linguistic processing may prove to be a useful tool for a unified theoretical treatment of structural priming phenomena. Specifically, we illustrated how priming can be related to the repeated activation of linguistic processing units, notably AGs and CSs, and, ultimately, to various degrees of CS-similarity. The formation and activation of AG circuits was supported by such intrinsic components of the AG model as conceptual domains definable over AGs, the developmental dynamics of the AG space, and a reconstruction mechanism for identifying underspecified linguistic material. The circuitry setting for AGs was particularly insightful in explaining the difference between short-lived lexical boost and longer-term general structural priming as related to the activation of node populations and/or memory processes (viz. repetition suppression and enhancement), as well as in interpreting cross-linguistic priming results.

In the analyses we met various issues that require further experimental investigation. In connection with the structural similarity of various utterance components, we raised the question whether there could be priming between prepositional phrases in non-POD sentences (e.g. *Baby brings tea* ***with*** *mommy*) and POD constructions (e.g. *Baby brings tea* ***to/for*** *mommy*) as the analysis of the POD construction in Section 4.1 and the discussion of locative and agentive by-phrases in Section 4.3 would suggest. By the same token, given the similarity rank-order of CSs for morphologically related sentence variants in Section 4.7, we would anticipate some fine-grained difference in the priming potentials of the corresponding CSs, and additionally expect some

facilitation between Past Progressive and Passive sentences, such as *the doctor was giving medicine to the patient* and *the teacher was given access to the children*. Discussing the possible connection between the reconstruction mechanism of the AG circuitry model and cross-linguistic priming in Section 5.5 it was unclear whether the reconstruction apparatus is needed in its entirety with support from cross-linguistic connections, or supporting activation via cross-linguistic connections alone could suffice to identify the necessary AGs. In experiments with anomalous utterances containing both true nonce words and nonce words that are meaningful in another language we might expect a difference in priming effects for bilinguals. Smaller priming for meaningful words would highlight the role of cross-linguistic links, otherwise the involvement of reconstruction would be underlined. The AG interpretation of the moderating effect of animacy on structural priming in young children in Section 6.5 would forecast a proportional relationship between the reduction in structural priming and the number of non-prototypical primes. The analysis of noun-animacy ordering priming effect in Section 6.6 predicts animacy priming only for the first post-verbal nouns. Whether or not there is priming between the second nouns, as well, could be determined experimentally.

Computational simulations of the circuitry version of the AG model might yield further empirical insights, too. For instance, by letting the search mechanism start looking for appropriate AGs for the current utterance in the sub-collection of appropriate AGs for the previous utterance, it could be tested what processing benefits (e.g. speed) that could mean for structurally similar utterances or how repeated words can enhance processing.

The AG model allows for recursive AG combination but it is as yet unclear how recursion should precisely be incorporated in the circuitry architecture, in particular. Recursively (i.e. repeatedly) activated nodes might need to be related to memory processes, possibly via explicit links to dedicated memory nodes.

Especially in connection with Hungarian data, we ignored topic-focus issues influencing word-order, as a deeper consideration might involve additional cognitive-linguistic components, which would complicate analyses beyond the scope of this study. By the same token, we did not deal with quantifier scope phenomena that would require a more detailed picture of cognitive-semantic modules. However, from the Lexical layer to the AG/CS layers, the structural properties of, e.g., sentence *Every girl loves a boy* would be the same for both interpretations (*each girl has a different lover* contra *all the girls love the same boy*). For an outline account of the semantic dichotomy we note that the two interpretations may reflect a difference in conceptual coupling strategies. While coupling every instantiation/activation of concept GIRL with a single activation of concept BOY can correspond to one interpretation (girls loving the same boy), another possible strategy could be to link each instantiation of GIRL to a matching instantiation of BOY (for girls loving different boys). The former case would be reminiscent of the cognitive "ALL-TO-ONE" strategy in e.g. Drienkó (2012) for checking agreement features in syntactic processing (between a noun and its possibly several modifying adjectives in inflected languages, for instance) while the latter case may be analogous to the default strategy "FIRST-TO-FIRST", coupling each

occurrence of word-type A with an occurrence of word-type B in temporal order for checking agreement (e.g. for *I am, you are, and she is happy*). Thus, conceptual processes underlying quantifier scope interpretation might share a cognitive coupling mechanism with syntactic feature-checking. In an "abstract" AG framework no explicit feature-checking is required since grammaticality is achieved through AG combinability. On the other hand, the circuitry version of the model might benefit from a memory-related coupling mechanism, especially in controlling recursive mapping processes.

As it stands, however, the AG-circuitry framework, allowing for abstraction on the basis of appropriate grouping of memorised utterance exemplars, offers explanations for major syntactic priming phenomena which cannot be consistently interpreted within a single mainstream model. Self-priming is a consequence of the activation-based characteristic of the AG-circuitry model: nodes can be (re)activated both by system-internal and external stimuli. The inverse-frequency effect is connected to the model's reconstruction mechanism as activating node populations. The temporal difference between short-lived lexical boost and long-lived structural (abstract) priming is due to an interplay between the activation level of AG populations and memory processes.

Although the AG–circuitry model explains a wide variety of experimental data and can be improved in several ways, it remains to be seen whether it can stand the test of many more linguistic constructions of natural languages. While even rather complex constructions might be interpreted in the model, especially if equipped with memory-related coupling strategies or recursive AGs and CSs, it is unclear what construction types would possibly constitute critical challenges for the model.

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Awareness, knowledge, and attitudes towards Developmental Language Disorders (DLD) among public university Students in Bangladesh

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Abstract

Background: Developmental Language Disorder (DLD) affects communication and learning, yet remains less identified throughout South Asia. The study investigated public university students' awareness, factual knowledge and attitudes towards DLD in Bangladesh, with a focus on gender and regional differences. **Method:** The research used a cross-sectional survey method to gather data from 167 participants between 18 and 30 years old who studied at public universities across all eight administrative divisions of Bangladesh. The researchers used an online questionnaire, which was validated by the experts in the field. The survey instrument used a Likert scale and multiple-choice items to assess participants' understanding of DLD, their factual knowledge, and their attitudes. The researchers used both descriptive and inferential statistics to analyse participant responses. **Results:** The participants demonstrated average to strong self-assessed understanding of DLD (M = 6.51, SD = 1.79) and displayed positive attitudes towards DLD (M = 15.28, SD = 3.59). The participants demonstrated poor factual knowledge of DLD (M = 1.26, SD = 1.17) because their recognition of the condition did not match their actual comprehension. The regression results showed that knowledge and attitudes both influenced awareness, but attitudes had a stronger effect. The study found that female students outperformed male students in every domain, and students in Dhaka demonstrated better understanding and more positive attitudes about DLD than students from other peripheral areas. The study also found that DLD attitudes differ substantially between different regions because these areas experience different levels of exposure and inclusiveness. **Conclusion:** The research explored that students hold a favourable positive attitude about DLD, yet lack sufficient knowledge about the condition, which requires specific awareness programs and educational initiatives.

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Keywords: Developmental Language Disorder, awareness, knowledge, attitudes, university students, Bangladesh

1. Introduction

Developmental Language Disorder (DLD), a neurodevelopmental condition, affects 7% of people worldwide according to McGregor (2020), yet remains poorly identified. The condition affects individuals' learning and using language correctly, even though their mental abilities, brain function and sensory systems remain normal. People with DLD face enduring challenges in their academic performance, their ability to communicate socially. The condition remains invisible to both public discussions and health policy frameworks (Norbury & Sonuga-Barke, 2017).

Previous studies show that people from the general public, educational staff, and even healthcare providers demonstrate poor understanding of DLD while holding different perspectives about the condition (Kim et al., 2022; Kraljević et al., 2022). The level of DLD awareness reaches higher levels in nations that focus on specific educational initiatives, yet remains very low throughout most developing and emerging economies. The presence of awareness about DLD does not automatically translate to proper comprehension of the condition. Research indicates that multiple incorrect beliefs about DLD exist among the public including the false assumption that DLD equals delayed speech and the mistaken belief that poor parenting causes the condition and the incorrect notion that it will resolve on its own (Matić et al., 2021; Nudel et al., 2023).

The way people view DLD through their beliefs and attitudes determines how support systems develop, early intervention programs operate and how society includes people with the condition in a community. The perception determines whether families will seek help and schools will implement inclusive practices or not. Positive views promote early intervention, whereas negative views create delays in diagnosis and reduce help-seeking (McGregor, 2020). Research about how people perceive DLD through attitudinal dimensions remains scarce, especially when focusing on South Asian populations and low- and middle-income countries.

The public education system of Bangladesh has not incorporated Developmental Language Disorder (DLD) into its curriculum, while clinical training and media discussions about the condition remain minimal. The study investigates how Bangladeshi university students perceive DLD through their awareness levels, their knowledge base and their attitudes toward the condition. The study evaluates the variance of perception about DLD in different demographics. The research explored the perception of this population to develop better educational programs, public health initiatives and policy changes.

1.1. Literature Review

Developmental Language Disorder exists as a widespread issue which receives inadequate attention from the public. The factual knowledge about the condition is limited, and people’s reactions to individuals with DLD mostly

stem from two different sources: one is clinical or educational institutions, and the other is public awareness initiatives (McGregor, 2020).

1.1.1. Global Awareness of DLD

Studies demonstrate that people across different regions show varying degrees of understanding about DLD. Kraljević et al. (2022) conducted research in the Adriatic region, which showed that 70% of Croatian, Italian and Slovenian adults responded that they had heard about DLD. But among the participants, 40% Italian, 20% Croatian and only 5% Slovenian can accurately define DLD. There is a targeted educational campaign in Croatia and Italy about DLD, which could make an impact on awareness levels in Croatian and Italian populations. Mostafa and Ahmed (2018) studied 1380 Egyptian participants who showed that 74.5% participants are aware of DLD, and 69% of them identified speech-language therapy as their preferred treatment method.

The public shows minimal understanding of Developmental Language Disorder (DLD) in nations that lack dedicated public health initiatives about this condition. The research conducted by Kim et al. (2022) found that Australian respondents showed minimal understanding of DLD since only 19.9% recognized the term, and even fewer could explain its meaning. The research indicates that economic development does not determine awareness levels because successful educational outreach programs play a crucial role in creating public understanding.

1.1.2. Misconceptions and Knowledge Gaps

The presence of awareness about a subject does not guarantee that people will understand it correctly. Research indicates that people who claim to know about DLD often possess superficial or incorrect information about the condition. The research by Matić et al. (2021) demonstrated that numerous study participants believed DLD represents a short-term condition which children naturally outgrow and they also believed language delays result from parental carelessness or child laziness. The incorrect beliefs people hold about DLD create obstacles for proper diagnosis and make them less likely to pursue professional help.

Healthcare providers demonstrate widespread knowledge deficits about DLD despite their professional expertise. The research by Nudel et al. (2023) revealed that numerous experts lacked understanding about DLD diagnostic methods and its enduring effects on patients. The existing knowledge deficits prevent proper referrals and lead to incorrect diagnoses, which result in underdiagnosis of DLD throughout healthcare systems.

1.1.3. Attitudes and Beliefs Toward DLD

The way society perceives and treats people with DLD through their attitudes and feelings of empathy and stigma determines the level of inclusive support they receive. Research on public attitudes toward DLD remains scarce but existing studies indicate that people generally hold positive views but their understanding remains limited. The research by Matić et al. (2021) revealed that people showed compassion toward DLD patients, yet they believed the condition could be treated through strict discipline and extra academic

work.The way people view DLD determines their willingness to seek help and their social participation, and their need for educational support. McGregor (2020) explains that public beliefs about DLD influence the actual support received by people with the condition in real-world situations, particularly in Low- and Middle-Income Countries where misinformation and stigma are more widespread.

1.1.4. DLD research in the South Asian Context

Studies about Developmental Language Disorder (DLD) in South Asia have not been sufficiently conducted. The study by Naureen et al. (2024) in Pakistan analysed pragmatic language problems in children aged 6 to 12 years to demonstrate the necessity for universal diagnostic standards and public education initiatives. The research by Abbasi (2022) demonstrated that parents and teachers in Pakistan lack sufficient knowledge about language learning disabilities. The research by Heys et al. (2017) in Nepal revealed that people lack understanding about autism and other neurodevelopmental disorders while facing challenges in accessing related services. The research by Koly et al. (2021) in India demonstrated that public understanding of developmental disorders focuses mainly on autism and intellectual disability, while Developmental Language Disorder (DLD) receives minimal recognition and priority. The research indicates that DLD remains hidden by more well-known conditions, while requiring the immediate implementation of standardised awareness programs and training initiatives throughout South Asia.

1.1.6. Research Gap in Bangladesh

The public understanding of Developmental Language Disorder (DLD) in Bangladesh has not received any systematic research attention despite rising interest in neurodevelopmental disorders. The situation becomes more critical because university students in Bangladesh represent the future workforce and care providers, and policy makers who will shape the country's development. Kuiack (2023) stresses the necessity of youth involvement in neurodevelopmental awareness initiatives through digital platforms and educational system changes. The assessment of DLD awareness, knowledge and attitude levels of acceptance among this population will help develop proper public health materials and early detection methods.

2. Methodology

2.1 Participants

The study recruited participants from public universities across all eight administrative divisions of Bangladesh. While 458 students were initially invited to take part in the study through an online link, 167 voluntarily responded and participated in the research. The age of participants ranged from 18 to 30 years. Gender representation included male and female participants. Participants were selected using a combination of purposive and snowball sampling techniques to maximize regional and academic diversity.

Table 1
Demographic characteristics of the participant

Variable	**Category**	**n**	**%**
Gender	Male	104	62.3%
	Female	63	37.7%
Division	Barishal	20	11.98%
	Chattagram	22	13.17%
	Dhaka	23	13.77%
	Khulna	23	13.77%
	Mymensingh	22	13.17%
	Rajshahi	19	11.38%
	Rangpur	20	11.98%
	Sylhet	18	10.78%

2.2 Data collection and processing

The research team created a structured questionnaire to evaluate participants' understanding of Developmental Language Disorder (DLD) and their related knowledge and attitudes. Two faculty members from the Department of Communication Disorders, University of Dhaka, reviewed and validated the initial draft independently. The expert feedback helped the researchers modify the questionnaire to achieve content validity and contextual appropriateness.

The researchers used Google Forms to distribute the online survey, which provided easy access for participants to complete the study. The research team distributed the questionnaire to 458 public university students across Bangladesh through a secure survey link, an informed consent form and a study purpose explanation. The consent form emphasised the voluntary nature of participation, assured respondent anonymity, and clarified that no personally identifiable information would be collected. Participants were also informed of their right to withdraw at any time without consequence. Out of the total recipients, 167 students voluntarily completed and submitted the survey within a three-week data collection period. After the collection phase, responses were downloaded and screened to remove incomplete or invalid entries.

The questionnaire was divided into four sections: (A) Demographic Information, (B) General Awareness, (C) Knowledge Assessment, and (D) Attitudes. Items in Section A gathered basic respondent data, including the university name, gender and administrative division. Section B measured awareness of DLD through three Likert-scale items and one dichotomous item. Section C assessed factual knowledge of DLD using multiple-choice and

multiple-response formats, which includes question about the recognition of DLD symptoms, age of identification, and permanence of the condition of DLD. Section D evaluated attitudes through Likert-scale statements on the educational inclusion of individuals with DLD, early intervention opportunities, and the academic and social impact of DLD.

2.3 Data analysis

The collected data from participant responses were analysed across three main sections: awareness, knowledge, and attitudes toward Developmental Language Disorder (DLD). In the awareness section, four items were included. The first three items were measured on a five-point Likert scale and recoded into a three-point format for analysis to enhance interpretative clarity: Strongly Disagree and Disagree were coded as 1, Neutral (clarified as "unsure or undecided") as 2, and Agree and Strongly Agree as 3. The fourth item was a binary Yes/No question on awareness of intervention services for DLD, scored as 1 or 0, respectively. The total awareness score ranged from 0 to 10. Clarification of scale meanings was included in the questionnaire to minimise ambiguity in the self-assessment of the participants.

In the knowledge assessment section, three questions were asked. The first allowed for multiple correct selections (three correct statements), while the next two were single-answer questions, each with one correct response. An explicit "Don't know" option was provided to reduce forced guessing. This section had a total possible score of 5 based on the number of correct answers.

The attitudes section included four items measured on a five-point agreement scale ranging from Strongly Disagree (1) to Strongly Agree (5). Respondents were instructed to answer based on their beliefs and perceptions, with interpretive guidance provided (e.g., Neutral defined as "unsure or undecided") to reduce social desirability bias and support accurate self-reporting. This section was scored out of a maximum of 20.

Descriptive statistical analysis was conducted on scores from all three sections to summarise participant responses. Correlation and multiple regression analysis were performed using Python (Anaconda platform) to examine potential collinearity and relationships among awareness, knowledge, and attitude.

3. Findings

3.1. Awareness, Knowledge, and Attitude Scores Toward Developmental Language Disorder (DLD)

The section contains result of the descriptive statistics that analyse three essential domains: Awareness, Knowledge and Attitude about (DLD). The analysis provides mean scores and standard deviations and total participant numbers for each domain to show how students understand and perceive Developmental Language Disorder (DLD).

Table 2
Scores in Three Domains: Awareness, Knowledge, and Attitude Toward DLD

Statistic	Awareness Score	Knowledge Assessment	Attitude
Count	167	167	167
Mean ± SD	6.51 ± 1.79	1.26 ± 1.17	15.28 ± 3.59

3.1.1. Awareness Score

The participants demonstrated an average awareness score of 6.51 (SD = 1.79) through their responses on a 0 to 10 rating scale. Most students demonstrated average to high understanding of DLD because their scores ranged between 5 and 8 on the IQR and their median score was 6. The distribution showed a slight negative skew of -0.03 and a platykurtic shape with kurtosis at -0.42 which indicates that responses were evenly distributed with few extreme values. The overall awareness level was satisfactory yet some participants achieved scores as low as 2 which demonstrated that certain individuals lacked sufficient understanding about DLD.

3.1.2. Knowledge Score

The participants demonstrated a low level of accurate DLD knowledge because their factual knowledge score averaged 1.26 (SD = 1.17) out of 3 possible points. Most students demonstrated either no understanding of DLD or held false beliefs about it because their scores ranged from 0 to 1 with a median of 1. The scores followed a positive skew (skewness = 0.33) and platykurtic distribution (kurtosis = -1.38), which showed that most scores clustered at the lower end but had few extreme values. The obtained results demonstrate a wide knowledge deficit which requires specific educational programs to address it.

3.1.3. Attitude Score

The participants showed positive attitudes toward children with DLD because their attitude scores averaged 15.28 (SD = 3.59) across the maximum output 20 scale. The majority of participants (75%) scored 17 which indicates they viewed children with DLD favourably and supported early intervention. The data points showed a negative skew (skewness = -1.53) and leptokurtic distribution (kurtosis = 2.85), which indicates that most participants held strong positive attitudes, but a few expressed less supportive opinions.

3.2. Relationship Among Awareness, Knowledge, and Attitudes Toward DLD

The study used Pearson's correlation and multiple regression analysis to examine how participants' awareness and factual knowledge, and their attitudes toward Developmental Language Disorder (DLD), relate to each

other. The research examined both the relationship strength between these domains and how knowledge and attitude influence outcome awareness.

3.2.1. Correlation Analysis

The three variables showed positive and statistically significant relationships according to Pearson's correlation coefficients, which appear in Table 3. The relationship between awareness and knowledge showed a weak positive correlation with r = 0.354, although the effect size remains small. The study found a moderate positive relationship between DLD awareness and attitude scores (r = 0.498), which shows that people who understand DLD better tend to hold more positive views about it. The relationship between knowledge and attitude scores showed a positive but weak correlation (r = 0.323), which indicates that factual knowledge has a minimal impact on how people believe about DLD. All correlations reached statistical significance at p < .005, which shows that these relationships exist beyond random chance.

Table 3
Pearson's Correlation Coefficients Between Awareness, Knowledge, and Attitudes Toward DLD

Variable	Awareness Score	Knowledge Assessment	Attitude
Awareness Score	1.000	0.354***	0.498***
Knowledge Assessment	0.354	1.000	0.323***
Attitude	0.498***	0.323***	1.000

p < .005

3.2.2. Multiple Regression Analysis

The study used multiple linear regression to determine which variables from knowledge assessment and attitude scores would predict awareness scores. The model achieved statistical significance ($F(2, 164) = 33.42$, $p < .001$) while explaining 29.0% of the variance in awareness scores ($R^2 = 0.290$; adjusted $R^2 = 0.281$). The results in Table 5 show that Knowledge assessment proved to be a significant predictor (B = 0.33, SE = 0.11, t = 3.10, p = .002), which indicates that better factual knowledge leads to slightly higher awareness levels. The results showed that Attitude demonstrated slightly stronger predictive factors for awareness scores (B = 0.21, SE = 0.04, t = 6.16, p < .001) than the knowledge score.

Table 4
Multiple Regression Predicting Awareness Scores from Knowledge and Attitude

Variable	Coefficient (B)	SE	t	p-value	R^2	Adj. R^2
Constant	2.84	0.52	5.50	<.001	0.290	0.281
Knowledge Assessment	0.33	0.11	3.10	.002		
Attitude	0.21	0.04	6.16	<.001		

These findings suggest that both cognitive and affective components (knowledge and attitude) significantly contribute to participants' self-reported awareness of DLD, with attitudes having a slightly stronger predictive power. This highlights the importance of awareness-raising initiatives that incorporate both factual content and emotional engagement.

3.3. *Divisional Analysis of Awareness, Knowledge, and Attitude Toward DLD*

The study presented descriptive statistics for awareness, knowledge, and attitudes toward DLD for each of Bangladesh's eight administrative divisions in Table 6. The participants from Dhaka Division achieved the highest scores in all three domains, with awareness at 7.22 (SD = 1.70), knowledge at 1.65 (SD = 1.40) and attitudes at 16.91 (SD = 3.07).

The participants from Chattogram, Sylhet and Barisal divisions displayed average awareness and positive attitudes, but their knowledge about DLD remained restricted. The lowest scores emerged from Rangpur and Mymensingh and Khulna divisions, where knowledge and attitudes toward DLD were particularly low, which indicates substantial regional differences in DLD understanding and perception. The results indicate that DLD understanding and belief differ across regions because people in various areas have different levels of access to information and educational resources and service availability.

Table 5
Divisional Analysis of Awareness, Knowledge, and Attitude Toward DLD

Division	Awareness (M ± SD)	Knowledge (M ± SD)	Attitude & Belief (M ± SD)
Barishal	6.65 ± 1.87	1.35 ± 1.09	16.10 ± 3.51
Chattagram	6.73 ± 1.88	1.45 ± 1.14	16.09 ± 3.52
Dhaka	7.22 ± 1.70	1.65 ± 1.40	16.91 ± 3.07
Khulna	6.26 ± 1.60	1.26 ± 1.10	13.70 ± 4.39
Mymensingh	5.77 ± 1.34	1.09 ± 1.19	14.23 ± 3.91
Rajshahi	6.32 ± 1.38	1.16 ± 1.07	15.53 ± 2.12
Rangpur	6.35 ± 2.21	0.85 ± 0.99	13.40 ± 3.73
Sylhet	6.83 ± 2.12	1.22 ± 1.35	16.39 ± 2.17

The researchers performed one-way ANOVA tests to determine if the observed differences reached statistical significance (Table 7). The awareness scores between different divisions showed no significant differences according to $F(7, 159) = 1.33$ and $p = .2389$. The results from the analysis showed that knowledge assessment scores maintained equal levels across different divisions, $F(7, 159) = 0.90$ and $p = .5047$. Neither knowledge and awareness score not reaches statistical significance. But the attitude scores between divisions produced a statistically significant difference, $F(7, 159) = 3.22$ and $p = .0032$, which indicates DLD attitudes differ substantially between regions. The research indicates that public understanding of DLD facts and awareness levels stay stable between regions, yet people in different areas hold different attitudes about the condition.

Table 6
One-Way ANOVA Results for Awareness, Knowledge, and Attitude Scores Across Divisions.

Variable	F-statistic	P-value
Knowledge assessment	0.9043	0.5047
Attitude	**3.2161**	**0.0032**
Awareness Score	1.3310	0.2389

Significant result bolded at p < .05 level.

3.4. Gender-based analysis of Awareness, Knowledge, and Attitude

The research analysed awareness, knowledge and attitude towards DLD differences between male and female participants. The study divided participants into two distinct groups based on their gender. The data presented in Table 8 shows that female participants achieved better results than male participants in every assessment area. The mean scores for females exceeded those of males in all three domains: awareness (M = 7.13, SD = 1.71), knowledge (M = 1.75, SD = 1.80) and attitudes (M = 16.84, SD = 2.73). The DLD score which combines all three domains showed higher values for females (M = 25.72, SD = 4.34) than for males (M = 21.38, SD = 5.14).

Table 7
Gender based Analysis of Awareness, Knowledge, and Attitude Toward DLD

Gender	Awareness (M ± SD)	Knowledge (M ± SD)	Attitude (M ± SD)	Overall DLD Score (M ± SD)
Female	7.13 ± 1.71	1.75 ± 1.80	16.84 ± 2.73	25.72 ± 4.34
Male	6.13 ± 1.74	0.95 ± 1.06	14.30 ± 3.71	21.38 ± 5.14

The researchers performed one-way ANOVAs to determine statistical significance for each domain. The results showed substantial gender-based differences in all three measured variables. The results showed significant gender differences in knowledge assessment $F(1, 165) = 11.38$ $p < .001$, attitude $F(1, 165) = 11.78$ $p < .001$ and awareness score $F(1, 165) = 6.70$ $p = .0016$. The study established that women demonstrated superior understanding of DLD and displayed more favorable opinions about the condition than men.

Table 8
One-Way ANOVA Results for Awareness, Knowledge, and Attitude Scores based on Gender

Variable	F-statistic	P-value
Knowledge assessment	11.3803	<0.0001
Attitude and belief	11.7791	<0.0001
Awareness Score	6.6970	<0.0001

4. Discussion

The research investigates the understanding of Developmental Language Disorder among public university students in Bangladesh based on their gender and the region they live in. The study revealed that people in this population demonstrate strong awareness of DLD and positive attitudes, yet they lack sufficient knowledge about the condition.

The result found that the average awareness score about DLD is high for the study group. The results match previous research findings, which show that people tend to report higher awareness than their actual comprehension of DLD. Kraljević et al. (2022) conducted a study that revealed that numerous participants believed they knew about DLD, while they could not differentiate it from other developmental or language-related conditions. People develop an exaggerated sense of DLD knowledge because they encounter related terms through casual conversations, but lack proper education about the condition. Another survey results show that people learn about DLD through media and everyday conversations instead of professional or academic resources (Kim at el., 2022). The study shows that public comprehension of DLD exists at a basic level thus requiring targeted awareness programs to link recognition with proper understanding. The public and private sectors, along with government-funded initiatives such as the Child Development Centre (CDC) and Neurodevelopmental Disability Protection Trusts (Alam, Hand, & Ballard, 2023), have worked to increase the identification and discussion of DLD in Bangladesh over the past two decades. The interaction with media, internet access, social media platforms and awareness campaigns from national and international NGOs has disseminated superficial knowledge among the people in Bangladesh.

The participants showed average awareness, but their knowledge scores remained at a low level. The results match international patterns because people in countries with advanced speech-language services still demonstrate poor comprehension of DLD. McGregor (2020) discovered that the general public mixes up DLD with autism spectrum disorder and believes speech delay equals DLD. People lack understanding about how common DLD is among children (7-10% prevalence) and its lasting effects on learning and social growth. The insufficient understanding of DLD in Bangladesh leads to delayed interventions and social discrimination against children with the condition because the country lacks proper speech-language pathology education and

early diagnosis systems. The lack of DLD information in formal educational materials and health resources maintains its hidden status in the public domain. The scarcity of DLD-related content in Bangladeshi educational materials and media serves as a reason why people lack specific knowledge about the condition.

Most participants from different groups showed positive attitudes about DLD because they recognised the necessities for early intervention, inclusive support and public education. The study by Matić et al. (2021) demonstrates that individuals develop a more positive view of DLD after experiencing it in real-life situations, which leads them to support educational and social inclusion. The results indicate that cultural values emphasizing inclusiveness exist despite limited formal information about DLD. These positive attitudes toward DLD might exist without leading to concrete actions. The absence of sufficient knowledge prevents public support from becoming effective advocacy, which in turn hinders community-wide transformations. The main task for policymakers consists of converting existing positive attitudes into concrete actions, such as launching school screening, language intervention service promotion and stigma resistance.

The research showed that female participants outperformed male participants in every domain, which included awareness, factual knowledge and attitudes towards DLD. The results match previous research on health literacy and developmental psychology, which shows gender differences in both national and international studies (Pervin & Hagmayer, 2022). The study results about gender differences in DLD knowledge match Kraljević et al. (2022), who studied adults from Adriatic region countries. The number of female students is growing in Bangladeshi public universities who study education, psychology and social sciences because these fields incorporate child development knowledge (Ahmmed & Sharma, 2012). Women in Bangladeshi society usually receive an automatic cultural expectation that prepares them for roles which involve caring for children and families through professional work and domestic responsibilities. Women in society commonly enter teaching, nursing and early childhood education roles because these professions match their nurturing nature. The cultural norms in this society make women more aware of child development stages and more sensitive to speech or language problems in children (Islam et al., 2022). Research indicates that female students demonstrate higher emotional involvement and better social attitudes when interacting with a person with pity. Women in Western and South Asian societies demonstrate higher emotional empathy and concern for vulnerable populations, which leads to more positive views about children with neurodevelopmental disorders (Yeasmin, 2024). The study results show that female participants demonstrated better knowledge about DLD and more positive attitudes because emotional factors strongly influence how people perceive and support DLD. In addition, the way universities organise their structure and outreach programs could influence these results. The majority of female students join student organisations or extracurricular activities which focus on health advocacy, disability rights, inclusive education and mental health awareness rather than athletics (Khan, 2011). The research demonstrates how educational experiences, cultural expectations, emotional involvement and extracurricular activities create

differences in DLD understanding between men and women. While female students demonstrated stronger performance across all domains, these advantages should not obscure the broader need for gender-inclusive educational interventions that ensure all university students, regardless of academic track or gender.

The findings of the study indicate that students of Dhaka, capital of Bangladesh achieved the highest results in DLD awareness, knowledge and attitude assessment than other peripheral areas of the country. The research findings also reveal that educational infrastructure, resource distribution, and social perceptions across different regions in Bangladesh create various obstacles towards DLD. The healthcare system of Bangladesh, together with special education services, primarily maintain their operations in urban areas. The major institutions based in Dhaka, where speech therapy clinics, special education centers and disability support NGOs are operating. These initiatives usually work with universities and welcome student volunteers. The practical experience of working with these services enables students to develop a better understanding and more positive attitudes toward DLD (Begum, Perveen, & Chakma, 2019). The absence of such services in peripheral areas like Rangpur, Khulna and Mymensingh results in insufficient knowledge and disinterest about Developmental Language Disorder. The different divisions exhibit major variations regarding their academic educational program availability. The universities in the capital has departments and faculty members who specialise in child development, special education and speech-language pathology, which enables students to study DLD and participate in research seminars and thesis supervision (Tamanna et al., 2025). The public universities located in out of Dhaka divisions do not have specialised academics who teach DLD-related subjects, which hinders student participation in these subjects.

People's media literacy skills and digital access determine their understanding of information, which affects their awareness levels. Students from urban areas access media campaigns, educational resources, and NGO awareness materials, while students from peripheral areas rely mostly on textbooks and traditional classroom teaching that fails to include discussions about DLD or neurodevelopmental disorders (Choudhuri et al., 2005). The digital disparities between students hinder them from grasping modern inclusive education principles effectively. The research shows that DLD awareness differences between regions result from educational, structural, social and cultural aspects. The implementation of specific programs should target all public universities to establish inclusive education as a core subject in their standard curriculum, especially in areas with restricted resources.

The combination of cultural prejudices and disability discrimination between different areas produces substantial knowledge gaps. The rural sections with conservative values throughout the country hold false beliefs about developmental disorders, which blame DLD on poor parenting and spiritual or moral issues (Beutel, Tangen, & Carrington, 2019). The deeply ingrained beliefs about developmental disorders may lead students and teachers to develop unfavourable perspectives or dismiss that educational institutions with weak support for inclusive education programs tend to experience higher rates of stigma and false information about developmental

disabilities (Dundar et al., 2014). Institutional development in the peripheral areas remains underdeveloped because these areas lack programs that integrate health education with multiple disciplines. Institutional limitations prevent students from accessing courses about language development, learning disabilities and inclusive teaching methods (Anitha et al., 2022). Students in under-resourced educational systems tend to develop surface-level understanding, which they mistake for deep comprehension, thus creating this knowledge gap.

The findings of the study indicate that students' awareness depends on both their knowledge and attitudes, but attitudes show a slightly stronger relationship with awareness. It shows that public university students in Bangladesh demonstrate better emotional and value-based involvement than factual understanding of Developmental Language Disorder. The absence of developmental and speech-language disorder content in undergraduate curricula represents a primary reason for this educational gap. Students who study outside medical, psychology and education departments at public universities do not receive any formal training about neurodevelopmental disorders, including Developmental Language Disorder. The way people understand DLD develops from unstructured sources, including media content, social encounters and community stories, according to Siddique et al. (2022). The sources tend to use emotional content, personal stories and moral obligations to create empathy in people who lack proper knowledge about the subject (Marzan et al., 2021). The Bangladeshi public seems to base their understanding of DLD more on empathy and social values than on clinical knowledge, even though participants show strong positive attitudes. The research shows that social beliefs and emotional orientation play a more significant role than knowledge in developing public understanding of developmental disorders because attitudes proved more influential than knowledge in this context.

The collectivist cultural framework of Bangladesh strengthens the impact of affective involvement on public behaviour. The values of community welfare for communities, moral duty and compassion form essential parts of youth identity and public conduct in collectivist societies (Soorkia, Snelgar, & Swami, 2011). Students tend to support DLD early intervention programs and inclusive education because of their emotional and ethical beliefs about the matter even though they lack deep understanding of diagnostic procedures and intervention methods. The observed pattern of high awareness and positive attitudes without sufficient knowledge matches previous research on health issues throughout Bangladesh and South Asia. College students in Hossain et al. (2020) showed positive social attitudes toward thalassemia patients although they demonstrated minimal understanding of the condition. The study by Siddique et al. (2022) revealed that Bangladeshi students displayed high mental health awareness but their factual understanding remained poor which suggests that brief social media and peer contact creates a false sense of understanding.

The emotional nature of public awareness in Bangladesh presents a chance for intervention instead of being considered a drawback. Public health initiatives that use child rights and religious or moral narratives and empathetic storytelling will prove more successful than clinical or academic

approaches for increasing both awareness and behavioural intent about DLD. Seewooruttun (2013) discovered that South Asian communities responded better to emotionally engaging interventions through film-based stories than to fact-based instruction for stigma reduction.

The study has some limitations, including the fact that the number of students from the region is not substantial enough to represent the students of the region. The sample size and the convenience sampling approach may limit the generalizability of the results. In addition, to assess awareness, knowledge and attitude standardized tool with psychometric validation would assess it with more precision instead of the one. Along with the quantitative study, a mixed-methods research design would provide a deeper understanding of the topic.

5. Conclusion

The study aimed to assess the awareness, knowledge and attitude of university students towards DLD in Bangladesh. Participants show a positive attitude and good awareness while scoring low in factual knowledge. The students who reside in Dhaka were more aware, knowledgeable and positive towards DLD than in other peripheral areas. This indicates the disparity between the students from the capital city and other regions of Bangladesh. On the other hand, female students were more aware, knowledgeable and positive towards DLD than male that also demonstrates the gender difference about the issue. Attitude and knowledge both are contributes on the level of awareness, though attitude was a slightly stronger predictive factor for awareness, which indicates the emotional nature is emphasized more than the cognitive factor in terms of awareness about DLD. Despite the study has limited sample size and design constraints, it provides a primary understanding of the topic and lay foundation for further studies. It also indicates the regional and gender based differences to design targeted initiatives for increasing awareness, knowledge and positive attitudes towards DLD in Bangladesh.

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Appendices -1

Survey Questionnaire

Section A: Demographic Information
1. Age: _____ - [ ] 18-21 - [ ] 22-25 - [ ] 26-30
2. Gender:
- [ ] Male - [ ] Female
3. Division you live in:
- [ ] Dhaka - [ ] Chattogram - [ ] Khulna- [ ] Rajshahi - [ ] Sylhet - [ ] Barisal - [ ] Rangpur - [ ] Mymensingh
4. Name of your University: -

Section B: General Awareness of DLD
Please rate your agreement with the following statements:
(1 =Never heard 2 = heard , 3 = heard little, 4 = know little, 5 = Well aware)
QB1. I have heard of Developmental Language Disorder (DLD).
[ ] 1 [unknown] 2 [ ] 3 [ ] 4 [ ] 5 [known]
QB2. I understand and recognize what DLD is.
[ ] 1 [unknown] 2 [ ] 3 [ ] 4 [ ] 5 [known]
QB3. I can recognize potential signs of DLD in children.
[ ] 1 [unknown] 2 [ ] 3 [ ] 4 [ ] 5 [known]
QB4. Are you aware of any professional services available for DLD in your area?
- [ ] Yes - [ ] No

Section C: Knowledge Assessment

QC1. Which of the following are potential signs of DLD? (Select all that apply)
- [ ] Difficulty following instructions
- [ ] Poor vocabulary compared to peers
- [ ] Trouble forming complete sentences
- [ ] Physical disability
- [ ] Difficulty maintaining conversations
- [ ] Poor memory
- [ ] Don't know

QC2. At what age can DLD typically be identified?
- [ ] Birth
- [ ] 2-3 years
- [ ] 4-5 years
- [ ] Above 6 years
- [ ] Don't know

QC3. Is DLD: (Choose one)
- [ ] A temporary condition that children outgrow
- [ ] A lifelong condition that requires support (Right answer)
- [ ] A contagious disorder
- [ ] Don't know

Section D: Attitudes and Beliefs

QD1. Children with DLD can succeed in regular schools with proper support.

1 [negative] 2 [ ] 3 [ ] 4 [ ] 5 [positive]

QD2. Early intervention is important for children with DLD.

1 [negative] 2 [ ] 3 [ ] 4 [ ] 5 [positive]

QD3. DLD affects a child's academic performance.

1 [negative] 2 [ ] 3 [ ] 4 [ ] 5 [positive]

QD4. DLD affects a child's social relationships.

1 [negative] 2 [ ] 3 [ ] 4 [ ] 5 [positive]

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Impact of COVID-19 lockdown on communication development in young children: A retrospective descriptive study from Hubli-Dharwad region

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Abstract

The COVID-19 pandemic and associated lockdowns disrupted early childhood environments, limiting social interaction, structured play, and caregiver engagement, which may have adversely affected communication development in children aged two to five years. This study aimed to profile communication abilities in young children suspected of developing communication disturbances following the lockdown in the Hubli-Dharwad region.

A retrospective descriptive design was employed with ten children (8 males, 2 females) aged 2–5 years from middle-upper and upper-class families. Data collection occurred between June 2021 and December 2022. Post-lockdown assessments included the Receptive–Expressive Emergent Language Scale (REELS) and the Communication DEALL (ComDEALL) Developmental Checklist to evaluate receptive and expressive language, cognitive, and social-communicative skills. Retrospective parental reports and an investigator-developed checklist captured pre-linguistic abilities, social-behavioural functioning, and screen exposure during lockdown, while clinical observations documented attention, eye contact, initiation, imitation, and responsiveness to verbal prompts. Quantitative data were summarized descriptively, and qualitative patterns were thematically analyzed.

All children demonstrated delays in expressive and receptive language, with expressive skills more affected. Over half showed deficits in pre-linguistic skills, including attention, eye contact, and concentration. Behavioural concerns such as irritability, inattention, restlessness, and limited peer interaction were observed. Higher daily screen exposure (≥4 hours) was associated with more pronounced language delays and attentional difficulties. Clinical observations confirmed poor initiation, minimal reciprocal communication, and limited joint attention.

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These findings suggest that communication delays and behavioural concerns may be linked to restricted social interaction, limited parental engagement, and excessive screen exposure during the lockdown. Early identification, structured parent–child interaction, moderated screen use, and opportunities for social play are recommended to support post-pandemic recovery in young children.

Keywords: Covid-19 pandemic, lockdown, communication delay, speech and language, children, screen time

1. Introduction

The COVID-19 outbreak was a major global medical emergency that threatened survival and posed significant life-threatening risks. In response, the Government of India imposed a nationwide lockdown beginning in March 2020, which lasted for several weeks, followed by phased restrictions and gradual reopening. It ultimately took nearly two years for daily life across the country to return to a semblance of normalcy (Mint, 2022; Pasricha, 2022; The Straits Times, 2022). The majority of government assistance and human resources were focused on meeting the needs of people who tested COVID positive and halting the disease's spread.

Despite its unavoidability, the lockdown posed substantial risks to even those who did not have the sickness as well as to the state of the community at large. Social disruption and economic repercussions, due to the lockdown caused several difficulties like financial insecurity, the strain of providing care, the stress associated with confinement, product scarcity, the ability to access medical care, an upsurge in domestic violence, anxiety, and fear of contracting the virus, grief due to loss of loved ones; to name a few (Mackolil & Mackolil, 2020; Prime et al., 2020). These challenges affected the well-being of the general population, not just those with COVID-19. Young children were among the most vulnerable groups during the pandemic, as their adaptation to the economic and social repercussions of COVID-19 had an outsized impact on their emotional, social, and developmental well-being (Fegert et al., 2020).

The developmental well-being of young children is important both as an investment in the future of our society and because children constitute an important group themselves (Wallander & Koot, 2016). Childhood is a crucial period of motor, speech and language, psychological, cognitive, social, and emotional development. Especially from birth to 5 years of age, children rapidly develop foundational capabilities on which subsequent development builds. Sensitive periods are optimal times in development when the brain's plasticity is high and certain areas of the brain are most ready to benefit from the experience. Early experience exerts a profound influence on the brain and on development. Such periods allow experience to instruct neural circuits to process or represent information in a way that is adaptive for the individual (Knudsen, 2004). Optimal development during this period requires an integration of several factors such as the adequate amount and quality of positive parent-child interaction (Myers et al., 1989), good stimulation and model, enriching peer interactions (Cameron & Tenenbaum, 2021), and a healthy and supportive familial environment influencing the

behaviour and development. However, many of the above-mentioned factors were impacted by lockdown due to COVID-19 pandemic, in diverse ways. COVID-19 increased the likelihood that children would experience maltreatment, domestic violence, and poor nutrition which would severely impact children's physical well-being (Hoffman & Miller, 2020).

Early research during the pandemic indicated that younger children (ages 3-6 years) displayed serious psychological disorders that included increased irritability, and inattention, along with feeling uncertain, afraid, and alone. Also, it revealed that kids struggled with nightmares, poor appetite, and separation anxiety (Jiao et al., 2020). In addition to these challenges, communication and social development were notably affected. Although parents spent majority of their time at home, with their children during the lockdown, parents could not spend quality time with their children due to demands of working from home. The economic hardships, layoffs, and social restrictions imposed during the pandemic further intensified these parenting challenges. The resulting profound changes to daily family life significantly increased parental stress and intrafamilial tension, which in turn heightened the risk of adverse childhood experiences. Studies suggest that these conditions may have contributed to increases in domestic violence, child abuse, and neglect, leaving children more vulnerable during an already challenging time (Calvano et al., 2022). Moreover, the reduction in parental speech stimulation, parent–child playtime, positive interactions, and emotional bonding likely had an adverse impact on children's speech and language development.

Peer interactions play an integral role in children's social, emotional, and cognitive development, enabling them to build social communities and establish norms for interaction (Balter & Tamis-LeMonda, 2016). Such interactions are vital for cognitive growth, as discussing ideas with peers promotes learning more effectively than solitary study by encouraging 'exploratory talk' (Tenenbaum et al., 2020). In this type of dialogue, children co-construct knowledge by sharing, challenging, and evaluating ideas collaboratively, developing important skills that often require guidance to fully flourish (Mercer, 2008).

However, lockdowns restricted children's opportunities for face-to-face connection with peers, potentially delaying social and language skills. Play, a crucial aspect of childhood, was also disrupted; with playgrounds and schools closed, traditional play spaces became inaccessible (Graber et al., 2021). The shift to isolated, home-based play limited children's natural development of social skills through peer exchange, potentially impacting their language and emotional resilience.

Furthermore, reduced opportunities for independent peer interactions away from adults hindered young children's ability to engage in social problem-solving on their own terms. These self-directed exchanges are important for learning conflict resolution, cooperation, and communication in contexts that are outside of adult influence (Cameron & Tenenbaum, 2021). Social distancing and lockdown measures thus had a direct impact on children's development of essential interpersonal skills.

However, COVID-19 pandemic and the resulting lockdown measures led to an exponential increase in screen usage among children across many

regions (Bergmann et al., 2022). Although virtual platforms allowed people to stay connected during isolation and offered some benefits, increased social media use among parents also contributed to more screen exposure for children. Factors such as parental and sibling screen habits, socioeconomic status, and the extent of lockdown restrictions all influenced the rise in young children's screen usage. This prolonged screen time, especially more than one hour daily for children under five, has been linked to a higher risk of language delays, particularly affecting expressive vocabulary development during the pandemic (Ghaisani & Salam, 2022).

Several Indian studies have provided deeper insight into how the COVID-19 lockdown affected young children's communication, language, and psychosocial development. Kaur et al., (2022) examined 30 children with Autism Spectrum Disorder through a cross-sectional design. Parents rated their child's developmental abilities before and after lockdown, and the study found significant regression across domains—particularly in language and social engagement—emphasizing how therapy discontinuation and isolation adversely affected progress.

Dave and Yagnik (2020) analysed CHILDLINE India helpline data and reported a 50% rise in child distress calls during lockdown, indicating heightened psychosocial vulnerability and reduced access to reporting systems due to school closures. Similarly, the study by Banerjee and Mukhopadhyay (2021) on early childhood care in Ahmedabad investigated the impact of the COVID-19 lockdown on children under six years from poor and marginalized households attending the full-day Bal Sewa centres run by Sewa's Sangini Co-operative. The study documented significant disruptions in holistic growth and development, highlighting issues such as limited access to early childhood education and care, increased developmental risks, and the cascading effects of lockdown-related closures on both children's progress and maternal well-being within these vulnerable communities.

Further, Khobragade and Shenoy (2025) conducted a cross-sectional analytical study on under-five children and found that an average daily screen use of 2.22 hours was significantly correlated with delayed speech and weaker social reciprocity. A hospital-based prospective observational study (Harsha et al., 2025) also demonstrated that children exposed to screens for more than two hours daily were nine times more likely to experience speech delays. Pasi et al., (2024) investigated the neurobehavioral profile of school-aged children and revealed that restricted mobility and online learning stress predicted increased aggression, attention difficulties, and mood swings. Additionally, reports such as The Indian Express (Tripathy, 2025) corroborated these findings through clinical observations, highlighting a nationwide rise in referrals for communication delays, particularly among toddlers who replaced peer play with passive digital interaction.

In parallel, a systematic review (Abdoli et al., 2024) highlighted the negative behavioural and emotional consequences of increased screen time in children, noting a rise in anxiety, irritability, and attention deficits—precursors to social and communication difficulties. The researchers observed associations between excessive exposure and symptoms of ADHD, depression, and social withdrawal, emphasizing that the quality of media content and parental involvement are crucial factors in mitigating these effects.

In the study by Varghese and Karuppali (2024), 192 parents of typically developing children aged 6 to 10 years were surveyed. While some parents reported positive outcomes—such as improvements in receptive and expressive language related to vocabulary, syntax, and pragmatics—statistical data indicated notable limitations in language use associated with screen exposure. Specifically, 55% of children rarely asked for word meanings, 58% rarely shared information, 64% showed reduced understanding and use of higher language functions such as jokes and sarcasm, and 54% seldom talked about daily activities with peers. These findings highlight a dual impact of screen exposure: moderate, interactive, and parent-supervised use may foster learning, whereas prolonged, passive engagement is linked to weaker expressive language development. The study emphasizes that parental mediation and purposeful, interactive engagement are crucial for positive communication outcomes.

Although screen use has become an integral aspect of modern childhood, its developmental effects depend largely on the quality, duration, and context of use. During the COVID-19 lockdown, children frequently experienced extended, unsupervised screen exposure due to restricted outdoor play and increased parental workload. This limited opportunities for reciprocal interaction, shared attention, and natural language stimulation, which are vital for fostering early communication. Consequently, excessive screen use, when combined with reduced peer interaction and parental stress, may have significantly contributed to the emergence of communication disturbances in young children during the pandemic.

Though some studies have reported positive effects of the COVID-19 lockdown on young children's development—such as greater parental engagement, shared reading, and responsive caregiving within a supportive home environment—the majority of research points to predominantly negative consequences. Lockdowns led to social isolation, reduced opportunities for peer play, increased screen time, and elevated caregiver stress, all of which are associated with delays in speech, language, social, and cognitive domains. While a few children benefited from enriched home-based interactions, these gains were less consistent and limited in scope. Overall, the global evidence indicates that the cumulative developmental impact of the pandemic has been largely detrimental, particularly for early communication and social skills (Mulkey et al., 2023; Sato et al., 2023; Scott et al., 2024). In light of these findings, the present study aims to examine how pandemic-related environmental factors, particularly excessive and unmonitored screen exposure, may have influenced receptive and expressive language development in young children within the Indian sociocultural context.

1.1. Need for the study

The COVID-19 pandemic and subsequent lockdown created an unprecedented disruption in young children's developmental environments, limiting opportunities for social interaction, structured play, and language-rich communication. Early childhood, being a critical period for speech, language, and cognitive development, may have been particularly vulnerable to these environmental constraints. While previous research has highlighted potential communication and social challenges arising from the pandemic,

there remains limited systematic evidence on the specific factors that contributed to such developmental disturbances in young children.

This study aims to bridge this gap by examining how pandemic-related influences—such as increased screen time, reduced peer interaction, and heightened parental stress—may have affected communication development. It further explores the impact of lockdown conditions on receptive and expressive language, cognitive skills, pre-linguistic abilities, and social-behavioural functioning in children aged two to five years.

Understanding these effects is essential for identifying early risk indicators and supporting recovery in post-pandemic contexts. The findings will provide valuable insights for parents, educators, and speech-language pathologists in designing targeted interventions to enhance communication outcomes, promote healthy social engagement, and reduce the long-term developmental impact of crisis-induced isolation among young children.

1.2. Aims and objectives

Aim: To profile communication skills in young children suspected to have developed communication disturbances due to covid-19 pandemic lockdown.

Objectives:

1. To report the receptive language age (RLA), expressive language age (ELA), and cognitive age (CA) in two- to five-year-old young children reported to have developed communication disturbances due to covid-19 pandemic lockdown.
2. To report screen time, pre-linguistic skills, and social behavioral problems in two- to five-year-old young children suspected to have developed communication disturbances due to covid-19 pandemic lockdown.

2. Methodology

2.1. Research Design

The study employed a retrospective descriptive research design, where the development of communication abilities in young children post-pandemic lockdown (March 2020–March 2022) was evaluated. This design relies on post-lockdown assessments and retrospective parental reports to determine suspected delays in communication abilities. The retrospective component involved reviewing parental recall of the child's communication, play, and social behaviours during the lockdown period, while the descriptive component involved formal and informal assessments conducted after the lockdown.

Case files, parental interview records, and standardized assessment outcomes were reviewed for all participants. The retrospective review included case files and assessment records collected between June 2021 and December 2022, covering children born between 2016 and 2020 who were between two to five years of age at the time of data collection. Thus, this dual approach allowed for triangulation of retrospective parental information with direct post-lockdown clinical observations, ensuring both historical and current perspectives on communication development.

2.2. Participants

Data collection took place between June 2021 and December 2022. Convenience sampling was used for selecting participants. The study included 10 children aged between two to five years from the Hubli-Dharwad districts of Karnataka (Table 1). These children, consisting of eight males and two females, belonged to middle-upper and upper-class socio-economic statuses.

Each child's year of birth, current age at assessment, and approximate age during the COVID-19 lockdown (2020–2021) were recorded to better interpret developmental variations across infants, toddlers, and preschoolers. This categorization is essential as developmental domains such as pre-linguistic, linguistic, and cognitive skills evolve differently across these age groups. Hence, communication disturbances were interpreted in relation to age-specific expectations.

Inclusion criteria: Children with predominant complaints of impaired communication abilities post-pandemic lockdown. All the participants had experienced approximately one to two years of restricted social and educational exposure during the lockdown. Prior to the lockdown, all children were reported by their parents to have normal speech, language, cognitive, motor development, and age-appropriate social skills, with no abnormal behaviors observed before the pandemic.

Exclusion criteria: Children with a history of spoken language disorders; children with pre-, peri-, or post-natal risk factors for speech and language disorders; and those with developmental delays or atypical behaviours prior to lockdown were excluded.

Table 1
Participant Demographics, Age during COVID-19 Lockdown, and Developmental Groupings

Participants	Year of Birth	Age During Pandemic (2020-21)	Current Age (at assessment)	Gender
Participant 8	2019	1 yr (infant)	24 months	Male
Participant 3	2019	1 yr (infant)	25 months	Male
Participant 1	2019	1–2 yrs (toddler)	29 months	Male
Participant 4	2019	1–2 yrs (toddler)	29 months	Male
Participant 6	2018	2 yrs (toddler)	36 months	Male
Participant 9	2018	2 yrs (toddler)	36 months	Female
Participant 2	2017	3–4 yrs (preschooler)	48 months	Female
Participant 7	2017	3 yrs (preschooler)	48 months	Male
Participant 5	2016	4 yrs (preschooler)	51 months	Male
Participant 10	2016	4 yrs (preschooler)	54 months	Male

Note: Data were collected retrospectively between June 2021 and December 2022. Children were grouped as infants (0–2 years), toddlers (2–3 years), and preschoolers (3–5 years) to interpret developmental impact relative to age-specific domains.

2.3. Materials

The study employed a combination of standardized and investigator-developed tools to comprehensively assess the participants' language, cognitive, and social-communication abilities, as well as to gather retrospective information about their developmental experiences during the

COVID-19 lockdown. The Receptive–Expressive Emergent Language Scale (REELS) (Brown et al., 2020) was used to evaluate receptive and expressive language skills through a structured parent interview and direct observation. The Communication DEALL (ComDEALL) Developmental Checklist (Karanth, 2011) was administered to assess cognitive, pre-linguistic, and social-communicative domains through play-based interaction.

In addition to standardized tools, an informal communication and behavioural checklist was developed by the investigators to capture parental recall of the child's communication, play, and social behaviours during the lockdown period. This semi-structured checklist focused on five developmental areas—pre-linguistic skills (such as eye contact, attention, and concentration), expressive language (naming, requesting, and sentence use), receptive language (understanding words and commands), social interaction (initiating or responding to play), and behavioural patterns (attention, irritability, or screen dependence).

A screen-time documentation form was also used to record the average daily duration, content type, and level of caregiver involvement during screen exposure. Parents reported whether screen use was interactive (e.g., co-viewing or discussing content) or passive (e.g., unsupervised viewing). Screen time was categorized using World Health Organization (2019) and American Academy of Pediatrics (2020) recommendations—no screen time for children below two years (except video calls) and up to one hour per day of high-quality, supervised content for those aged two to five years. Children exceeding these recommendations or demonstrating passive viewing patterns were classified as high-risk screen users.

2.4. Procedure

The data collection followed a two-phase process that combined retrospective parental reporting with post-lockdown developmental assessments. In the first phase, a semi-structured parental interview was conducted to obtain retrospective information about each child's communication, play, and social behaviours during the lockdown (March 2020–March 2022). A uniform set of core questions was asked to ensure consistency across participants, covering domains such as expressive and receptive communication, pre-linguistic skills, and screen use. Example questions included, "How did your child communicate needs during the lockdown?", "Did your child initiate interaction with siblings?", and "Was your child supervised during screen use?" Additional age-specific probes were included for infants, toddlers, and preschoolers to elicit relevant developmental information. Parents were encouraged to provide concrete examples and recall specific behaviours to improve accuracy. The responses were compared against developmental milestones outlined in the REELS and ComDEALL manuals for validation.

In the second phase, post-lockdown clinical assessments were conducted in a quiet clinical setting by two experienced Speech-Language Pathologists, each with more than three years of clinical experience. The REELS was administered to determine receptive and expressive language ages, while the ComDEALL checklist was used to evaluate cognitive, pre-linguistic, and social-communicative skills. Informal behavioural observations were made

during play-based interactions to corroborate parental reports. Each assessment session lasted approximately 60–75 minutes. Information from parental interviews, standardized tests, and behavioural observations was integrated to develop a comprehensive communication profile for each child, thereby allowing both retrospective and current developmental information to be analyzed together.

2.5. Statistical Analysis

Both quantitative and qualitative descriptive analyses were employed in this study. Quantitatively, data from each participant—including chronological age, gender, receptive language age (RLA), expressive language age (ELA), delay durations, cognitive age, and daily screen time—were summarized through frequency counts, ranges, and presented in tabular form. No inferential or hypothesis-driven statistical tests were performed due to the small sample size and descriptive study design.

Qualitatively, parental reports and clinical observations regarding pre-linguistic skills and social-behavioral problems were analyzed thematically to capture patterns of attention, concentration, eye contact, social engagement, and behavioral difficulties. These narrative observations provided contextual detail to supplement the quantitative findings, enabling a comprehensive, mixed-methods understanding of communication and behavioral changes in the children post-lockdown.

3. Findings

The results of the present study are given under the following sub-headings.

3.1. Language and Cognitive Age in Children Aged two- to five-years.

Receptive Language Age (RLA), Expressive Language Age (ELA), and Cognitive Age (CA) were assessed among ten children aged two to five years using standardized tools. The results are presented in Table 2.

Table 2
Receptive and Expressive Language Ages of Participants

Participants	**Developmental Group**	**Current Age (at assessment)**	**Gender**	**RLA (in months)**	**RLA Delayed by (in months)**	**ELA (in months)**	**ELA Delayed by (in months)**
Participant 1	Infant	24 months	Male	6 to 7	17 to 18	5 to 6	18 to 19
Participant 2	Infant	25 months	Male	14 to 16	9 to 11	8 to 9	16 to 17
Participant 3	Toddler	29 months	Male	18 to 20	9 to 11	11 to 12	17 to 18
Participant 4	Toddler	29 months	Male	22 to 24	5 to 7	10 to 11	18 to 19
Participant 5	Toddler	36 months	Male	24 to 27	9 to 12	16 to 18	18 to 20

Participant 6	Toddler	36 months	Female	11 to 12	24 to 25	5 to 6	30 to 31
Participant 7	Preschooler	48 months	Female	36 to 42	6 to 12	22 to 24	24 to 26
Participant 8	Preschooler	48 months	Male	33 to 36	12 to 15	18 to 24	24 to 30
Participant 9	Preschooler	51 months	Male	36 to 42	9 to 15	33 to 36	15 to 18
Participant 10	Preschooler	54 months	Male	24 to 27	27 to 30	22 to 20	32 to 34

Note: RLA = Receptive Language Age; ELA = Expressive Language Age.

The assessment results revealed that all ten participants exhibited delays in both receptive and expressive language development relative to their chronological ages. The receptive language age (RLA) delays ranged from 5 to 30 months, while expressive language age (ELA) delays ranged from 16 to 34 months. All participants demonstrated significant delays across both domains, with expressive language being more adversely affected than receptive language. The cognitive age (CA), as determined using the ComDEALL checklist, was found to be within normal limits for all participants.

3.2. Screen Time, Pre-Linguistic Skills, and Social-Behavioral Problems in Children Aged Two- to Five Years

The screentime, pre-linguistic skills, and social behavioural problems were documented in two- to five-year-old young children. The results are tabulated below in Table 3.

Table 3
Screentime, pre-linguistic skills, and social behavioural problems, in two- to five-year-old young children

Participants	**Screentime per day (in hours)**	**Pre-linguistic skills**	**Social behavioural problems as reported by parents**
Participant 1	4	Inadequate attention, concentration, and eye contact	Throws temper tantrums, Inattentive
Participant 2	4	Inadequate attention, concentration, and eye contact	Does not socialize with peers
Participant 3	4	Inadequate attention, concentration, and eye contact	Self-injurious behaviour, throws temper tantrums, does not socialize with peers, distractive, irritable, and restless
Participant 4	4	Age adequate	Quarrelsome

Participant 5	2	Inadequate attention, concentration, and eye contact	Nil
Participant 6	6	Inadequate attention, concentration, and eye contact	Does not socialize with peers, restless
Participant 7	2	Age adequate	Does not socialize with peers, aggressive, quarrelsome, restless
Participant 8	3	Age adequate	Restless
Participant 9	6	Age adequate	Quarrelsome, throws temper tantrums, aggressive, irritable
Participant 10	8 to 10	Inadequate attention, concentration, and eye contact	Does not socialize with peers, restless

The screen exposure was substantially high among participants, ranging from 2 to 10 hours per day, far exceeding the guidelines on screen time (supervised) given by Indian Academy of Pediatrics, which is 1 hour per day (Gupta et al., 2022). Six out of ten children had screen times of four hours or more daily, and these children also exhibited inadequate attention, poor eye contact, and concentration difficulties. Social-behavioural challenges were reported in nine out of ten children. The most common behaviours included poor peer interaction, temper tantrums, irritability, restlessness, and aggression. A few participants exhibited self-injurious or distractive behaviours.

During clinical observation, several children demonstrated poor reciprocal interaction, minimal initiation of conversation, and reduced response to verbal prompts from the examiner. Instances of limited imitation, lack of peer-oriented play, and poor joint attention were also noted. Parents additionally reported reduced opportunities for social play and decreased verbal engagement at home, indicating both quantitative and qualitative limitations in caregiver–child and peer interactions during the lockdown.

4. Discussion

The present study examined the possible effects of the COVID-19 lockdown on communication development in young children aged two to five years, focusing on receptive and expressive language, pre-linguistic abilities, and social-behavioural functioning. The findings revealed consistent delays in both receptive and expressive language, deficits in pre-linguistic skills, increased screen exposure, and behavioural concerns such as irritability, inattention, and poor peer interaction. These outcomes may be due to interrelated environmental and psychosocial factors that altered children's developmental contexts during the lockdown period.

All participants demonstrated noticeable delays in receptive and expressive language development, with expressive delays being more

pronounced. This pattern may be because expressive language development depends heavily on active social interaction, verbal modeling, and feedback from caregivers and peers (Myers et al., 1989). The restrictions on social engagement and the absence of routine classroom and outdoor interactions may have limited opportunities for natural language use and conversational turn-taking (Balter & Tamis-LeMonda, 2016). The resulting reduction in linguistic stimulation may have contributed to slower expressive vocabulary growth.

Changes in the home environment during the lockdown could also explain the observed language delays. Parents balancing work-from-home responsibilities may have had limited time and emotional resources to engage in responsive communication with their children (Calvano et al., 2022). The reduced frequency and quality of parent–child verbal exchanges may have slowed expressive language development. Similar findings were reported by many researchers (Banerjee & Mukhopadhyay, 2021; Harsha et al., 2025; Kaur et al., 2022), who observed that the pandemic disrupted early developmental trajectories due to reduced stimulation and therapy discontinuation.

Interestingly, receptive language delays were comparatively milder. This may be because comprehension skills can be sustained through passive listening and exposure to everyday speech within the household, even when opportunities for active expression are limited. Varghese and Karuppali (2024) found that receptive vocabulary often remains stable with consistent auditory exposure, while expressive skills decline without active verbal engagement.

The study also found that children with higher daily screen exposure (≥4 hours) exhibited more significant expressive delays, poorer eye contact, and reduced attention spans. These outcomes may be because excessive screen use restricts opportunities for reciprocal communication, which is crucial for language development (Bergmann et al., 2022). Passive screen viewing does not offer the contingent feedback necessary for learning linguistic rules and pragmatic use of language (Tenenbaum et al., 2020). Prolonged exposure to digital media may further overstimulate attention systems, leading to shorter concentration spans and decreased focus on verbal input (Abdoli et al., 2024). Comparable results were reported by Harsha et al. (2025) and Khobragade and Shenoy (2025), who found that extended screen exposure correlated with significant delays in speech and social reciprocity.

The quality of media use may also play a critical role. Varghese and Karuppali (2024) emphasized that interactive, parent-mediated viewing can facilitate learning, while unsupervised or passive screen use is associated with poorer expressive outcomes. In the present study, most parents reported that screens were used as a substitute caregiver while they attended to work or household duties, which may have intensified the negative effects on communication skills.

Deficits in pre-linguistic abilities—such as attention, concentration, and sustained eye contact—were evident in many participants. These challenges may be because such skills develop through shared social routines, imitation, and play, all of which were limited during the lockdown (Cameron & Tenenbaum, 2021). Only eye contact, attention, and concentration were included as representative pre-linguistic indicators because these were

consistently documented across participants. Although pre-linguistic skills broadly include gestures, imitation, and joint attention, the study focused on these core behaviours due to retrospective data limitations and participants' varied developmental stages.

Behavioural difficulties, including irritability, temper tantrums, and inattention, were also reported and may reflect the effects of confinement stress, disrupted routines, and reduced opportunities for social play. Parental anxiety and limited social support may have further contributed to children's emotional dysregulation (Prime et al., 2020). Pasi et al. (2024) similarly found that restricted mobility and online learning stress were associated with increased aggression and attention problems. Moreover, exposure to fast-paced digital content may have conditioned children to seek constant stimulation, reducing their tolerance for delayed gratification (Abdoli et al., 2024).

Overall, these findings suggest that the communication delays and behavioural challenges observed may be the cumulative result of reduced social interaction, inadequate linguistic stimulation, high levels of screen exposure, and increased psychosocial stress during the lockdown. The greater impact on expressive language implies that environmental deprivation may have particularly affected the use and practice of communication rather than comprehension. Similar conclusions have been drawn by few researchers (Mulkey et al., 2023; Sato et al., 2023; Scott et al., 2024), who also reported post-lockdown delays in language and social skills. Although some studies noted enhanced parent–child bonding in supportive households, the overall evidence suggests that most children—especially those with excessive screen exposure—experienced measurable developmental setbacks (Varghese & Karuppali, 2024).

5. Conclusion

The study found that young children exhibited notable delays in receptive and expressive language, along with deficits in pre-linguistic skills and behavioural issues such as inattention and irritability following the COVID-19 lockdown. These outcomes may be due to reduced social interaction, limited verbal engagement, and increased screen exposure during home confinement. The findings emphasize the importance of early screening, parental responsiveness, and promoting interactive communication to support recovery in post-pandemic developmental trajectories.

6. Future Directions

Future research should examine larger, more diverse populations to validate and generalize these findings across different socioeconomic and cultural contexts. Longitudinal studies are recommended to track the long-term effects of pandemic-related environmental changes on communication and social development. Intervention studies focusing on structured parent–child interaction, guided peer play, and moderated screen exposure could help identify effective strategies to mitigate post-lockdown developmental delays. Additionally, incorporating comprehensive pre-linguistic and cognitive

assessments will provide a clearer understanding of early communication trajectories.

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Assessment of cognitive linguistic skills in Malayalam speaking children

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Abstract

Understanding the relationship between cognition and language is critical for assessing normal child development. However, studies investigating cognitive-linguistic abilities of young children are limited in the Indian context. The present study assessed the developmental pattern of cognitive-linguistic abilities in Malayalam-speaking children. Forty children aged 4–8 years (equal number of males and females) participated, selected from regular schools in Kerala, India. 'Cognitive Linguistic Assessment Protocol for Children in Malayalam', comprising tasks in attention, memory, and problem solving, was administered. Findings revealed age-related improvement in all domains. Performance on memory tasks was comparatively lower than attention and problem-solving domains. The results indicate a progressive developmental trend in cognitive-linguistic abilities among Malayalam-speaking children, which could support early identification and intervention for children with delays.

Keywords: cognitive linguistics; Malayalam-speaking children; attention; memory; problem solving

1. Introduction

In Language is the means through which individuals encode and express thoughts, emotions, and experiences. Cognitive linguistics views language as an integral part of cognition, working in parallel with other cognitive abilities. Previous research across linguistics, psychology, and neuroscience has shown that higher-order functions such as attention, memory, and problem-solving are closely linked to language development (Janda, 2015; Crystal & Glanzman, 2013).

The need for the present study arises from the lack of standardized data on the developmental trajectory of cognitive-linguistic skills in Malayalam-speaking children. Such normative information is essential for evaluating children with suspected developmental or language-related disorders. The present study therefore aimed to assess the development of attention,

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memory, and problem-solving skills among typically developing Malayalam-speaking children aged 4–8 years.

The Sapir-Whorf hypothesis, also known as linguistic relativity, suggests that the structure and vocabulary of a language can shape or influence the way its speakers perceive and think about the world. Researches in this area have explored the extent to which language affects cognitive processes and conceptualization. Language is often considered a cognitive tool that humans use to process and convey information. Cognitive linguistics examines the relationship between language and cognition by focusing on mental processes involved in language use. This includes research on metaphor, conceptual blending, and cognitive semantics, exploring how these cognitive mechanisms are reflected in language. Overall, these studies collectively contribute to our understanding of the intricate relationship between language and cognition, shedding light on how language shapes thought processes and vice versa. Individual biological characteristics and the environment in which a child grows significantly impact cognitive development (Kurashige et al., 2020).

Studies on language acquisition in children have played a crucial role in understanding the relationship between language and cognition. Researchers have shown that the development of language skills in early childhood is closely linked to cognitive abilities. Piaget's theory of cognitive development, for example, considers how language acquisition is intertwined with the development of abstract thinking. The process of acquisition of language has been explained by a number of mechanisms. There have been proposals for imitation of adult speech, reinforcement, and analogy. None of these potential learning mechanisms explains why kids come up with novel phrases that follow language norms or why children make mistakes those others do not make (Fromkin, Rodman & Hyams, 2007).

Mental processes such as perception, memory, and problem-solving are very much interlinked with the language development. Studies in cognitive psychology have explored that how language influences these cognitive processes. Attention, memory, knowledge, decision-making, planning, reasoning, judgment, perception comprehension, language, and visuospatial functions are all examples of high-level intellectual functions and processes (Dhakal & Bobrin, 2023). These elements are primarily considered to be related to cognition; however, these are equally relevant linguistically as well.

The ability to concentrate one's perception and thought on a particular task while ignoring unrelated stimuli is referred to as attention (Erbay, 2013). Recognizing and responding to the environment's essential components is required for learning new skills. According to Richards and Turner (2001) infants are better at paying attention as they get older and spend a higher percentage of their time doing so. The general arousal/attention system undergoes substantial changes in development throughout infancy and early childhood, which is characterized by increases in the size and length of sustained attention periods (Reynolds and Romano, 2016). Several researchers have looked at how attention-executive processes evolve over time in typically developing children. Between the ages of six and ten, attentiveness, sustained attention, and spatial orienting (visual search) improve the fastest, according to numerous studies on children's attention

development (Betts et al., 2006). Zimmermann and Fimm (2002) investigated the overall attention development of healthy 5 to 12-year-old children. They found that rapid growth occurred from the ages of 5–6 years to 8–9 years, followed by a developmental plateau with only minor improvement from 8–9 years to 11–12 years.

Memory is the nervous system's ability to learn and retain practical knowledge and skills, allowing organisms to gain from experience (Crystal & Glanzman, 2013). Working memory appears during the preschool years and develops linearly between the ages of 4 and 15, with visual-spatial WM reaching a peak around the age of 11 (Best et al., 2009). In a 2014 study, León, Cimadevilla, and Tascón evaluated the spatial abilities (spatial reference memory and spatial working memory) of children aged 4 to 10. The participants in this study were 50 boys and 50 girls. Overall, the results showed that the 4- and 5-year-old groups performed worse than the older groups". "The ability to keep novel phonological structures in working memory is crucial for the generation of new words throughout the early stages of language acquisition for both native and foreign language learning (Archibald, 2017).

Al-Tarawneh (2012) defines problem-solving as "the process of recognizing a problem, generating possible solution paths, and choosing a suitable course of action." Very basic problem solving skills develop before the age of one year. The preschool years are a critical time for the development of both problem-solving skills and metacognitive abilities (Wang, 2014).

It is important to assess the sequential cognitive linguistic milestones, and also to identify and diagnose cognitive linguistic disabilities in children; and render appropriate interventions for the population lacking these skills. Any such study which focuses upon tapping the cognitive linguistic abilities of children is much needed presently. Cognitive-linguistic tools are needed to confront mental limitations such as memory in tasks such as thinking, learning, and problem-solving.

Understanding the relationship between cognition and language, as well as the pattern of development of cognitive-linguistic abilities in typically developing children is crucial. Studies on cognitive and linguistic abilities in the Indian context are scarce especially in the context of Malayalam to the best of our knowledge. This study attempted to assess the pattern of the development of cognitive linguistic abilities of Malayalam speaking children. Forty children between the age range of 4-8 years participated in the study. Equal number of males and females were included in the study. The participants were chosen from regular schools at Kerala, India. 'Cognitive Linguistic Assessment Protocol for Children in Malayalam' which assesses attention/discrimination, memory, and problem-solving tasks, was used for the study.

2. Methodology

2.1. Participants

The study enrolled typically developing Malayalam-speaking children aged 4;0 to 8;11 years. Participants were divided into four age groups: 4;0–

4;11 years, 5;0–5;11 years, 6;0–6;11 years, and 7;0–8;11 years, with equal numbers of males and females in each group.

There were a total of ten participants (5 males and 5 females) in each subgroup.

2.1.1. Inclusion criteria

For the purpose of selecting participants, the following criteria were used:

1) Participants must be native speakers of Malayalam and studying in English-medium schools in Kerala.
2) Participants should have normal or corrected vision and no significant deficit in hearing sensitivity for speech.
3) During the testing period, participants should be physically fit.

2.1.2. Ethical considerations

Ethical clearance was sought from the Institutional Review Board (IRB) for Bio-Behavioral research involving Human Subjects (SH/IRB/M1.SLP/R 39)

2.1.3. Exclusion criteria

Children with diagnosed developmental, neurological, or psychiatric disorders, uncorrected hearing or vision impairments, or non-native Malayalam speakers were excluded.

2.2. Procedure

Children were comfortably seated and tested in a room with minimal external noise. 'Cognitive Linguistic Assessment Protocol for Children in Malayalam (Joby, Priyadarshi & Abhishek, 2023) was used for the study. Following domains were assessed:

a) Attention, Discrimination, and Perception
b) Memory
c) Problem-solving

The items/tasks within each domain were organized in a hierarchy so that the task complexity increased as the presentation of the levels progressed. The test was conducted on both the auditory and visual sensory modalities. It took around 45 minutes to administer the entire protocol, and then the child's responses were scored. The test material comprised of three domains. Each domain comprised of tasks. Each correct response was given a score of 1. Discrimination task required the participants to differentiate between minimal pairs presented in visual and auditory modality. The memory domain task required the participants to recall the words or digit in forward and backward order. Problem solving required the participants to analyze a scenario and predict the cause or outcome.

3. Findings

Table 1
Subsections of CLAP-C

Sl No.	Domains	Tasks given Auditory mode	Score	Tasks given Visual mode	Score
1	Attention/ Discrimination	Digit count test	5	Odd one out test	5
		Sound count test	5	Letter cancellation	5
		Auditory word discrimination	10	Visual-word discrimination	10
	Total score		20		20
2	Memory	Digit-forward span	5	Alternate sequence	5
		Word recall	5	Picture counting	5
		Digit backward span	5	Story sequencing	5
	Total score		15		15
3	Problem-Solving	Predicting the outcome	10	Association task	5
		Predicting the cause	10	Overlapping test	5
		Compare and contrast	10	Mazes	5
	Total score		30		15

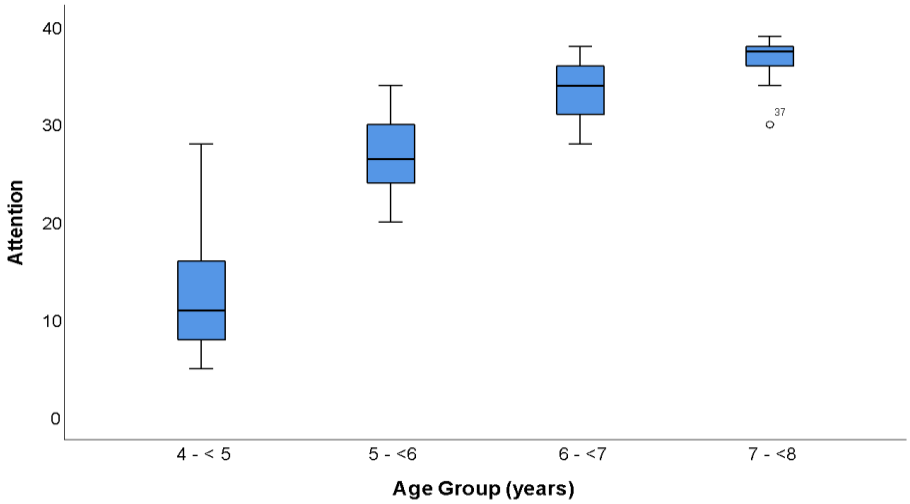
The scores obtained after administering the protocol were totaled for each participant across all age groups for each domain. The mean scores of the children in each age group were compared and tabulated using the SPSS software (Statistical Package for the Social Sciences, Version 26) and then subjected to statistical analysis. The descriptive statistical analyses for the domains are as follows:

Table 2
Mean and the standard deviation scores of participants across age range for all the domains

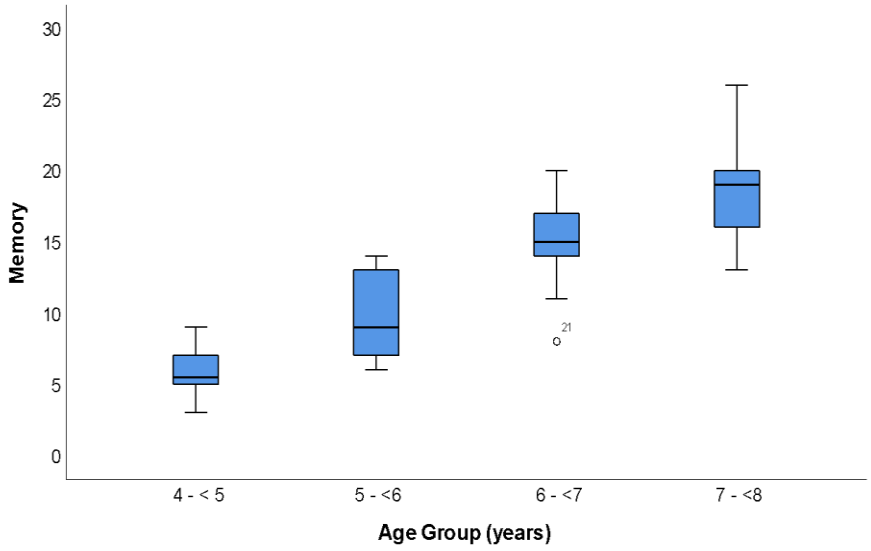
Domains	Age group (years)	Mean	SD	N
Attention (%)	4 - < 5 years	33.5000	19.26424	10
	5 - <6 years	67.0000	10.91635	10
	6 - <7 years	82.7500	8.37075	10
	7 - <8 years	91.2500	6.89706	10
	Total	68.6250	25.29284	40
Memory (%)	4 - < 5 years	19.0000	5.67646	10
	5 - <6 years	32.6667	9.78787	10
	6 - <7 years	49.3333	11.41798	10
	7 - <8 years	63.0000	12.51666	10
	Total	41.0000	19.48336	40
Problem Solving (%)	4 - < 5 years	32.0000	18.77453	10
	5 - <6 years	58.0000	8.14478	10
	6 - <7 years	72.8889	13.61029	10
	7 - <8 years	87.11	11.026	10

	11	84	
Total	62.5000	24.375 39	40

Mixed ANOVA test was administered to compare the performance of individuals on the domains across age groups and pair wise comparisons among domains. The results were demonstrated.

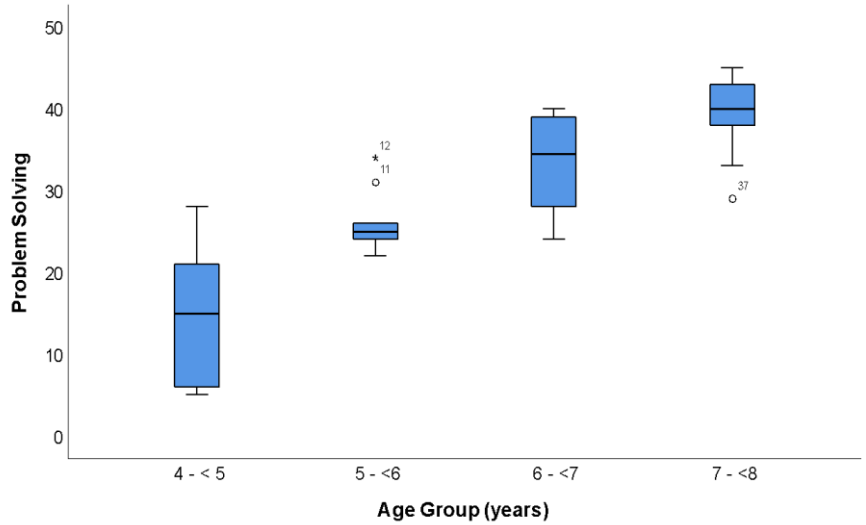


Note: Total scores of attention tasks is displayed on the Y Axis
Figure 1. Performance of Participants in the Attention domain across age groups



Note: Total scores of Memory tasks is displayed on the Y Axis

Figure 2. Performance of Participants in the Memory domain across age groups



Note: Total scores of problem solving tasks is displayed on the Y Axis
Figure 3. Performance of Participants on Problem solving domain across age groups

Figure 1 illustrates the mean attention scores across age groups, demonstrating clear improvements from 4;0 to 8;11 years. Figure 2 presents memory scores showing age-related increases but comparatively lower than attention and problem-solving. Performance of the participants improved as the age range increased from 4- <5years to 7-<8 years old across all the domains. There was a statistically significant difference found for age groups across domains, with F (3, 36) = 50.403, P<0.01, ηp2=0.808. There was a statistically significant difference found between domains as well, with F (2,72) = 125.825, P<0.01, ηp2 (Partial Eta (partial eta squared) = 0.778. An interaction effect was also seen between domains and age groups, with F(6,72)=3.294,P<0.05, ηp2=0.215.This result also revealed that there is significant interaction between the three domains (Attention, Memory and Problem solving) and four age groups (Between 4 and 8 years).

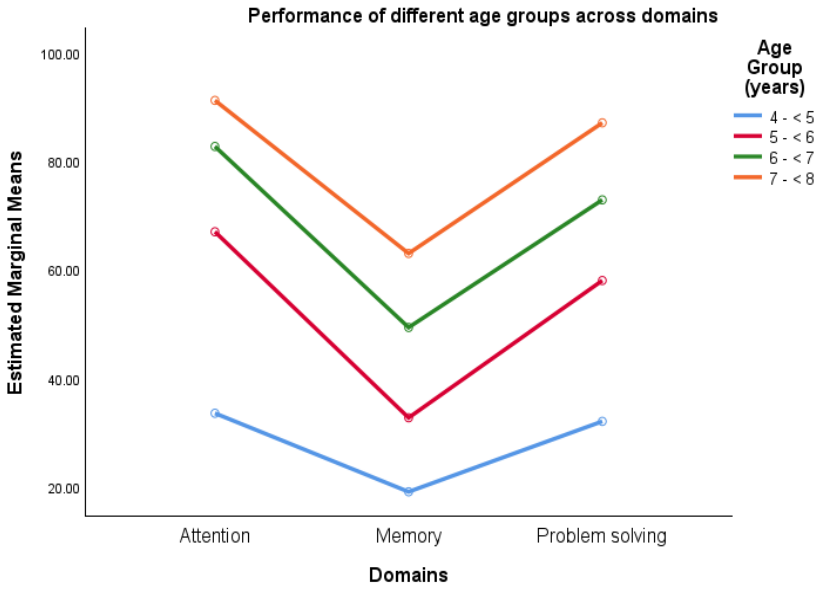


Figure 4. Performance of different age groups across domains

Figure 3 displays problem-solving scores, with steady growth particularly in older children. Figure 4 compares domain performances across age groups, highlighting that the youngest group showed less distinction between domains, while older children showed more domain-specific development patterns. A clear-cut developmental trend can be visualized from this figure. The performance of participants in memory, was reduced compared to other domains of attention and problem solving. Group 1 (4-<5 years) was showing a different pattern compared to the other age groups. There is not much difference between the three domains for participants aged 4-<5 years. Repeated measures ANOVA was done to check the differences among different domains. Bonferroni's adjustment for multiple comparisons was made during pair wise comparisons.

Table 3
Comparison between domains

(I) domain	(J)domain	Mean Difference (I-J)	Std. Error	Sig.[b]
1	2	27.625*	1.933	.000
	3	6.125*	1.833	.006
2	1	-27.625*	1.933	.000
	3	-21.500*	1.715	.000
3	1	-6.125*	1.833	.006
	2	21.500*	1.715	.000

Based on estimated marginal means

*. The mean difference is significant at the 0.05 level.

b. Adjustment for multiple comparisons: Bonferroni

The results suggested that statistically significant differences exist in the performance of participants in different domains. (P <0.05 for all the domains; which means all domains are different from each other).

The interaction effect indicates differing developmental trajectories by domain and age. Younger children (4;0–4;11 years) exhibit less differentiated cognitive-linguistic skills across domains, whereas older children show more specialized development with notably lower memory relative to attention and problem-solving abilities. This reflects neurocognitive maturation and environmental influences on cognitive functions.

4. Discussion

Our findings corroborate previous research showing progressive development of attention, memory, and problem-solving in childhood (Betts et al., 2006; Best et al., 2009). Memory development lagging behind other domains aligns with known protracted maturation of working memory capacity. While cognitive-linguistic assessment studies specific to Malayalam are scarce, similar developmental patterns have been reported cross-linguistically.

Both sustained and selective attentions were evaluated using CLAP-C (Malayalam). Digit count tests, sound count tests, and auditory word discrimination were used as tasks for auditory attention. The findings revealed that children's attention abilities improve with age. However, as the levels progressed, the participants' performance deteriorated. The visual attention tasks used in this study were the odd one out test, letter cancellation (LC), and visual word discrimination, all of which required sustained attention. A clear pattern of hierarchy was observed. When compared to lower age group children, higher age group children performed better on the more difficult items.

Between the ages of 6 and 10, attentiveness, sustained attention, and spatial orienting (visual search) improve the fastest, according to numerous studies on children's attentional development (Betts et al., 2006). The level of cerebral maturation has the greatest influence on attentional functions, as it does on all cognitive mechanisms. Zimmermann and Fimm (2002) investigated the overall attention development of healthy 6 to 12-year-old children. They found that, despite unavoidable inter-individual differences, getting older invariably improved attentional test performance, and that these levels of performance, which were at first highly heterogeneous, tended to stabilize. Flexibility, which is necessary for controlling the focus of attention, increases with child maturation. Rapid growth occurred from the ages of 5–6 to 8–9 years, followed by a developmental plateau with only minor improvement from 8–9 to 11–12 years. According to research by Posner & Rothbart in 2007, the central executive attention network significantly improves during the preschool years.

The tasks used to evaluate memory in the auditory modality were word recall, digit forward span, and digit backward span. The main purpose of digit span tests was to evaluate working memory. Results showed that as children get older, their ability to recall more items increases. Working memory appears during the preschool years and develops linearly between the ages of 4 and 15, with visual-spatial WM reaching a peak around the age of 11 (Best et al., 2009). No matter whether the tasks are digit or word span or object or spatial span, various cross-sectional studies have found that the number of items retained varies from 3 to 5 years of age. However, capacity for both digit-word and object-spatial spans improves after preschool (e.g., from 4 blocks at 5 years to 14 blocks at 11 years) (Garon, Bryson & Smith, 2008). Between the ages of 3 and 5 years, the number of items that children can remember backward expands from 1.58 to 2.88 items and beyond (Carlson, 2005).

The visual memory tasks used in this study were Alternate Sequence Tasks, Picture Counting, and Story Sequencing. Memory capacity increases

along with a consistent rise in chronological age. Supporting the research findings on rehearsal strategies may help explain why children from older groups perform relatively well. It has been established that as children grow older, there appears to be an improvement in their recall strategies. Supporting the research findings on rehearsal strategies may help explain why children from older groups perform relatively well. It has been established that as children grow older, there appears to be an improvement in their recall strategies.

In this study, auditory problem-solving tasks included predicting the outcome, predicting the cause, and comparing and contrasting. Association tasks, overlapping test and Mazes were the tasks done to assess memory in the visual modality According to the findings of this study, there was a significant difference across age groups for all problem-solving tasks. The findings revealed that as one gets older, one's problem-solving abilities improve even more.

In essence, the findings in this domain revealed that problem-solving abilities such as reasoning, thinking, and so on develop, as a child grows older. The environment to which the child is exposed is also crucial to the development of these skills. Younger children appeared to exert more effort when planning, as evidenced by the fact that they paused for longer periods of time than older children. Children under the age of five have a hard time following instruction when performing 'tower tasks' (Baughman & Cooper, 2007) or using standard computer interfaces, like those required for 'maze navigation planning tasks' (Miyata, Itakura, & Fujita, 2009). Cognitive linguistic skills in Malayalam has not been carried out in Malayalam using the same tests or tests meant for the same purpose to correlate the findings of the current study with previous findings.

5. Conclusion

The findings of this study highlight several points of interest. The development of cognitive-linguistic skills in children tested using this assessment tool was discovered to follow a developmental trend. Within all age groups, basic attention tasks such as digit count and odd one out were the easiest and showed high accuracy, even among younger children. More complex tasks involving working memory (digit backward span, story sequencing) and problem-solving (predicting outcomes or causes) were the hardest, with gradual improvement observed with age yet remaining challenging. The findings also indicated that as the complexity of the stimulus increased, the children's performance decreased. This study will help in identifying the sequential cognitive linguistic milestones, which can further help in diagnosing cognitive linguistic disabilities in Malayalam speaking children, and allow intervention based on the developmental schedule.

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Lexical development in Tamil-speaking preschool and primary school children – development and validation of a vocabulary checklist

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Abstract

Vocabulary is key to language learning and communication. It is essential for reading, writing, and forming sentences. Vocabulary also reflects intelligence and word knowledge. To accurately assess a child's language skills, a culturally fair vocabulary checklist is needed. This tool can help predict cognitive abilities and support language development, which is crucial for academic success. Since there are limited studies on Tamil vocabulary assessment, the current study aimed at developing and validating a vocabulary checklist for Tamil-speaking children. The study included development and validation of the lexical inventory checklist, and administration of the checklist on 60 primary school Tamil speaking children. From the results obtained it is inferred that vocabulary knowledge increases as age increases. The study highlights the importance to track the developmental trend with the help of vocabulary checklist.

Keywords: vocabulary, checklist, Tamil speaking children, development, validation

1. Introduction

Lexical inventory refers to the collection of words known by an individual or by a Group of people. By the age of eighteen months, children typically attain a vocabulary of 50 words in production (Doughty & Long, 2008). Vocabulary spurt is defined as a shift from slow vocabulary growth to a faster growth. A vocabulary spurt occurs over time as the number of words learning accelerates. It is believed that most children learn about 10 to 20 words a week (Ganger & Brent, 2004). Vocabulary is classified into four types: i) Listening Vocabulary, ii) Speaking Vocabulary, iii) Reading Vocabulary, iv) Writing Vocabulary (Biemiller, 2001; Manzo & Thomas, 2006; Cohen & Steinberg 1983; Xu & Yapanel et al., 1999). The vocabulary is also

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referred to as lexicon/ lemma. Mental lexicon is the processes involved in language use, such as language acquisition, perception, comprehension, and production. The mental lexicon (or the internal lexicon) is a field of psycholinguistics that focuses on the organization of word knowledge in one's permanent memory (Briscoe & Carroll, 2002).

Lexicon is the total set of word and word elements that carry meaning and it is the bridge between the language and knowledge (Sowa, 2005). Every language has a different vocabulary and grammatical structure.

Reading comprehension relies on vocabulary. Readers cannot comprehend what they are reading unless they are familiar with the meaning of the terms (Miller, Anglin & Wakefield, 1993). Listening, speaking, reading, and writing are all made easier with a large vocabulary (Nation, 2015). The process of acquiring words is known as vocabulary development which begins with babbling and progresses to meaningful speech as infants grow. Children continue to expand their vocabulary throughout their school years (Ghassabian et al., 2013; Bishop et al., 2012).

Neuman and Celano (2001) in their study on vocabulary development found that children's language proficiency is dependent on their capacity to perceive sounds throughout infancy. Children between the ages of six and ten months can distinguish sounds used in various languages around the world. Between the ages of 18 months to 7 years, phonological register is completed and there is a relationship between phonetic skills and lexical progress in children.

Failure to develop the pre-requisite phonetic skills in the pre-linguistic phase results in delay in acquiring word. It is also stated that the amount of speech input given to the children and the richness of the vocabulary is a positive predictor of language development (Bornstein, Haynes, & Painter, 1998; Hart & Risley, 1995; Hoff & Naigles, 2002; Huttenlocher, & Lyons et al., 1991; Weizman & Snow, 2001).

In an account to document the vocabulary development in children, many checklists were developed in western population such as Expressive Vocabulary Test (EVT-2), Peabody Picture Vocabulary Test (PPVT), Preschool Language scale PLS-5, Receptive and Expressive One Word Picture Vocabulary Test (ROWPVT-4).

Similarly, vocabulary checklist was also developed in Indian context namely Classroom Vocabulary Assessment for Indian Children (CVA-3), Clinical Practice Guidelines for Children (CPGC) and Assessment in Early Childhood Education (AECE-8) are the few well know Test material for the vocabulary assessment. It gives a complete review on all areas of early childhood skills and provides baseline for the child's academic knowledge. The domains of this tool include (i) Physical well- being and motor development (ii) Approaches towards learning (iii) Language development and cognition (iv) general knowledge.

Lee (2011) inferred vocabulary development of two-year old children, that helps in predicting early language and literacy skills. Study included 1,071 children, they were further categorized into large and small vocabulary Groups with the help of their Communicative Developmental Inventory (CDI) score. Results revealed that children with a larger vocabulary size at age 2 were observed to be advanced in language and literacy development than

their peers with a smaller vocabulary size. The development of early expressive vocabulary emerges in the form of babbling to the meaningful utterances (Nott & Cowan et al., 2009).

Benedict (1979) analyzed the acquisition of first 50 comprehended and produced words among eight children between 0.9 to 1.8 months and reported that the age of acquiring 10 to 50 words was 2.7 months in the receptive lexicon, while the expressive lexicon was 4.8 months. Caselli et al., (1995) studied the both receptive and expressive vocabulary in a total of 659 English and 195 Italian children between 8 months to 1.4 years using the MacArthur communicative inventory and reported that the acquisition order of the words belonging to different adult- like vocabulary was highly parallel in both the languages.

Jones et al., (2020) have done a study on developing vocabulary checklist for young children in multilingual region, where they included 20 categories and scoring was determined as early, mid and late acquired. From this study we can conclude that the noun categories, action words are attained early in the development while time words, pronoun, quantifier, question, locations acquire late during development. Kern et al (2007) explored the early lexicon development of 548 French-speaking infants aged 8.0–16.0 months of age. French adaptation of MacArthur-Bates Communicative Development was used and result revealed individual variations both in terms of onset and rate of lexical growth. The total vocabulary scores increased in all sections with chronological age. Noun was observed early in the production and comprehension of vocabulary between 8 to 16 months regardless of the lexicon size.

Caselli et al., (1995) observed the sequence of grammatical development, within and across natural languages. They measured the onset and rate of growth in lexical categories such as nouns, verbs, adjectives and grammatical function words. This study focusses on the parental report data on the first stages of expressive and receptive lexical development for 659 English infants and 195 Italian infants between 8 and 16 months of age. There was a growth in the proportion of vocabulary particularly in nouns. Grammatical function words, verbs and adjectives are rare in earlier vocabulary production, although verbs are reported earlier for receptive vocabulary.

Dixon (1982) recommended the hierarchy of development for adjectives such as value, dimension, physical property, speed, color, human propensity, age. Bever (1970) also conducted a study to identify the age of acquisition of adjectives across two to five years of age and found that children around two to three years performed better on repeating unnatural adjective and stable adjective production by five years of age.

Ching & Collyer et al., (2020) carried out a study to develop a checklist that was assessed in 33 parents to estimate vocabulary development in Indigenous Australian children among pre-school and primary school children. Results revealed, positive vocabulary development with increasing

age and positive effects in word combination around 3 years of age. Study concluded that the vocabulary development is more prominent in primary school children.

There are many factors that influence the development of vocabulary such as i) Environment, ii) bilingualism iii) speech and language disorders (Arriag & Fenson et al., 1998). Stevenson and Richman (1976) did a study on epidemiological survey of vocabulary development for three-year old children. They concluded that there was an influence of language disorder over vocabulary development.

Silva (1980) examined the age of acquisition of vocabulary in children with mental retardation. This study included 937 children with mental retardation, with the age range of three years having borderline Intelligence Quotient (IQ). Results revealed 85% of the children had poor acquisition of both receptive and expressive vocabulary.

Luyster et al, (2008) conducted a study to investigate language in toddlers who are at risk of Autism Spectrum Disorder (ASD) and to identify early correlates of receptive and expressive vocabulary. The study included 164 toddlers who are at risk of Autism Spectrum Disorder (ASD) between the ages of 18 and 33 months. Several languages, cognitive and behavioral measures were administered. Results suggested that children who are at risk of Autism spectrum Disorder (ASD) yield significantly poorer score both in receptive and expressive vocabulary.

Stork et al., (2009) conducted a study in which they explored the factors that influence vocabulary development in children, they explored the relative impact of demographic, cognitive, behavioral, and psycholinguistic factors on vocabulary development in two-year-old children. A total of 232 children between 24–30 months were tested on expressive and receptive vocabulary, cognitive development, word learning and working memory skills.

Fenson et al., (1993) explored the impact of demographic, behavioral, cognitive and psycholinguistic factors on vocabulary development in two-year-old children. A total of 232 children with the age range of 24-30 months were included in this study and tested the expressive vocabulary, receptive vocabulary, cognitive development, word learning and working memory skills. They have concluded children with cognitive and behavioral problem exhibit poor acquisition of receptive and expressive vocabulary along with poor scores in word learning and working memory skills.

Ebert el al (2013) studied the internal and external influence on vocabulary development in pre-school children. The internal aspect of phonological working memory and external aspect as exposure to the school and home was considered. The study included 547 children from 97 German preschools. Children's vocabulary was assessed at the ages of three, four and five years. They have concluded that the phonological working memory has a strong impact on vocabulary development and there is no influence of environment in vocabulary development.

It is postulated that girls develop vocabulary at a more accelerated rate compared to boys (Bornstien et al., 1998; Huttenlocher et al., 1991). Some research suggest that gender differences are minimal and is typically observed between the ages of three and four years that usually lasts for four to six months beyond which vocabulary attain exponential growth

(Huttenlocher, Haight et al., 1991). Hyde and Linn (1988) found that, there is no significant gender difference with respect to vocabulary development. According to Bornstien et al., (1998) sensitive period for vocabulary growth occurs between the ages of three and four.

Hoff et al., (2014) studied the course of language development among children from bilingual homes and monolingual homes. 31 children from monolingual-English homes and 11 children from bilingual home were participated in the study. The finding suggested that native language vocabulary is developed faster than the non-native language with respect to bilingual and monolingual homes. There is also an influence of migration over vocabulary development.

It is warranted to develop vocabulary checklist to avoid cultural bias, to estimate the child's linguistic ability and its correlation with concurrent measures of language development. It is essential to predict the cognitive ability, as it facilitates in development of functional language and an important prerequisite for pre-academic skill.

Vocabulary is the basis for language learning and is considered as a critical element to acquire language (Sothan,2015). It is essential for communication, reading, writing and to form grammatically appropriate sentences (Nation, 2001). It also relates to intelligence and is the base for word knowledge (Nation, 1990; Schmitt & McCarthy, 1997). It is warranted to develop vocabulary checklist to avoid cultural bias, to estimate the child's linguistic ability and its correlation with concurrent measures of language development. It is essential to predict the cognitive ability, as it facilitates in development of functional language and an important prerequisite for pre-academic skill. There are only minimal studies available to assess vocabulary in Tamil. Thus, there is a need to develop and validate vocabulary checklist/lexical inventory for Tamil speaking childrenthe introduction part, the study should be introduced, literature should be reviewed and discussed on the narrow line of the research topic in relation to relevant theories and the gap filled by your research should be stated clearly.

Please note that the first line of each paragraph is **indented.** Please do not change the indentation value (if you cannot see the value, please click the 'View and then mark the 'Ruler' box); align your manuscript to the template's indentation value. No space is added between paragraphs.

2. Methodology

The aim of the study is to adapt and validate lexical inventory for Tamil speaking preschool and primary school children age ranged from three years to six years eleven months.

2.1. Material Development and Validation

The test tool was developed in Tamil, by adapting the categories of the lexicons from Mac Arthur Communicative Development Inventory, Tamil text books from first to third standard. The words were categorized into 20

categories based on the Mac Arthur communicative development inventory and few added categories with words including Nouns such as colours, vegetables, fruits, animals, birds. Verbs such as action words; prepositions and adjectives such as colours, vegetables, fruits, animals, birds, body parts, vehicles, food items, small household things and toys, house appliances and rooms, outside things and places, nature, people, action words, words denoting time, adjectives, pronouns, questioning words, location words and quantifiers.

The words were validated by arranging it according to Likert's scale, which is a five-point rating scale and the rating was based on the familiarity of the words, where 1 represents very unfamiliar and 5 represents very familiar. The unfamiliar words were revised and new words were adapted. Picture stimulus was also arranged accordingly to the words. It was validated by five speech and language pathologists with more than two years of experience and 10 pre-school and primary school teachers with experience of greater than five years and are native speakers of Tamil.

2.2. Participants

A total of 60 Tamil speaking children between the age range of three to six years eleven months were included in the study. Participants were further divided into four Groups according to the age. Group I included 15 participants with the age range of 3.0 to 3.11 years; Group II included 15 participants with the age range of 4.0 to 4.11 years; Group III included 15 participants with the age range of 5.0 to 5.11 years; Group IV included 15 participants with the age range of 6.0 to 6.11 years. The participants were selected from a school in a rural place in Tamil Nadu. Informed consent was received from the parents of the children who participated in the study. Speech and Language screening was done for all the participants prior to the administration of the checklist developed.

2.3. Data collection and processing

The procedure was explained through zoom sessions to the volunteers and the volunteers assessed the material on children. The internet connectivity was made sure to be stable during the training session. The volunteers assessed the children in a quiet and distraction free environment. The children were asked to name the picture stimuli and respond to the words which was provided. There were no time restrictions given for the response and prompts were not provided. Verbal praises were given for each correct response and each child was provided with a tangible reinforcement at the end of the assessment.

Scoring sheets were used individually for each child which had 'Yes' or 'No' response in it against each word. For each correct response a score of 1 was given and 0 for each incorrect response.

Table 1

Mean and standard deviation of all four Groups

Categories	Group I		Group II		Group III		Group IV	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Category 1	6.4	1.3522	11.4	2.1314	16.267	2.4339	17.333	1.633
Category 2	7.467	0.9155	11.667	2.1931	18.667	1.9518	19.333	2.82
Category 3	5.8	0.9411	10.667	1.633	14.8	1.5213	15.933	1.3345
Category 4	13.067	1.1629	14.733	0.7988	20.867	1.2459	23.467	2.3258
Category 5	6.267	0.5936	10.867	2.774	13.733	1.1629	14.6	1.1832
Category 6	12.867	0.9155	15.133	0.9904	21.2	1.9712	24.00	1.3628
Category 7	6.00	0.5345	7.533	0.9155	9.933	0.9612	10.8	1.0142
Category 8	12.4	0.9103	14.533	0.9904	16.2	1.5213	18.733	0.9612
Category 9	14.533	1.302	19.00	1.4142	23.467	1.4573	25.867	1.8848
Category 10	13.467	0.9904	15.667	1.1751	21.2	1.9712	24.00	0.9258
Category 11	7.333	0.7237	9.667	0.8997	11.000	0.000	11.00	0.000
Category 12	8.4	0.9103	9.8	0.7746	10.667	0.488	11.00	0.000
Category 13	11.00	1.1952	12.467	1.6417	16.00	1.5119	17.2	1.0142
Category 14	25.067	3.8816	34.6	1.6388	38.8	1.8205	40.533	1.3558
Category 15	6.333	0.488	8.333	0.9759	9.4	1.0556	11.00	1.4639
Category 16	16.333	0.8997	23.867	1.8848	29.267	2.1865	32.2	0.8619
Category 17	4.333	0.488	8.4	0.5071	15	0.000	15	0.000
Category 18	7.4	0.6325	8	0.000	8	0.000	8	0.000
Category 19	8.267	0.9612	10	0.000	10	0.000	9.333	2.582
Category 20	6.133	0.3519	7	0.000	7	0.000	7	0.000

2.4. Data analysis

The collected data was tabulated and descriptive statistics was applied based on the mean of "correct "responses for each stimulus presented. The responses were ordered according to the age range from 3.0 - 3.11 to 6.0 -

6.11 years which was determined from 60 participants. The mean and standard deviation was calculated for all the categories between the groups. The Statistical Package for Social Science (SPSS) version 21 was used for statistical analysis, all the variables were subjected to nonparametric test to estimate the significant difference between the groups. From the study it can be concluded that there is a statistically significant difference ($p<0.05$) between the age groups on all categories. Pair wise Comparison was estimated with the help of Dunn's pair wise tests. P values <0.05 were considered as statistically significant.

3. Findings

Descriptive statistics was estimated for all the categories between the Groups. The statistical analysis was carried out using SPSS (Statistical Package for Social Science) version 21. All the variables were subjected to nonparametric test to estimate the significant difference between the Groups. The significant difference were found between the Groups ($p < 0.05$).

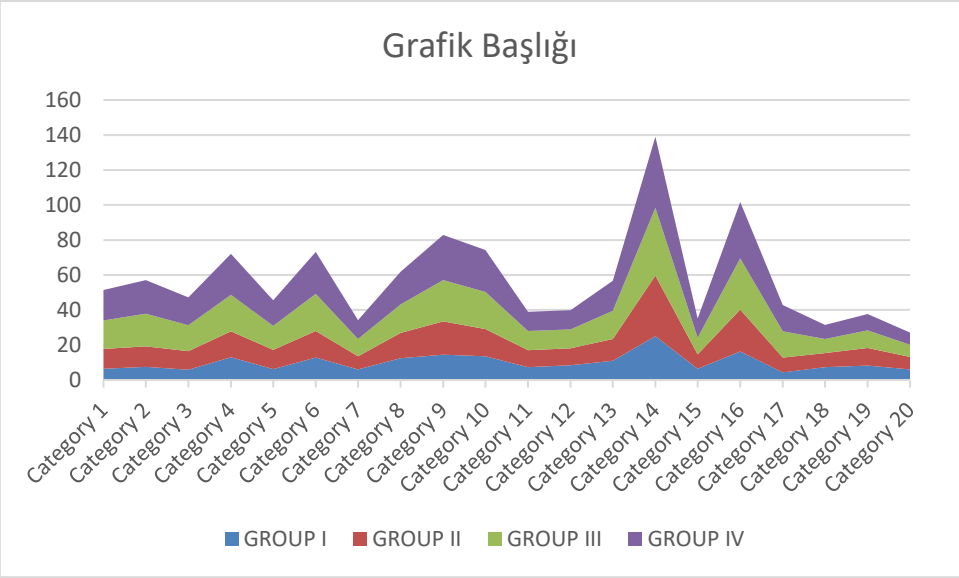

Figure 1. Denotes the mean and standard deviation of all four Groups

From Table 1, we could infer the mean and standard deviation of four Groups across all the 20 categories and figure 3.1 represent the linear increase in the mean scores for all 20 categories across age range of Group I scoring with least and Group IV performing with highest. This finding is supported by the inference of Nation and Warring (1997), where they suggested that vocabulary increases as age increases. Similarly, Huttenlocher, Haight, Bryk, Seltzer and Lyons (1991) suggested that, the increase in mean scores on varied categories is dependent on the exposure to the lexical category. The highest scores were significantly obtained for category 4 (animals), category 6 (body parts), category 9 (small household things and toys), category 10 (house appliances and rooms), category 14 (action words) and category 16 (adjectives) which attributes to literacy, where it is inferred that literacy have an influence over vocabulary development

(Richa, Sujatha & Premlatha, 2013). In addition to the current findings Ghassabian et al., 2013; Bishop et al., 2012; Jones, 2020 suggested that children learn more word at primary school age when compared to pre-school age. Kern et al (2007) explored the early lexicon development and found that the total vocabulary scores increased in all sections with chronological age.

Table 2

(*P) value comparison between the first Group with other Groups (Group I with Group II, Group III, Group IV)*

Categories	Group II	Group III	Group IV
Category 1	0.106	.000	.000
Category 2	0.221	.000	.000
Category 3	0.091	.000	.000
Category 4	0.453	.000	.000
Category 5	0.091	.000	.000
Category 6	0.231	.000	.000
Category 7	0.16	.000	.000
Category 8	0.096	.000	.000
Category 9	0.106	.000	.000
Category 10	0.275	.000	.000
Category 11	0.015	.000	.000
Category 12	0.056	.000	.000
Category 13	0.955	.000	.000
Category 14	0.079	.000	.000
Category 15	0.007	.000	.000
Category 16	0.068	.000	.000
Category 17	0.069	.000	.000
Category 18	.000	.000	.000
Category 19	.000	.000	.000
Category 20	.000	.000	.000

Note: p<0.05 – significant value.

Table 2 denotes the significance table of Group I with Group II, Group III and Group IV respectively. When comparing Group I with other Groups, significant difference obtained between Group I and Group II, Group I and Group IV in all 20 categories. The current finding is supported by the inference of Nation and Warring (1997), where they suggested that vocabulary increases as age increases. Nieminen (1991) also inferred that children between 0.8 months to two years acquired receptive lexicons four to five times faster than expressive lexicon.

Similarly, Jones et al., (2020) have done a study on developing vocabulary checklist for young children in multilingual region, where he included 20 categories and scoring was determined as early, mid and late acquired. From this study we can conclude that the action words are attained early in the development while words denoting time, pronoun, quantifier, question, and locations are acquired late during development.

Inferences on specific categories, Group I children were observed to have significant differences on all categories when compared with Group III and Group IV. This finding is supported by Gentner, (1982); Bornstein et al., (2004) that nouns are acquired early compare to that of verbs. It is also suggested that the noun dominance is observed in early lexical acquisition than verbs (Borodiskey, 2001).

The grammatical function words such as prepositions, pronouns, question words and quantifiers are very rare in early lexicon, however it starts to develop around two to three years (Marchman & Bates et al., 1994; Caselli et al., 1995).

The hierarchy of development was suggested by Brown, (1973); Laubscher and Light (2020), where nouns and action words develop early followed by adjectives and adverbs. It does not contain preposition, conjunctions articles or auxiliary verbs during early development. Similarly, with respect to the development of adjectives, Martin and Molfese, (1972) have observed that younger children tend to produce adjective orders that are less adult-like and as children get older, they attain adult pattern of adjectives.

Dixon (1982) recommended the hierarchy of development for adjectives such as value, dimension, physical property, speed, color, human propensity, age.

Bever (1970) also conducted a study to identify the age of acquisition of adjectives across two to five years of age and found that children around two to three years performed better on repeating unnatural adjective and stable adjective production by five years of age.

The concept of time is dependent on dimension of speed, distance and spatial orientation. All these dimensions are mastered only after eight years (Richards& Siegler, 1979; Richards, 1982; Matthews & Meck, 2016). The temporal representation starts as early as 18 to 24 months of age, where it begins with the usage of past tense and at age two to three years children mainly relate to temporal concepts that are related to location or distance (Shirai & Andersen,1995; Nelson & Fivush, 2004; Shirai & Miyata, 2006). By three years, children can distinguish between past and future events, however spatial time concepts develop between six to eight years (Nelson & Fivush, 2004).

One of the significant categories is quantifiers which denote syntactically numerical logic events (Noveck, 2001). Children by three years of age begin to use quantifiers rather than numbers and children by age of five years start to use complex quantifiers that are relevant to context (Papafrago, 2003). Number of appropriate answers to question and asking question develops as age increases (Salamo et al., 2012). Children around three to four years uses variety of "wh" question and the development of "why" question is acquired only between the age of five to six years (Nicolosi, 2004).

Significant difference between three years and four years was observed only for category 15 (time concept) which is supported by the study done by Nelson & Fivush (2004) where they suggest that, by three years of age children can distinguish between past and future events, however spatial time concepts develop adult pattern between five to eight years of age.

Table 3
(P) value comparison of the second Group with other Groups (Group II with Group I, Group III, Group IV)

	Age range		
	Group	Group	Group
Categories	I	III	IV
Category 1	0.106	0.016	0.001
Category 2	0.221	0.003	0.001
Category 3	0.091	0.022	.000
Category 4	0.453	0.014	.000
Category 5	0.091	0.089	0.002
Category 6	0.231	0.034	.000
Category 7	0.16	0.019	.000
Category 8	0.096	0.409	.000
Category 9	0.106	0.037	.000
Category 10	0.275	0.036	.000
Category 11	0.015	0.01	0.01
Category 12	0.056	0.09	0.003
Category 13	0.955	0.005	.000
Category 14	0.079	0.041	.000
Category 15	0.007	0.797	.000
Category 16	0.068	0.1	.000

Category 17	0.069	0.001	0.001
Category 18	.000	1.000	1.000
Category 19	.000	1.000	1.000
Category 20	.000	1.000	1.000

Table 3 denotes statistical significance of Group II when compared with other age Groups. Significant difference were obtained between Group II and Group III in following categories, category 1 (colours), category 2 (vegetables), category 3 (fruits), category 4 (animals), category 6 (body parts), category 7 (vehicles), category 9 (small house hold things & toys), category10 (house appliances), category 11 (outside things and places), category 13 (people), category 14 (action words). These findings are supported by Jones et al., (2020) have done a study on developing vocabulary checklist for young children in multilingual region, where he included 20 categories and scoring was determined as early, mid and late acquired. From this study we can conclude that the noun categories, verb categories are attained early in the development while time words, pronoun, quantifier, question, locations acquire late during development.

Similarly, Gentner, (1982); Bornstein et al., (2004) reported that nouns are acquired early compare to that of verbs. It is also suggested that the noun dominance is observed in early lexical acquisition than verbs (Borodiskey, 2001). It is also suggested that, grammatical function words such as prepositions, pronouns, question words and quantifiers are very rare in early lexicon, however it starts to develop around two to three years (Bates et al., 1994; Caselli et al., 1995). Bates (2000) concluded that there are noun bias observed with respect to productive lexicon such as animals, game routine and place. The receptive lexicon of the categories are observed as early as 16 months, however expression was reported to be delayed. Development of colours was studied by Pitch ford and Mullen (2010) where they reported that children between the age of two to three years respond better on five primary colours. Children by age four respond even better for complex colours without any error, however colours such as brown and grey are acquired only after five years of age (Johnson, 1977).

Similarly significant difference between four years and six years were obtained in all these categories category 1 (colours), category 2 (vegetables), category 3 (fruits), category 4 (animals), category 5 (birds), category 6 (body parts), category 7 (vehicles), category 8 (food items), category 9 (small household things and toys), category 10 (house appliances), category 11 (outside things and rooms), category 13 (people), category 14 (action words), category 15 (words denoted time), category 16 (adjectives) and category 17 (pronouns).

This finding was supported by Gentner, (1982); Bornstein et al., (2004) reported that nouns are acquired early compare to that of verbs. It is also suggested that the noun dominance is observed in early lexical acquisition than verbs (Borodiskey, 2001). Few categories were reported to have good receptive vocabulary than expressive vocabulary Caselli et al., (1995) observed the sequence of grammatical development and found that grammatical function words, verbs and adjectives are rare in earlier

vocabulary production, although verb are reported earlier for receptive vocabulary.

Bates (2000) concluded that there is noun bias observed with respect to productive lexicon such as animals, game routine and place. The receptive lexicon of the categories is observed as early as 16 months; however expression was reported to be delayed. It is also suggested that, grammatical function words such as prepositions, pronouns, question words and quantifiers are very rare in early lexicon, however it starts to develop around two to three years (Bates et al., 1994; Caselli et al., 1995).

Nelson and Fivush (2004) found that children by the age of three years can distinguish between past and future events, however spatial time concepts develop between six to eight years. With respect to questions, Nicolosi (2004) found that the children around three to four years uses variety of "wh" question and the development of "why" question is acquired only between the age of five to six years.

Significant difference between three years and four years is observed only for category 15 (time concept) which is supported by the study done by Nelson & Fivush (2004) where they suggest that, by three years of age children can distinguish between past and future events, however spatial time concepts develop adult pattern between five to eight years of age.

Table 4
(P) value comparison of the third Group with other Groups (Group III with Group I, Group II, Group 1V)

Categories	Group I	Group II	Group IV
Category 1	.000	0.016	1.000
Category 2	.000	0.003	1.000
Category 3	.000	0.022	1.000
Category4	.000	0.014	0.659
Category5	.000	0.089	1.000
Category6	.000	0.034	0.387
Category7	.000	0.019	1.000
Category8	.000	0.409	0.066
Category9	.000	0.037	0.693
Category 10	.000	0.036	0.319
Category 11	.000	0.01	1.000
Category 12	.000	0.09	1.000

Category 13	.000	0.005	1.000
Category 14	.000	0.041	1.000
Category 15	.000	0.797	0.449
Category 16	.000	0.1	0.235
Category 17	.000	0.001	1.000
Category 18	.000	1.000	1.000
Category 19	.000	1.000	1.000
Category 20	.000	1.000	1.000s

Table 4 indicates statistical significance of Group III. Statistically significant difference between Group III with Group I was obtained for all 20 categories. The current finding is supported by the inference of Nation and Warring (1997), where they suggested that vocabulary increases as age increases.

Similarly, Jones et al., (2020) have done a study on developing vocabulary checklist for young children in multilingual region, where he included 20 categories and scoring was determined as early, mid and late acquired. From this study we can conclude that the action words are attained early in the development while time words, pronoun, quantifier, question, locations acquire late during development.

Inference of statistical significance on specific categories suggest that nouns are acquired early compare to that of verbs (Gentner, 1982; Bornstein et al., 2004). It is also suggested that the noun dominance is observed in early lexical acquisition than verbs (Borodiskey, 2001). Authors recommend that grammatical function words such as prepositions, pronouns, question words and quantifiers are very rare in early lexicon, however it starts to develop around two to three years (Bates et al., 1994; Caselli et al., 1995).

For Group III when compared with Group II significant difference were obtained for the following categories, category 1 (colours), category 2 (vegetables), category 3 (fruits), category 4 (animals), category 6 (body parts), category 7 (vehicles), category 9 (small house hold things & toys), category10 (house appliances), category 11 (outside things and places), category 13 (people), category 14 (action words). These findings are supported by Jones et al., (2020) have done a study on developing vocabulary checklist for young children in multilingual region, where he included 20 categories and scoring was determined as early, mid and late acquired. From this study we can conclude that the noun categories, verb categories are attained early in the development while time words, pronoun, quantifier, question, locations acquire late during development.

Similarly, Gentner, (1982); Bornstein et al., (2004) reported that nouns are acquired early compare to that of verbs. It is also suggested that the noun dominance is observed in early lexical acquisition than verbs (Borodiskey, 2001). It is also suggested that, grammatical function words such as prepositions, pronouns, question words and quantifiers are very

rare in early lexicon, however it starts to develop around two to three years (Bates et al., 1994; Caselli et al., 1995).

Bates (2000) concluded that there is noun bias observed with respect to productive lexicon such as animals, game routine and place. The receptive lexicon of the categories is observed as early as 16 months; however, expression was reported to be delayed. Development of colours was studied by Pitchford and Mullen (2010) where they reported that children between the age of two to three years respond better on five primary colours. Children by age four respond even better for complex colours without any error, however colours such as brown and grey are acquired only after five years of age (Johnson, 1977).

Significant differences were not obtained between Group III and Group IV. In contrast to the current findings, Nelson and Fivush (2004) reported that, by three years of age children can distinguish between past and future events, however spatial time concepts develop adult pattern between five to eight years of age.

Table 5
(P) Value comparison on forth Group with other Groups (Group IV with Group I, Group II, Group III)

	Age range		
	Group	Group	Group
Categories	I	II	III
Category 1	.000	0.001	1.000
Category 2	.000	0.001	1.000
Category 3	.000	.000	1.000
Category 4	.000	.000	0.659
Category 5	.000	0.002	1.000
Category 6	.000	.000	0.387
Category 7	.000	.000	1.000
Category 8	.000	.000	0.066
Category 9	.000	.000	0.693
Category 10	.000	.000	0.319
Category 11	.000	0.01	1.000
Category 12	.000	0.003	1.000

Category 13	.000	.000	1.000
Category 14	.000	.000	1.000
Category 15	.000	.000	0.449
Category 16	.000	.000	0.235
Category 17	.000	0.001	1.000
Category 18	.000	1.000	1.000
Category 19	.000	1.000	1.000
Category 20	.000	1.000	1.000

Note: p<0.05 – significant value.

Table 5 denotes statistical significance of Group IV with other age Groups. When comparing Group IV with Group I. The current finding is supported by the inference of Nation and Warring (1997), where they suggested that vocabulary increases as age increases. Similarly, Jones et al., (2020) have done a study on developing vocabulary checklist for young children in multilingual region, where he included 20 categories and scoring was determined as early, mid and late acquired. From this study we can conclude that the action words are attained early in the development while time words, pronoun, quantifier, question, locations acquire late during development.

Statistically significant difference was obtained for each category when compared between Group IV with Group I. Many studies supported the finding Gentner, (1982); Bornstein et al., (2004) found that nouns are acquired early compare to that of verbs. It is also suggested that the noun dominance is observed in early lexical acquisition than verbs (Borodiskey, 2001). The grammatical function words such as prepositions, pronouns, question words and quantifiers are very rare in early lexicon, however it starts to develop around two to three years (Bates et al., 1994; Caselli et al., 1995). The hierarchy of development was suggested by Brown, (1973); Laubscher and Light (2020), where nouns and action words develop early followed by adjectives and adverbs. It does not contain preposition, conjunctions articles or auxiliary verbs during early development. Similarly, with respect to the development of adjectives, Martin and Molfese, (1972) have observed that younger children tend to produce adjective orders that are less adult-like and as children get older, they attain adult pattern of adjectives. Dixon (1982) recommended the hierarchy of development for adjectives such as value, dimension, physical property, speed, color, human propensity, age. Bever (1970) also conducted a study to identify the age of acquisition of adjectives across two to five years of age and found that children around two to three years performed better on repeating unnatural adjective and stable adjective production by five years of age.

The concept of time is dependent on dimension of speed, distance and spatial orientation. All these dimensions are mastered only after eight years (Richards& Siegler, 1979; Richards, 1982; Matthews & Meck, 2016). The temporal representation starts as early as 18 to 24 months of age, where it

begins with the usage of past tense and at age two to three years children mainly relate to temporal concepts that are related to location or distance (Shirai & Andersen,1995; Shirai & Miyata, 2006; Nelson & Fivush, 2004). By three years children can distinguish between past and future events, however spatial time concepts develop between six to eight years (Nelson & Fivush, 2004). One of the significant categories is quantifiers which denote syntactically numerical logic events (Noveck, 2001). Children by three years of age begin to use quantifiers rather than numbers and children by age of five years start to use complex quantifiers that are relevant to context (Papafrago, 2003). Number of appropriate answers to question and asking question develops as age increases (Salamo et al., 2012). Children around three to four years uses variety of "wh" question and the development of "why" question is acquired only between the age of five to six years (Nicolosi, 2004).

Similarly significant difference between Group IV and Group II were obtained in the following categories, category 1 (colours), category 2 (vegetables), category 3 (fruits), category 4 (animals), category 5 (birds), category 6 (body parts), category 7 (vehicles), category 8 (food items), category 9 (small household things and toys), category 10 (house appliances), category 11 (outside things and rooms), category 13 (people), category 14 (action words), category 15 (words denoted time), category 16 (adjectives) and category 17 (pronouns). This finding was supported by Gentner, (1982); Bornstein et al., (2004) reported that nouns are acquired early compare to that of verbs. It is also suggested that the noun dominance is observed in early lexical acquisition than verbs (Borodiskey, 2001). Bates (2000) concluded that there is noun bias observed with respect to productive lexicon such as animals, game routine and place. The receptive lexicon of the categories is observed as early as 16 months; however, expression was reported to be delayed. It is also suggested that, grammatical function words such as prepositions, pronouns, question words and quantifiers are very rare in early lexicon, however it starts to develop around two to three years (Bates et al., 1994; Caselli et al., 1995).

Nelson and Fivush (2004) found that children by the age of three years can distinguish between past and future events, however spatial time concepts develop between six to eight years. With respect to questions, Nicolosi (2004) found that the children around three to four years uses variety of "wh" question and the development of "why" question is acquired only between the age of five to six years.

Significant differences were not obtained between Group IV and Group III. In contrast to the current findings, Nelson and Fivush (2004) reported that, by three years of age children can distinguish between past and future events, however spatial time concepts develop adult pattern between five to eight years of age.

4. Discussion and conclusion

Lexicon is the total set of word and word elements that carry meaning. The lexicon is the bridge between language and knowledge (Sowa, 2005). Lexeme is a set of related word forms. The study of meaning of words within language is referred to as lexical semantics. The lexicon contains set of link between signs and codes of semantic attributes (Osgood, 1980). In terms of speech production, a lexicon represents a list of conceptual condition to convey relevant message.

Vocabulary/Lexicon is considered as a critical element to acquire language. It is essential for communication, reading, writing and to form grammatically appropriate sentences (Nation, 2011). The need for developing vocabulary checklist is to avoid cultural bias, to estimate the child's current linguistic ability, its correlation with other concurrent measures of language development and to predict the cognitive ability. It is also important to assess the child's ability to develop literacy skills. Thus, the aim of the present study is to adapt and validate lexical inventory in preschool and primary school Tamil speaking children. The study included development and validation of the lexical inventory checklist, and administration of the checklist on 60 preschool and primary school Tamil speaking children.

The mean and standard deviation was calculated for all the categories between the Groups. The Statistical Package for Social Science (SPSS) version 21 was used for statistical analysis, all the variables were subjected to nonparametric test to estimate the significant difference between the Groups. From the study it can be concluded that there is a statistically significant difference ($p<0.05$) between the age Groups on all categories. Pair wise Comparison was estimated with the help of Dunn's pair wise tests which revealed,

i) Group I when compared with other age Groups, significant difference obtained between Group I and Group III; Group I and Group IV in all 20 categories, however significant differences between Group I and Group IV was observed only for category 15.

ii) Group II when compared with other age Groups significant difference were obtained between Group II and Group III in all categories except category 5, category 8, category 12, category 15, category 16, category 17, category 18, category 19 and category 20, similarly significant difference between Group II and Group IV were obtained in all the categories except category 12, category 18, category 19 and category 20.

iii) Group III when compared with Group IV significant difference were not observed in any of the category.

From the current study, it is inferred that vocabulary knowledge increases as age increases. It is also essential to track the developmental trend with the help of vocabulary checklist. Hence vocabulary checklist can be administered to track the development and academic skills.indings should be discussed here with reference to the findings in the related literature.

Limitation of the study

Gender effects could not be studied as the participants in the Group were not equal in the number. The developmental trend of word in each category were not analyzed. Varied grammatical categories were not included.

Future direction

To administer the vocabulary checklist on a large scale to estimate the sensitivity of the developed material. It can also be administered on a variety of clinical population. Gender effects can also be studied to estimate the difference on the age of acquisition between male and female.

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The effect of free play in preschoolers´ language improvement: a systematic review

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Abstract

The main purpose was twofold: systematically gather and analyze the existing research literature in order to synthesize and critically evaluate the available evidence to determine the extent to which free play interventions contribute to improving language skills in preschool-aged children, and provide recommendations for practitioners and policymakers regarding the potential benefits of incorporating free play interventions into early childhood education programs to support language development. A systematic review of relevant articles was carried out using two electronic databases until October 1, 2022. From 674 studies, 8 were included in the qualitative synthesis. Most studies were observational and video observation or recording-based. Free play resulted effective for language development. Self-talk resulted both particularly relevant to develop language skills and age-dependent. Teachers should consider free-play settings for fueling language improvements. For improving these results, teacher should consider self-selected activities than alone, free-play than structured play, and during complex non-verbal cooperation contexts.

Keywords: unstructured play; language; cognitive; communication; development

1. Introduction

Language development in early childhood is a complex and dynamic process that involves many different aspects of language, cognitive, and social development. Children's language skills during this period lay the foundation for later language development and academic success (Taylor & Boyer, 2020). Unfortunately, children who struggle with language and communication may have difficulty expressing their emotions and understanding the emotions of others, which can lead to frustration, inability to communicate needs, behavior problems and tendency to peer rejection (Hagen, 2018; Parsons et al., 2019). Likewise, young children who have difficulty engaging in social interactions and playing with peers may become isolated and withdrawn, leading to negative impacts on their social and emotional development (Parsons et al., 2019). Additionally, recent research has shown that play-based interventions that include a language component can be effective in improving language and communication skills in children with language delays or disorders (Kuhaneck et al., 2020). These interventions can also be beneficial for typically developing children who may benefit from additional language practice and support.

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In the context of language development, following the Vygotsky theory (Duncan & Tarulli, 2003; Nicolopoulou, 1993) proposed that language emerges through social interaction and is acquired through communicative exchanges with more knowledgeable others, such as parents, teachers, and peers. He also emphasized the importance of play in supporting children's language development, as it provides opportunities for children to engage in language-rich interactions with others and to practice using language in a meaningful context. Free play interventions that include a language component can be effective in improving not only play skills but also language and communication skills in children. Play-based interventions have been shown to be a useful tool for enhancing children's cognitive, social, and emotional development (Aras, 2016).

Developmentally appropriate programs in early childhood education often include a mix of structured and unstructured play activities that are carefully planned to promote learning and development across multiple domains, including language, social, emotional, and cognitive development (Kelly-Vance & Ryalls, 2020). These programs may also incorporate teacher-guided activities that promote learning and development, such as circle time, story time, and art activities. The goal of developmentally appropriate programs in early childhood education is to provide children with a safe, supportive environment that encourages exploration, experimentation, and learning through play (Ledford & Pustejovsky, 2023). Play is self-initiated and voluntary, intrinsically motivated and process-oriented where children focus on the activity itself, rather than the outcome or end result. Play is a critical component of children's development and learning. Research has shown that play promotes the development of a range of skills and abilities that cannot be taught through direct instruction alone (Stagnitti et al., 2016). These programs are designed to help children develop the skills and knowledge they need to succeed academically and socially as they grow and develop (Wasik & Hindman, 2023). By promoting play-based learning, developmentally appropriate programs in early childhood education can help children develop a love of learning that lasts a lifetime.

Language development during free play tasks in early childhood can be significant and beneficial for children. Play-based learning provides a meaningful context for language use and interaction, allowing children to practice and develop their language skills in a natural and engaging way (Brodin & Renblad, 2020). Play-based learning activities can expose children to a range of new vocabulary words and concepts, such as naming objects, describing actions, and identifying colors, shapes, and sizes (Bauminger-Zviely et al., 2020). In this context, these activities can help children become more aware of the features of language, such as sounds and syllables, and develop their phonological and phonemic awareness. Incorporating free play learning activities into early childhood education can have long-term benefits for children's language skills such us vocabulary acquisition (Yang et al., 2021), grammar development (Colliver et al., 2022), conversation skills (Yang et al., 2021), metalinguistic awareness (White et al., 2021) and pragmatic language skills (Hanish et al., 2022).

Language is clearly correlated with play (Conner et al., 2014). As children's language skills develop between the ages of 24 to 35 months, their

play also becomes more complex. At this age, children begin to engage in more sophisticated forms of play, such as associative play and cooperative play, which involve more interaction with other children and require greater levels of language skills (Brodin & Renblad, 2020). During associative play, children begin to interact more with each other, although they may not be playing the same game or using the same toys. They begin to share materials, take turns, and engage in simple conversations with each other. This type of play requires children to use language to communicate with their peers and negotiate the rules of the game (Jarvis et al., 2014). As children progress into cooperative play, they begin to work together to achieve a common goal.

The main objective was twofold, systematically gather and analyze the existing research literature in order to synthesize and critically evaluate the available evidence to determine the extent to which free play interventions contribute to improving language skills in preschool-aged children and provide recommendations for practitioners and policymakers regarding the potential benefits of incorporating free play interventions into early childhood education programs to support language development.

2. Methodology

2.1. Experimental Approach to the Problem

This systematic review was reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021) and guidelines for performing systematic reviews in sport sciences (Rico-González et al., 2022).

As information sources, systematic search of two databases (Web of Sciences and PubMed) was performed to identify articles published prior to October 1, 2022.

2.2. Search strategy

The PICO (Patient, Problem, or Population – Intervention or Exposure – Comparison, Control, or Comparator – Outcome[s]) design was used to provide an explicit statement of the question. The authors were not blinded to journal names or manuscript authors. In Web of Science the language filter was applied to English and Spanish. The following search terms were used: (preschool* OR kindergarten) AND ("physical education").

2.3. Eligibility criteria

The authors independently completed the search and compared results to ensure that the same articles were identified. Then, identifying information from the papers (title, authors, date, and database) was downloaded and transferred into an Excel spreadsheet (Microsoft Corporation, Redmond, WA, USA) and duplicates were removed. The remaining articles were independently screened for meeting inclusion and exclusion criteria (Table 1). Moreover, relevant articles not previously identified were also screened in an identical manner and further studies that complied with the inclusion-exclusion criteria were included and labeled as “included from external sources”.

Table 1
Inclusion/exclusion criteria

Item	Inclusion	Exclusion
Population	Preschool children	Non preschool children
Intervention or Exposure	Preschool children participating in physical education sessions with free-play activities	Children non participating in physical education classes
Comparator	-	-
Outcome[s]	Outcomes about language skills	Results that do not assess language skills
Other criteria	Peer reviewed, original, full-text studies written in English or Spanish.	Written in another language or non-peer reviewed original full text studies.

2.4. Data extraction

Data extraction was prepared using an Excel spreadsheet in accordance with the Cochrane Consumers and Communication Review Group's data extraction template (Group, 2016). The spreadsheet was used to assess inclusion and exclusion requirements for all selected studies. The process was independently conducted by the authors. Any disagreement regarding study eligibility was resolved in a discussion. Full text articles that were excluded from the analysis were recorded with reasons for exclusion. All records were stored in the spreadsheet.

2.5. Extracted information and variables of interest

A list of the articles included in the data sheet and qualitative synthesis is reported in Tables 3. The following information was extracted from each article: the aim of the study, characteristics of the sample (nº of children, nº of schools involved in the research, country, mean age, level and grade), group differences (in the case of randomized controlled trials), type of study, duration, the name of the test, variables evaluated, outcomes, and conclusions.

2.6. Assessment of study methodology

On the one hand, the methodological quality was assessed using methodological index for non-randomized studies (MINORS) (Slim et al., 2003). The MINORS scale is a list that contains 8 essential points and it is expanded to 12 points when the studies to be treated are comparative. In this case, it was assessed considering 9 items (out of 18 points) due to the non-possibility to applicate (NA) three of them. The score that each section receives can be from 0 to 2, depending on the quality obtained by each point. The MINORS checklist asks the following information (2 = High quality; 1= Medium quality; 0 = Low quality).

On the other hand, the Physiotherapy Evidence Database (PEDro) scale was used to assess the methodological quality of pre-test post-test studies with experimental (EXP) group and control (CON) groups randomly selected. The scale scores the internal study validity in a range of 0 (low

methodological quality) to 10 (high methodological quality). The score that each section receives can be from 0 ("no") to 1 ("yes"), depending on the quality obtained by each point. Ten items are measured in the scale.

3. Findings

3.1. Identification and selection of studies

A total of 674 original articles were initially retrieved, of which 172 were duplicates. Thus, a total of 502 unique articles were identified. After checking titles and abstracts, 118 articles were excluded because they not met inclusion criteria number five. The full text of the remaining 384 articles was then analyzed; 46 articles were excluded because they did not meet inclusion criteria number one, 269 articles were excluded because they did not meet inclusion criteria number two, and 61 articles were excluded because they did not meet exclusion criteria number four. Thus, a total of 8 articles met all the inclusion criteria and were included in the final qualitative synthesis (Figure 1).

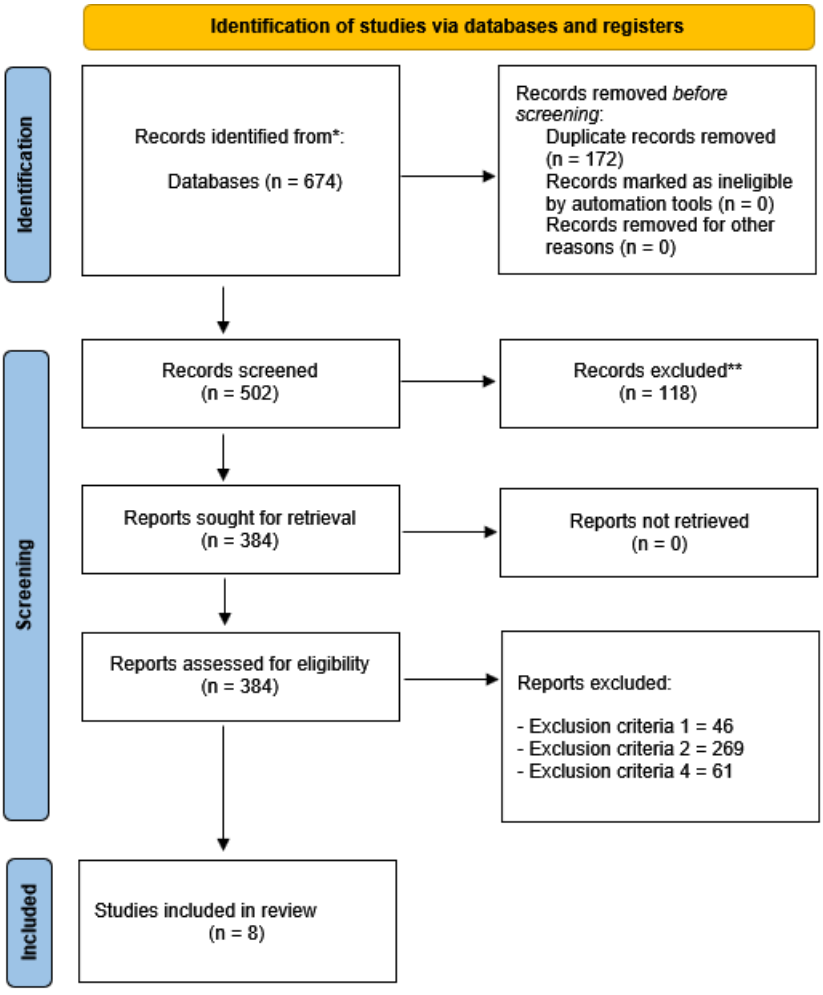

*Figure1.*Flow diagram of the study

3.2. Quality assessment

The quality assessment for this systematic review can be found in Table 2.

Table 2.
Methodological assessment of the included studies.

Reference	1	2	3	4	5	6	7	8	9	10	11	12	Score
Using MINORS Scale													
Hart & Risley (1974)	2	2	2	2	2	2	0	0	-	-	-	2	14/18
Winsler et al. (2000)	2	2	2	2	2	2	0	0	-	-	-	2	14/18
Fekonja et al. (2005)	2	2	2	2	2	2	0	0	-	-	-	2	14/18
Chen et al. (2009)	2	2	2	2	2	2	2	0	-	-	-	2	16/18
Piker (2013)	2	2	2	2	2	2	0	0	-	-	-	2	14/18
Vriens-van Hoogdalem et al. (2016)	2	2	2	2	2	2	0	0	-	-	-	2	14/18
Schwartz et al. (2021)	2	2	2	2	2	2	2	0	-	-	-	2	16/18
Using PEDro Scale													
Kirk et al. (2014)	1	1	1	0	0	0	1	1	1	1	-	-	7/10

Note: NA = non applicable. **The MINORS checklist** (2 = High quality; 1= Medium quality; 0 = Low quality)**:** Clearly defined objective (item 1); Inclusion of patients consecutively (item 2); Information collected retrospectively (item 3); Assessments adjusted to objective (item 4); Evaluations carried out in a neutral way (item 5); Follow-up phase consistent with the objective (item 6); Dropout rate during follow-up less than 5% (item 7); Prospective estimation of sample size (item 8); Adequate control group (item 9); Simultaneous groups (item 10); Homogeneous starting groups (item 11); and, appropriate statistical analysis (item 12). **The PEDro checklist** (0 = No; 1 = Yes)**:** subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received) (item 1); allocation was concealed (item 2); the groups were similar at baseline regarding the most important prognostic indicators (item 3); there was blinding of all subjects (item 4); there was blinding of all therapists who administered the therapy (item 5); there was blinding of all assessors who measured at least one key outcome (item 6)**;** measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups (item 7); all subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least one key outcome was analysed by "intention to treat" (item 8); the results of between-group statistical comparisons are reported for at least one key outcome (item 9)**;** the study provides both point measures and measures of variability for at least one key outcome (item 10).

3.3. Study characteristics

The characteristics of studies were extracted and clustered into Tables 3.

Reference	Aim	Sample	Intervention			Results			Highlights
			Group differences	Type of study	Duration	Test instrument	Variables	Results	
Hart & Risley (1974)	Ecologically investigating "incidental teaching" (viz., within-free play teaching) effects on language development in disadvantaged preschool children	Nº children: 12 Schools: 1 Country: USA (Mean age 4 yrs) Level: preschool Grade: n/a	EXP (n = 12)	Observational study	8 mos	Ecological observations	Used nouns, adjective-noun combinations and compound sentences count	Incidental teaching improves only children related language aspects but not their interactions with teachers or their play behavior	Incidental teaching is effective only in the phase of discovery of new play material
Winsler et al. (2000)	Ecologically investigating the contexts in which preschool children use self-talk and such contexts' age-related changes	Nº children: 28 Schools: 1 Country: USA (Mean age 51 mos) Level: preschool Grade: n/a	EXP (n = 28)	Observational study	10 weeks	Naturalistic observations	Self-talk use time-sampling	Children use self-talk more during self-selected activity when alone. Older children use self-talk more during sustained and focused goal-directed activity	Self-talk is used systematically in preschool children and older children use it more selectively than younger
Fekonja et al. (2005)	Ecologically investigating preschool children' language	Nº children: 60 Schools: 3 Country: Slovenia (Mean age 4.5 yrs) Level: preschool Grade: n/a	EXP (n = 60)	Observational study	n/a	Ecological audio-video recorded observations	Fraction of different language functions and utterances in the speech of the children	Children speak more, use more multi-word utterances, interrogative and negative clauses and use more often language's symbolic and regulatory function during free play than having breakfast and teacher-guided activity	At preschool, free play is an proper context for children' language development

Reference	Aim	Sample	Intervention			Results			Highlights
			Group differences	Type of study	Duration	Test instrument	Variables	Results	
Chen et al. (2009)	Comparing the habitual speaking pitch (frequency) featuring free play and structured speech activities of normally developing preschool children	Nº children: 10 Schools: 1 Country: USA (Mean age 55 mos) Level: preschool Grade: n/a	EXP (n = 10)	Observational study. Investigating to what extent preschoolers vary their vocal pitch among different speech environments	Three sessions	Throat microphone and voice analysis software	Pitch	Faster pitch during free play than during structured speech. No difference among different structured speech activities	Preschoolers' vocal usage more effortful during free play than during structured speech activities. Young children's voice should be evaluated during both free play and structured speech activities
Piker (2013)	Investigating how play among preschool-aged dual language children can foster English language learning	Nº children: 4 Schools: 1 Country: USA (Mean age 4 yrs) Level: preschool Grade: n/a	EXP (n = 4)	Observational study using an ethnographic approach	One academic year	Observation and video recording	Interactions of Spanish-speaking children with same-language and English-speaking peers	During play, Spanish-speaking children's oral English language supported or hindered	Play is an avenue for supporting English language learning at preschool
Kirk et al. (2014)	Investigating a 6-month, low cost, teacher-directed academic program taught using physical activity on free play physical activity and early literacy in preschool children	Nº children: 72 Schools: 2 Country: USA (Mean age 3.8 yrs) Level: preschool Grade: n/a	EXP (n = 51) Academic program taught using physical activity CON (n = 21) Regular	Two-group, quasi-experimental design	6 mos	Ecological observations. System for Observing Fitness Instruction Time Preschool Literacy Individual Growth and Development Indicators (Picture Naming, Rhyming and Alliteration). Child and Adolescent Trial	Correctly named pictures, correctly-identified rhymes and correctly identified alliterations count. Teacher perceptions of physical activity program implementation in the classroom	Free play physical activity significant increase and early literacy (Picture Naming and Alliteration) significant improvements vs. non-exercising control group	Academic lessons taught using physical activity improve physical activity and early literacy in preschoolers

Reference	Aim	Sample	Intervention			Results			Highlights
			Group differences	Type of study	Duration	Test instrument	Variables	Results	
			academic program			for Cardiovascular Health Physical Education Observation Form			
Vriens-van Hoogdalem et al. (2016)	Investigating the relationship of language ability and metacommunication to the complexity of cooperation in preschool children	Nº children: 24 Schools: 2 Country: The Netherlands (Mean age 61 mos) Level: preschool Grade: 1-2	EXP (n = 24)	Observational study. Free play and construction task	n/a	Video observations and language tests	Language ability and metacommunication (e.g., non-verbal cooperation)	In free play but not in construction task, high language ability related to more complex non-verbal cooperation	Role of language ability and metacommunication depends on the context of behavior
Schwartz et al. (2021)	Theorizing the role of free play as a social and language learning activity that stimulates a productive phase in second language (L2) progress in preschool (Arabic and Hebrew-speaker) children	Nº children: 8 Schools: 1 Country: Israel (Mean age 4 yrs) Level: preschool Grade: n/a	EXP (n = 8)	Observational study using an ethnographic approach	2 yrs	Video-recorded observations, interviews with teachers and field notes	L2 use count and characterization	Free play creates a fruitful language-conducive context for daring to use L2 (even with mistakes), peer language mediation, creative repetition, self-talk, focus on language form and corrective feedback for others' incorrect usage	Teachers need to consider planning for more opportunities for free play. Most of the children who show productive L2 skills during free play are Arabic speakers

4. Discussion

The main objective was twofold, systematically gather and analyze the existing research literature in order to synthesize and critically evaluate the available evidence to determine the extent to which free play interventions contribute to improving language skills in preschool-aged children and provide recommendations for practitioners and policymakers regarding the potential benefits of incorporating free play interventions into early childhood education programs to support language development.

Eight articles were found that have evaluated free play´s effects on language improvements (see Table 3). Between them, six studies analyzed the effects of free-play in children´s mother tongue. For example, Fekonja et al., (2005) divided 60 children from three preschools, and through audio-video recorded observations, analyzed different language functions and utterances in the speech. The results showed how children speak more, use more multi-word utterances, interrogative clauses and negative clauses. In addition, children use more often language´s symbolic and regulatory function during free play than during teacher-guided activity (Fekonja et al., 2005). In the same way, Kirk et al., (2014) evaluated a teacher-directed academic program taught using physical activity on free play and early literacy. The authors divided 72 children in the academic program (experimental group, EXP) and in a regular academic program (control group, CON). The results showed how free play physical activity significantly increases early literacy (picture naming and alliteration) during free play than non-exercising CON (Kirk et al., 2014). But, although a third study also found positive effects of free-play teaching in language-related aspects, the authors did not find more interactions with teachers or in their play behavior, declaring free-play teaching as effective only in the phase of discovery of new material (Hart & Risley, 1974). Therefore, free-play is a suitable methodology to enhance language skills in preschoolers.

Beyond, aiming to fueling these language improvements, three studies have showed the effect of free-play in self-talk (Winsler et al., 2000), pitch frequency (Chen et al., 2009), and overall language ability (Vriens-van Hoogdalem et al., 2016). First, Winsler et al., (2000) investigated the context in which preschool children use self-talk and such contexts´ age-related changes. The authors recruited 28 children and highlighted that children use self-talk more during self-selected activity when alone and that the older children use self-talk more during sustained and focused goal-directed activity (Winsler et al., 2000). Second, Chen et al., (2009) compared the habitual speaking pitch frequency during free-play and structured speech activities of normally developing preschool children. After three sessions, the results highlighted faster pitch during free-play than during structured speech, while no difference among different structured speech activities. Third, Vriens-van Hoogdalem et al., (2016) involved 24 children in an investigation through which the authors highlighted the influence of complex non-verbal cooperation during free-play, but not during construction task.

Interestingly, the effects of free-play remain when teaching a second language (Piker, 2013; Schwartz et al., 2021). First, Piker (2013) investigated how play among dual language preschoolers (Spanish speaking children) can foster English language learning. The results showed how free-play is an

avenue for supporting the second language (i.e. English language) learning at preschool. The second study, Schwartz et al., (2021) investigated the role of free play as a social and language learning activity that stimulates a productive phase in second language progress in eight preschool children. The results showed that the free play creates a fruitful language-conducive context for daring to use the second language (even with mistakes), peer language mediation, creative repetition, self-talk, focus on language form and corrective feedback for others' incorrect usage. Therefore, the authors declared that teachers should consider to plan more opportunities for free-play (Schwartz et al., 2021).

However, although free-play teaching showed positive effects in preschool-aged children both mother tongue and foreign language improvements, these results should be considered with caution cause the number of articles included in the present systematic review.

5. Conclusions and practical applications

Teachers should consider free-play settings for fueling language improvements. For improving these results, teacher should consider self-selected activities than alone, free-play than structured play, and during complex non-verbal cooperation contexts. However, caution is necessary to interpret these results due to the low number of articles found.

Conflict of interest/Competing interest

No conflict of interest has been declared.

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