

Abstracts

THURSDAY 13.30-15.00

SESSION A1 (Akademisalen) Chair: Heidi Hellstrand

Long-term effects of the home literacy environment on reading development: Familial risk for dyslexia as a moderator

Minna Torppa

This study aimed to gain better understanding of the associations between literacy activities at home and long-term language and literacy development. We extended the home literacy environment (HLE) model of Sénéchal and LeFevre (Child Development [2002], Vol. 73, pp. 445-460) by including repeated assessments of shared reading, oral language, and reading comprehension development, including examination of familial risk for dyslexia as a moderator, and following development over time from ages 2 to 15 years. Of the 198 Finnish participants, 106 have familial risk for dyslexia due to parental dyslexia. Our path models include development in vocabulary (25.5 years), emerging literacy (5.5 years), reading fluency (8 and 9 years), and reading comprehension (8, 9, and 15 years) as well as shared book reading with parents (2, 4, 5, 8, and 9 years), teaching literacy at home (4.5 years), and reading motivation (89 years). The results supported the HLE model in that teaching literacy at home predicted stronger emerging literacy skills, whereas shared book reading predicted vocabulary development and reading motivation. Both emerging literacy and vocabulary predicted reading development. Familial risk for dyslexia was a significant moderator regarding several paths; vocabulary, reading fluency, and shared reading were stronger predictors of reading comprehension among children with familial risk for dyslexia, whereas reading motivation was a stronger predictor of reading comprehension among adolescents with no familial risk. The findings underline the importance of shared reading and suggest a long-standing impact of shared reading on reading development both directly and through oral language development and reading motivation

Spel-Ett Läsflyt - an intervention study focusing on reading fluency

Nea Kronberg

Difficulties in reading fluency are found to be persistent among Finland Swedish children. In these cases, a lot of reading training as well as support for motivation is required to achieve fluency in reading. In grades 2 and 3 special education focuses largely on supporting students to read fluently. However, training methods for reading fluency for Finland Swedish children are poorly known. The aim of the study was to investigate how game-like training affects the development of reading fluency among poor readers in grade 2 and 3. The training was implemented in an app-based game-like format focused on Swedish morphology, particularly reading of affixes, as a means to train fluency in reading. The intervention study was carried out in the spring term of 2021 with 44 Finnish-Swedish special teachers and 277 low-performing readers in grades two and three in Finland-Swedish public primary schools. The study was realized as a controlled trial with pre-, post- and follow up-assessment for three groups. Two game versions were tried out in respective groups in comparison to a business-as-usual control group. The two game versions differed with regard to the role of tuition. An explicit game version comprised animations explaining the functions of the trained affixes, whereas an implicit game version lacked the tuition element. Both versions were completely parallel with regard to training assignments and game

progress. The training setup was based on repeated reading of words. Frequent affixes were practiced in combination with recurrent Swedish words pivotal for the age group. Students in the treatment groups played the game 45 times a week, during eight weeks. Specific instruments with linkage to the exercised content were designed in order to monitor progress in reading fluency during the intervention. In addition, standardized measuring instruments were also used for assessing reading fluency development. Reading measures were used at pre-, post- and follow-up testing. Students' motivation and self-efficacy for reading was parallelly monitored at pre- and post-testing. Background data was collected in order to study eventual moderators for intervention effects. Rapid Serial Naming was measured and data were collected with background questionnaires concerning childrens language background, familial risk for dyslexia and reading habits. The ongoing pandemic was a challenge for the implementation of the study. Despite some obstacles and an intensive pace, both students and special teachers appreciated both the game and this form of training. Likewise, they found participation in the study valuable and motivating. In the presentation we describe the theoretical background of the intervention study and the realization of the study. We describe the development of the training program and the measuring instruments for the study. Preliminary results are also presented.

From slow serial processing toward increasing awareness and adaptive use of strategies: Reading and calculation interventions in children with comorbid fluency problems

Jenni Pulkkinen

Reading and arithmetic become important tools for learning during the school years, but for some children these skills prove to remain slow and laborious. Fluency problems are not only the most common characteristics of reading and arithmetic difficulties, but they have also been shown to be relatively persistent, especially when they feature both academic areas. Consequently, fluency problems can become an excessive threshold for the development of higher-order skills, such as reading comprehension and problem solving. This presentation focuses on a quasi-experimental study, which aimed at investigating the effectiveness of two domain-specific intervention programs in children with comorbid reading and arithmetic fluency problems. Children participated either in reading or calculation intervention, or they received business-as-usual instruction in school. Both intervention programs shared the same principles of supporting children to proceed from slow serial processing strategies toward more efficient strategies and their flexible use. In total, 3365 children from second, third and fourth grades from 95 schools across Finland were screened for reading and arithmetic fluency problems with two computerized time-limited tasks. Children scoring below the 20th percentile in both tasks ($n = 366$) were further screened with individually administered reading and arithmetic fluency tasks. Eventually, 143 children from 48 schools formed the three intervention groups: Reading intervention group ($n = 51$), Calculation intervention group ($n = 45$), and Business-as-usual control group ($n = 47$). Both intervention programs consisted of thirteen 45-minute small group sessions and short recap activities between them. All assessments and intervention sessions were carried out by teachers during school days according to the instructions and manuals assembled by the research group. In this presentation, we will report domain-specific and cross-domain effects of the interventions by comparing pre- and post-assessment scores of the three groups. Preliminary analyses showed that children in the Calculation intervention group improved their single- and multi-digit addition fluency significantly more than the other two groups, suggesting that this type of small group support was beneficial for their

calculation skills. In terms of reading intervention, we did not observe intervention effects on group level in reading fluency tasks. In terms of cross-domain effects, our preliminary results indicate that reading or calculation training did not cause greater improvement in the skill that was not the focus of the intervention when compared to the results of the control group. Overall, the current findings provide novel insights into supporting basic academic skills in children with comorbid reading and arithmetic fluency problems, as well as information on pedagogical practices for teachers to use in school settings.

Developmental relationships between physical activity, fundamental motor and basic academic skills in children aged 7 to 9 years

Pirjo Aunio

Learning difficulties in basic academic skills can seriously harm an individual's future prospects as basic academic skills are important contributors to health, educational and career opportunities. Motor skills are related to physical activity, which has significant health benefits, and in addition, there exists evidence that motor and cognitive skills are developmentally related. The aim of this study was to study longitudinally how physical activity, motor and basic academic skills are developmentally related in students aged 7-10 years. The data used in the present study was drawn from an 8-year physical activity and dietary intervention study and a long-term follow-up study in a population sample of children from one city in Finland (Eloranta et al., 2011). Data from two time points were included in the analysis. Students completed measures of academic performance (i.e., arithmetic and reading skills), physical activity (measured by questionnaire and objectively through accelerometers) and, fundamental motor skills (shuttle run test) within both first and third grade. All students participating at least once across the measurement waves were included in the study, resulting in a total of 206 students. Our preliminary results revealed that fundamental motor skills (i.e, shuttle run test) in first grade (7 y.) significantly predicted later academic performance in third grade (9 y.), as students who performed the shuttle run task better, also performed better in school a few years later. No direct or indirect effects were found from physical activity to students' performance, although the indirect effect through students' motor skills was close to reaching significance ($r^2 = 0.04$, $p = 0.09$). However, a significant direct effect was detected from physical activity to students' fundamental motor skills. No significant effects were found from academic performance to physical activity or fundamental motor skills, indicating that initial academic performance in school does not affect students' physical activity or motor skills over time in the early school years. The effects of physical activity (or inactivity) and motor skills to children's academic learning is complex, highlighting the need for future studies.

THURSDAY 13.30-15.00

SESSION A2 (Auditorium Bruhn)

Chair: Anssi Vanhala

Individual Differences in Complex Word Problem-Solving Among Preschoolers

Terhi Vessonen

Word problem-solving skills are essential for later success in mathematics and in working-life. Especially complex word problems (i.e., contextualized problem tasks that may have multiple representations, a variety of mathematical domains and

multiple answers) have the ability to foster combining and applying mathematical knowledge into real-world situations. However, evidence concerning factors that contribute to word problem-solving skills among young children has been drawn based on cross-sectional and otherwise limited research. This study investigated which skills (i.e., numerical relational, counting, and expressive and receptive language skills, letter knowledge, and rapid automatized naming) contribute to individual differences in complex word problem-solving skills over one year among preschool-aged children ($N = 175$; 4-year-olds during time point 1). In the first time point, childrens numerical relational and counting skills were measured by a standardized Early Numeracy Test (numerical relational skills $\pm = .795$ and counting skills $\pm = .836$; Van Luit et al., 2006) and expressive and receptive language skills with items from a screening test called LENE (i.e., Preschool-aged childrens neurological evaluation; Valtonen & Mustonen, 2007; $\pm = .827$). Single items adopted from LUKIVA (Puolakanaho et al., 2011) were used to measure letter knowledge and rapid automatized naming (RAN) with objects. In the second time point complex word problem-solving skills were measured using a 21-item interview-based measure ($\pm = .817$) that was developed based on previous research on young childrens word problem-solving. All assessments were conducted individually in a separate room in the childrens own preschools during regular preschool hours. By means of confirmatory factor analysis, the complex word problem-solving measure was verified to represent arithmetic and non-arithmetic complex word problem-solving, $\chi^2 = 202.195$ (135), $p < .001$, CFI = .947, TLI = .940, and RMSEA = .060. By means of path analysis, counting, numerical relational and expressive and receptive language skills, letter knowledge, and rapid automatized naming were included as predictors of arithmetic and non-arithmetic complex word problem-solving one year later. The results revealed that numerical relational skills was the only significant predictor of arithmetic ($\beta^2 = .456$, $p < .001$) and non-arithmetic ($\beta^2 = .597$, $p < .001$) complex word problem-solving. As numerical relational skills are seen as a foundational skill among preschoolers' mathematical knowledge it is not surprising that these skills emerge as the most important predictor of problem-solving skills. Moreover, numerical relational skills are expected to encompass both numerical and language skills as numerical relational skills require linguistic understanding (e.g., understanding of more, less and bigger). The findings highlight the importance of fostering numerical relational skills in preschool-aged children in order to influence childrens complex word problem-solving skills.

Grade retention in Finland: Students skills across grades 1 to 4

Jenni Ruotsalainen

Compared to many other countries, grade retention is rare in Finland. Results of the benefits or harms of grade retention are not consistent internationally (e.g. Allen et al., 2009), and information considering the Finnish context is lacking to support decision making whether to retain students or not. The present study examines the skill development of students repeating first grade across four school years (in the springs of first grade [T1], second grade [T2], third grade [T3], and fourth grade [T4]). The data to the study is drawn from an extensive First Steps study (Lerkkanen et al., 2006), in which skill development of 2000 students have been followed since pre-primary education. Four groups were identified: 1) same-age retainers ($n = 34$) who were retained after T1, and thus on first grade for the second time at T2, and 2) same-grade retainers ($n = 32$), who were at first grade for the second time at T1, 3) a control group ($n = 34$) of promoted students was matched for the same-age retainers based on the students results in word recognition and arithmetic fluency at T1, gender, identified risk

for reading difficulties after pre-primary education, and parents education, and 4) other students ($n = 1828$). Students word recognition fluency, sentence level fluency, spelling, reading comprehension, and arithmetic fluency were assessed in each time point. Skills of identified three low-performing groups were compared with the skills of other students using the analysis of variance. Pairwise comparisons were conducted with Bonferroni correction. The preliminary results showed, first, that all three low-performing groups (groups 1, 2, and 3) showed lower performance than the other students in nearly all skills across all time points. However, the differences compared to average performance of students were not very large but ranged mainly between -0.6 and -1.5 standard deviations. Second, the reading and arithmetic fluency of same-age retainees and control students did not differ across time points. On the contrary, differences between the two groups (1 and 3) were found in spelling in T2 to T5, and in reading comprehension in T3 to T5. Third, as year older, the same-grade retainees (group 2) performed better than same-age retainees (group 1) in reading fluency in T1 to T3, but the differences disappeared in T4. Similarly, spelling and reading comprehension of same-grade retainees was better in the beginning than that of same-age retainees, but the groups did not differ in spelling in T5 and in reading comprehension in T3 and T5. No differences between the groups of retained students were found in arithmetic fluency. Similar to earlier studies, grade retention may give a short time advantage for students especially in reading. However, grade retention alone is not enough to boost student skill development, but sustained support is required.

Towards neighborhood schools: Developments in Finnish special support

Olli-Pekka Malinen

During the recent decades Finland has become increasingly committed to the principles of inclusive education both through national policies and international treaties such as the Salamanca Statement, and the UN Convention on the Rights of Persons of Disabilities. Currently, educational institutions from early childhood education to higher education are expected to respond to a wide spectrum of student diversity. This has required significant reforms in organization of comprehensive support for growth within the Finnish education system. One prominent example is the change in the government special education schools role from highly specialized boarding schools into resource and expertise centers that support inclusive education in neighborhood schools across the country. This presentation is based on a forthcoming book that is edited in collaboration between Valteri Center for Learning and Support, the University of Helsinki, and the University of Tampere. The authors of this presentation are responsible for editing the book, and authors of the individual book chapters are practitioners, administrators, and researchers invested in developing inclusive support for growth and learning. In the presentation we will give an overview of the book and discuss the following themes: - The role of government special education school and changes in their criteria of student selection and service provision - Finnish three-tiered support system and its national-, municipality-, and school-level implications - Moving towards more effective and structured support in early childhood education - Aiming for flexible and student-centered support through developing pedagogy and multidisciplinary collaboration. Towards the end of our presentation we will also invite the audience to reflect these themes and share ideas of how to move forward in building more inclusive system to support growth and learning in the Finnish educational institutions.

Effectiveness of the ENGAGE Intervention in Reducing Executive Function Difficulties in Finnish Preschoolers

Sini Teivaanmäki

Background Executive functions (EFs) are crucial for adaptive functioning in life and problems in their development should be addressed early to avoid accumulated difficulties. Yet, little is known about what kinds of interventions work best for preschoolers. **Objective** The aim of this study was to examine the efficacy of a novel play-based training program, Enhancing Neurobiological Gains with the Aid of Games and Exercise (ENGAGE), in reducing problem behaviors in Finnish preschoolers. **Method** 95 children who had parent-rated difficulties of hyperactivity and/or inattention were randomized to either the ENGAGE group (n= 55) or waitlist control group (n= 40). In the ENGAGE group families took part in the 8-week program during which they were instructed to play EF-training games at home every day at least 30 minutes. The program also included 6 group sessions and 2 individual phone calls for parents. Parent and day care teacher ratings of child behavior were obtained at pre- and post-intervention and 3-month follow up. **Results** At post-intervention, the ENGAGE group showed significantly greater decreases in problem behaviors than the control group across all parent-rated measures, with effect sizes mainly in the moderate category. In teacher ratings the differences between the ENGAGE and control groups were mainly nonsignificant. There was no significant change from post-intervention to follow up in either group based on parent and teacher ratings. **Conclusion** In line with previous findings (Healey & Healey, 2019), these results support the efficacy of ENGAGE and thus suggest it is a viable approach for families in need of low-threshold support. **References:** Healey, D., & Healey, M. (2019). Randomized Controlled Trial comparing the effectiveness of structured-play (ENGAGE) and behavior management (TRIPLE P) in reducing problem behaviors in preschoolers. *Scientific reports*, 9(1), 1-9.

FRIDAY 10.15-11.45

SESSION B1 (Akademisalen)

Chair: Anna Widlund

Dimensional comparison effects on math and Finnish self-concepts and value beliefs

Kukka-Maaria Polso

Achievement is known to predict self-perceptions of ability on not only the corresponding domain, but also other academic domains (Wigfield et al., 2020). Interpreted as results of dimensional comparison processes, such effects provide a valuable perspective to intraindividual motivational dynamics. The strongest (negative) effects have been found for subjects far apart in the continuum from mathematical to verbal domains (i.e., contrast effect), while weaker, positive effects have been detected for near subjects (i.e., assimilation effect) (Möller et al., 2020). There is also recent evidence for similar effects on intrinsic value and general task value (e.g., Jansen et al., 2020; von Keyserlingk et al., 2021) as well as attainment value and cost, whereas utility value seems less affected by such processes (Gaspard et al., 2018; Guo et al., 2017). Expanding the line of research into the Finnish context, this study explored how students' achievements in five different subjects are associated with their subject-specific self-concepts, task values, and perceived costs in math and Finnish. Data were gathered in autumn 2021 from a nationally representative sample of lower secondary students (N = 7745). Students' math and Finnish task values (intrinsic, attainment, utility) and costs (emotional, opportunity) were measured as well as their math, reading, and writing

self-concepts. Additionally, students reported their latest grades in math, Finnish, foreign language, history, and chemistry. For each subject-specific motivational factor, linear regression analyses were performed with grades as the explanatory variables. Replicating the findings from previous studies, the motivational factors were most strongly influenced by achievement in the corresponding subject, and both positive within-domain effects (assimilation effects) and negative between-domain effects (contrast effects) were found. As expected, evidence for dimensional comparison processes was found for self-concepts and intrinsic values as well as math emotional cost and attainment value, but not for, for example, utility values. On average, grades in the five subjects explained altogether 10-15% of the variation in motivational factors. The effects were stronger for math than Finnish, and up to 30% of the variation in math self-concept was affected by achievement. The strongest contrast effects were those of Finnish achievement on math-related factors, such as self-concept ($\beta = .150$, $p < .001$) and emotional cost ($\beta = .137$, $p < .001$). The strongest assimilation effects were those of foreign language and history achievements on reading self-concept ($\beta = .150$, $p < .001$ and $\beta = .144$, $p < .001$, respectively). Overall, the relations were meaningful, but most effects were small to modest in size. The findings contribute to our understanding of motivational development and offer interesting premises for further research. Future studies are needed on the longitudinal patterns of and individual differences in dimensional comparison processes.

University students' strivings and concerns during the pandemic: Perfectionistic tendencies as predictors of study stress and coping

Heta Tuominen

The rapid transition to remote teaching and learning due to the COVID-19 pandemic has affected university students' studies, as well as their well-being, in many ways. For example, there is evidence that university students' stress and depressive symptoms have increased due to this unprecedented situation. In this study, we investigated, first, university students' ($N = 737$) stress (challenge-hindrance), coping strategies, and recovery after the transition to remote teaching due to the COVID-19 pandemic in Spring 2020. As this new situation is likely to be reflected also in the level of goals students set for themselves and in the related self-evaluations and concerns, we assumed that examination of students' perfectionistic tendencies might provide added value. Thus, second, we examined how students' differential emphasis on perfectionistic strivings and concerns (i.e., perfectionistic profiles) link with stress, coping, and recovery. The results showed that, on average, students report more challenge stress than hindrance stress. The main stressors were feeling stuck, time pressures, and workload. The most typical coping strategies were acceptance, positive framing, and active coping, while seeking others' support was least typical. However, these somewhat varied in relation to the identified perfectionistic profiles. Using a person-oriented approach and latent profile analyses, we extracted four groups of university students with different perfectionistic profiles: ambitious (36 %), perfectionists (25 %), non-perfectionists (24 %), and concerned (15 %). Figure 1 illustrates the profiles. Regarding group differences, groups emphasising concerns – perfectionists and concerned – reported the most stress. Further, groups emphasising strivings – ambitious and perfectionists – favoured active coping and planning, while the others preferred acceptance or positive framing. In addition, perfectionists reported inferior recovery compared to the others. The identified profiles were in line with our expectations and prior studies. Interestingly, our findings suggest students' differential emphasis on their goals and related concerns to be linked with their

stress experiences, coping strategies, and strain recovery during the pandemic. It seems that particularly a combination of high strivings and concerns seems to threaten students' well-being. Key words: perfectionism, stress, coping strategies, remote learning, higher education, person-oriented approach

The Physical Activity During Preschool Hours and its Relation to Early Numeracy Performance: Individual Differences in the Context of Finnish Early Childhood Education **Natalia Stalchenko**

Early numeracy (EN) refers to young children's mathematical proficiency, including understanding and operating with quantities, number-word sequence, and number relation (Aunio & Niemivirta, 2010). EN skills are shown to strongly predict later mathematical competence (Jordan et al., 2007) and academic achievements (Duncan et al., 2007). Thus, it is important to support the development of children's EN skills. Physical activity (PA) is defined as any bodily movement that is produced by skeletal muscles and results in expenditure of energy (Caspersen et al., 1985). Several lines of evidence suggest the effectiveness of physical activity (PA) on children's cognitive outcomes (Zeng et al., 2017), including early numeracy (Becker et al., 2014). However, previous research has mainly focused on school-age children and cross-sectional data (Donnelly et al., 2016), while research in early ages is scarce. No previous studies have used intensive longitudinal sensor data to understand dynamics in young children's physical activity behaviour and EN performance, emphasizing relevance and value of the current research. *Objectives.* The current study investigates the relationship between PA during preschool hours and EN performance in children aged 4–5 years old. More specifically, the following research questions are addressed: 1) How are PA intensity levels (light PA, moderate PA, vigorous PA), sedentary time, and EN performance related? 2) What kind of profiles regarding PA levels and EN performance can be identified among preschoolers? *Methods.* The sample consisted of children ($N = 96$, $M_{age} = 4.6$) attending early childhood education centres in Helsinki, Finland. PA was measured during five consecutive preschool days using accelerometers (Actigraph wGT3X-BT), while EN performance was assessed using the Early Numeracy Test (Van Luit et al., 2006). The data is analysed using quantitative research analysis. Correlation matrix was performed to reveal relation between the variables of interest. Latent profile analysis (LPA) was used to identify children's profiles according to their PA data and EN test scores. *Results.* Spearman correlation analysis revealed no significant correlation between EN scores and PA in preschool in children of ages 4-5. LPA identified three profiles of children with high, medium, and low PA, whereas EN performance did not significantly differ among the profiles. *Conclusion.* The results of the current study are in line with previous research (Becker et al., 2014), suggesting a non-linear and indirect relation between PA and EN. Further research with larger sample data is needed to examine how variation in PA behaviour is related to EN performance in preschool.

The effects of motor skill and physical activity interventions on cognitive and academic skills in children with special educational needs: A systematic review

Pinja Jylänki

Children's fundamental motor skills, cognitive skills, and academic skills have been found to be developmentally related in preschoolers (Diamond 2000). In recent decades, studies examining the effects of fundamental motor skills and physical activity interventions on cognitive skills have increased rapidly (Pesce et al., 2021). A recent systematic review demonstrated the positive effects of fundamental motor skills and physical activity interventions on preschoolers' cognitive and academic skills in typically developing children

(Jylänki et al., 2022). However, the quality of the studies as well as the effects of fundamental motor skills and physical activity interventions on children with special educational needs have not been previously reviewed. Considering that children with special educational needs are at risk for developing more severe problems in their academic skills later on, it is highly important to investigate what types of interventions seem to be most effective for supporting children's cognitive and academic skills at an early age. Systematically reviewing such literature might be particularly important, as the majority of previous intervention studies in typically developing children have shown rather weak quality (Jylänki et al., 2022). Thus, this systematic review aimed to investigate the methodological quality and the effects of fundamental motor skills and physical activity interventions on cognitive and academic skills in 3- to 7-year-old children with special educational needs. The review was reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) statement. A literature search was carried out in April 2020 (updated in January 2022) using seven electronic databases including ERIC, Scopus, Web of Science, PsycINFO, CINAHL, PubMed & SPORTDiscus. The methodological quality of the studies was assessed with the Effective Public Health Practice Project (EPHPP) Quality Assessment Tool. A total of 22 studies met the inclusion criteria, representing children with learning difficulties ($n = 7$; e.g., high risk of ADHD), learning disabilities ($n = 5$; e.g., autism spectrum disorder), physical disabilities ($n = 2$; e.g., cerebral palsy), and at risk for learning difficulties due to family background ($n = 8$; e.g., low socioeconomic status). According to preliminary analyses, 17 of the 22 studies (77%) demonstrated significant effects of the intervention on children's cognitive and academic skills. Two of the included 22 studies displayed a strong methodological quality, while 19 were considered methodologically weak. The results of Cohen's d effect size calculations and post-hoc power analyses will be presented at the upcoming conference.

FRIDAY 10.15-11.45

SESSION B2 (Auditorium Bruhn)

Chair: Terhi Vessonen

Longitudinal associations of motor skills, executive functions, and early numeracy in preschoolers

Anssi Vanhala

Early numeracy is an important predictor for later academic performance (Duncan et al., 2007). Gaps in early numeracy have been observed already in preschool age children (Anders et al., 2012) and those with low performance have been shown to remain low-performing throughout their primary school years (Aubrey et al., 2006). Executive functions have been identified important for the development of early numeracy (Schmitt et al., 2017). Therefore, it is vital to understand different determinants of early numeracy and executive functions, especially in low-performers, to support the development of these important skills. Fundamental motor skills have shown to predict later executive functions in preschoolers (Niederer et al., 2011). Executive functions have been found to mediate the association between fundamental motor skills (Syväoja, 2021) and mathematical skills in school-aged children. We examined how fundamental motor skills predicts executive functions and early numeracy over one year, and whether executive functions mediate this association in preschoolers. Data were collected in the ongoing research project where 281 children ($Mage = 4.3$, $SD = 0.6$) were followed for one year at two time points. Fundamental motor skills

(locomotor, object control and stability skills), executive functions (inhibition, switching and working memory/updating) and early numeracy (relational and counting skills) were measured using age-appropriate tests. Our preliminary analysis showed that better locomotor and stability skills at the baseline positively correlated with higher scores in working memory task ($r = .240, p < .001$ & $r = .182, p < .05$) and early numeracy ($r = .140, p < .05$ & $r = .223, p < .01$) in one year later, while better object control skills positively correlated only with working memory ($r = .138, p < .05$). Our findings suggests that practicing fundamental motor skills might be beneficial for working memory and early numeracy skills in preschoolers and possible targets for interventions. In the OPTUP2022-conference, we will present our results also focusing on children with low performance in early numeracy.

Motor skills modified the effects of physically active math lessons on children's math anxiety and enjoyment

Heidi Syväoja

Introduction: Children's cognitive and academic performance, especially math performance, benefits from physical activity. These findings have encouraged the idea to implement physically active learning, where physical activity is integrated into learning objectives in academic school subjects, and other physically active classroom practices in a school setting. However, it is not known what type, time and frequency of physically active practices are the most appropriate from the perspective of learning. Furthermore, more high-quality studies examining the effects of physically active learning and physically active breaks in an authentic learning environment are needed. We studied the effects of physically active math lessons on children's math performance and math-related affective factors. **Methods:** A total of 22 volunteered third-grade teachers and their pupils with signed consent ($N=397$, mean age: 9.3 years, 51% female) from 13 schools in Central Finland participated in a 5-month, teacher-led, multi-arm, cluster-randomized controlled trial. The intervention included three groups: Group 1 (20 minutes of physical activity integrated into math tasks in each 45 min math lesson), Group 2 (two five-minute physically active breaks in each 45 min math lesson) and Group 3 (traditional teaching). Before and after the intervention, curriculum-based math performance was assessed with a custom-made test battery. Math enjoyment, math self-perceptions and math anxiety were measured with a self-reported questionnaire. The individual-level intervention effects were tested via covariate-adjusted linear mixed-effect models with school classes serving as random effects. **Results:** Changes in math performance or math self-perceptions did not differ between the intervention groups. Math anxiety in learning situations increased in Group 1 (effect 0.20, 95%CI = 0.01–0.40); there was no change in the other groups. Subgroup analyses suggested that math anxiety increased in Group 1 among pupils in the two lowest tertiles of motor skills; it decreased in the highest-third tertile. Math enjoyment decreased in Group 2 among pupils in the lowest-third motor skill tertile. **Conclusion:** Physically active math lessons did not affect math performance or math self-perceptions. However, they had divergent effects on math anxiety and math enjoyment depending on the children's motor skills level. When implementing physically active learning or other physically active classroom practices, children's motor skills should be considered, and physically active tasks should differ accordingly. It is essential to provide extra support, tools and training to teachers to identify children with different motor skill levels and differentiate tasks in physically active learning, especially from a motor learning perspective.

Math anxiety, arithmetic fluency and number processing: Gender and grade level differences

Johan Korhonen

The negative relationship between math anxiety (MA) and math performance is well established (Namkung et al., 2019). There is also some evidence that number processing and MA are related (Maloney et al., 2011). One view is that impaired number processing increases negative feelings about math while other studies have found number processing to mediate the relationship between MA and performance. Finally, some studies have not found any relationship between number processing and MA. MA also seem to be more common in older students compared to younger students and in girls compared to boys. However, longitudinal studies with elementary school students have usually found a stable or even decreasing trend in MA while studies with older students have found a stable or increasing trend in MA. Among older students, girls seem to experience more MA (Lau et al., 2022) while the results are less clear among younger students. Thus, to advance the current knowledge base, the aim of the current study was to investigate the relationship between MA and both arithmetic fluency and number processing across grades 3 to 9. We set the following research questions: (1)How is MA related to (a) arithmetic fluency and (b) number processing across grades 3 to 9? (2)Are there grade level differences in MA? (3)Are there gender differences in MA? (4)Is there an interaction effect grade level x gender on MA? Participants and procedure. The sample consisted of 7,320 students in grades 3 to 9 from Western Finland. The teachers conducted the computerized measures with their students during ordinary lessons. The students participated anonymously and no personal information other than their gender and grade level was collected. Measures. MA was measured with an adaptation of the modified version of the Abbreviated Math Anxiety Scale (mAMAS) (Carey et al., 2017). The scale consisted of 12 items measuring anxiety (e.g., How nervous do you feel when taking a math test) in Learning, Evaluation and Social situations in math on a five-point Likert type scale ranging from excited (0) to very anxious (4) supported by smileys. The original mAMAS included items measuring Learning and Evaluation MA and this version also included items measuring Social MA. The internal consistency for the whole scale was excellent, $\alpha = .91$. *Arithmetic Fluency and Number Processing* was measured with the digital Functional Numeracy Assessment – Dyscalculia Battery (FUNA-DB) (Räsänen et al., 2021). The scale consists of six tasks measuring number processing (NP) and arithmetic fluency (AF): number comparison (NP), digit-dot matching (NP), number series (AF), single-digit addition (AF), single-digit subtraction (AF) and calculation fluency (AF). The teachers were given word-by-word instructions on how to conduct the assessments. After login the pupils were able to proceed in their own speed with the tasks without further instructions from the teacher or other interruptions. Each task started with instructions and had a practice task with 4–5 practice items before that actual task. The preliminary analyses were conducted with the number comparison task (NP) and the calculation fluency task (AF). Overall, the associations were stronger between MA and arithmetic fluency than between MA and number processing. To answer **RQ2-RQ4** a two-way ANOVA was specified with MA as the dependent variable and grade level and gender as independent variables. There was a significant main effect of grade level indicating that older students reported higher levels of MA, $F(6, 7306) = 69.23, p < .001, \eta_p^2 = .054$ (**RQ2**). Overall, girls reported higher levels of math anxiety compared to boys, $F(1, 7306) = 424.14, p < .001, \eta_p^2 = .055$ (**RQ3**). Finally, we found a small grade level x gender interaction on MA, $F(6, 7306)$

= 6.00, $p < .001$, $\eta_p^2 = .005$ (**RQ4**). The gender difference in math anxiety seem to increase as a function of grade level.

Struggling readers take the stage - Readers theater in special education

Miia Ronimus

Readers' theater (RT) is a drama-based approach to practicing oral reading skills. In RT, students are provided with a script which is first thoroughly practiced and then read aloud with expression to an audience. Thus, RT provides a meaningful context for repeated oral reading, which is known to be an effective way to improve reading fluency. Previous research on RT has mostly focused on classroom-level programs where the teacher models the reading of the script, after which the students practice reading the text alone or in a group before performing it to their classmates. There is little previous research on the applicability of RT in special education context or its effects on student motivation. In the ReadDrama project, funded by the Academy of Finland, RT was adapted to special education with heavy emphasis on drama pedagogy. A play called "Wizard Contest" (in Finnish "Velhokisat"), designed for a small group of five students, was prepared for the adapted RT program. Various playful acting exercises were included in the program to create a warm and accepting atmosphere for learning, as students with reading difficulties often have low confidence in their reading skills and may feel anxious about reading aloud to an audience. The effectiveness of two versions of the RT program was studied with a randomized controlled trial involving dysfluent readers from Grades 3 and 4. In one program (RT Goal), the students prepared to perform the Wizard Contest play for their classmates at the end of the program ($n = 50$), while another program (RT Practice) focused on practicing the play without this goal ($n = 49$). A group of dysfluent readers receiving traditional oral reading intervention (Control group; $n = 59$) and a group of typically reading classroom peers (Mainstream group; $n = 159$) served as controls. The results indicated that both RT groups and the Control group developed faster than the Mainstream group in oral reading speed during the intervention period. RT Goal participants showed a temporary reduction in reading errors relative to other study groups, and reported higher engagement in RT as well as reduced anxiety towards reading aloud. RT had no effects on silent reading skills or reading self-efficacy. In conclusion, RT seems to be effective in supporting the development of oral reading skill in the special education context. In particular, the goal to perform for an audience seems to support courage and skill in reading aloud in public. However, more frequent practice and continuous support may be needed for obtaining higher gains and maintaining progress in reading fluency.

FRIDAY 12.30-14.00

SESSION C1 (Akademisalen)

Chair: Pirjo Aunio

Intergenerational transmission of dyslexia: How do different identification methods of parental difficulties influence the conclusions regarding children's risk for dyslexia?

Daria Khanolainen

Because dyslexia is a heritable neurodevelopmental disorder, studying how it is passed down within families is essential. By investigating children whose parents have dyslexia, family risk (FR) studies are expanding our understanding of the intergenerational transmission of dyslexia. These studies, however, vary in their identification of FR, and how the use of different identification methods influences research findings and conclusions is yet to be

systematically investigated. This study aims to evaluate the association between two FR identification methods—parental self-reports and formal skill assessments—and their unique contributions in the prediction of children’s reading. The study employed two datasets: a prospective FR sample (half of the parents in the sample had dyslexia and the remaining half did not) and an unselected sample. Parental self-reports and formal skill assessments correlated strongly (.60) in the prospective FR sample and moderately (.42) in the unselected sample. Moreover, both FR identification methods were almost equally predictive of children’s reading (explaining 5%–9% of the variance at different time points) in the prospective FR sample only. In the prediction of the children’s skills, the two methods complemented each other only for some of the measures. At the same time, in the unselected sample, parental skills were not predictive of children’s reading, whereas self-reports were. The two FR identification methods seem to have equally high predictive power when the variability in parental data is high. However, they lose their predictive power when either the lower or higher end of the parental reading distribution is underrepresented.

A school-based intervention on attention and executive functions: a case series pilot study **Henrik Husberg**

The purpose of this study was to examine the effect of a school-based behavioural and skills training intervention for children with attention and executive function (EF) difficulties, combined with a collaborative consultation model for classroom teachers. Because transfer of skills between settings can be a challenge additional support for the classroom teacher should improve the effectiveness of any intervention. School staff also need immediate feedback on the effectiveness of the provided support in order to adjust accordingly (DuPaul et al., 2011). In this study, children were provided with a small-group intervention that combines behavioural and cognitive methods, and has previously been found effective in improving children’s cognitive control. For this study, the classroom teachers also participated in three systematic collaborative consultation sessions with the intervention providers. The aim was to investigate the immediacy and trend of any intervention effect and to test the usability of an intensive repeated measures tool to evaluate the effects. Data were collected during two school years at four schools. Four children ages 8-10 participated in the first cohort, on which the preliminary results in this abstract are based. Seven more are enrolled in ongoing data collection. Inclusion criteria for participants were symptoms of inattention and/or executive functions deficits to such a degree that it negatively affects school routines and learning situations. Intervention providers were school personnel trained in implementing the intervention. Intervention providers and classroom teachers participated in one training session, and three consultations at each school. Children’s behaviour was assessed using Direct Behaviour Rating Scales (DBR) targeting academic engagement (AE), disruptive behaviour (DB), and respectful behaviour (RB) (Chafouleas, 2011). Pre- and post-measurements were also collected using a teacher evaluation of children’s difficulties with attention and EF (ATTEX; Klenberg et al., 2010). Repeated and frequent measures, i.e. a single-subject AB study designs, of the progress of the same subject over time were undertaken during a baseline phase and an intervention phase. In order to assess changes in level and trend, data was analysed using both visual analysis and calculations of phase contrasts and within phase trends using Tau-U (Brossart et al., 2014). The visual analysis did not show clear improvement on any of the scales, however the Tau-U omnibus effect size estimate suggested that statistically significant improvements in behaviour were obtained overall for DB (Tau = -.40, $p < .05$). No improvement was detected in AE or RB. In the ATTEX teacher evaluation, all

subjects showed decreases of difficulties from pre- to post-measurements (- 26 % in mean problem score). The pre- and post- measurements using the ATTEX-scale showed a quite large decrease in difficulties overall, however the DBR-scale showed only modest improvement in DB. Modifying the descriptions to better suit the targeted behaviours might make the scale more sensitive to detect improvements in EF. Due to the nature of the data in the first cohort, we were not able to separately study the effect of the collaborative consultation, but a stricter phasing of the data collection in the second cohort should make this possible.

In search of means to help learners to reach the goal of reading/ Lukiongelmien voittamisen haasteet maailmalla 2022. Tiiviste 30-vuotisen tutkimuksen ydinhavainnoista.

Heikki Lyytinen

Ekapeli and its versions defined to help children outside Finland (GraphoGame, see GraphoLearn, info) has now supported acquisition of the basic reading skill of millions of children especially in Africa, US and even in China. But ability to decode or spell written language is not enough for reaching the goal of reading, skills covering full literacy, which are reflected in the results of PISA. For this purpose, learners had to get training of reading comprehension skills. In fact, today less than 5 percent of children have difficulties in reaching the basic reading skill but more than 10% of adults face problems associated with reading comprehension. Thus, there is a need of Tokapeli (Comprehension Game, CG). It is now ready for research and has shown promising results not only in supporting children to acquire skills needed for comprehending written knowledge but also for learning to approach text with appropriate critics – a most needed skill today. As an additional result it instructs children to learn their schoolbooks because all training of the CG is proceeding in the context of their school learning, more specifically acquiring the key content of their schoolbooks. This presentation summarizes the goals and means of the CG as well as the present status of empirical validation of its efficiency as a tool which may be helpful for a number of different purposes which will be described with examples including demonstrations of the game. It is noteworthy that the CG can be implemented to be used in any language and help people of all ages - if they only have the basic reading skill which e.g. African children can acquire by using GraphoGame implemented to work in their own or second language.

FRIDAY 12.30-14.00

SESSION C2 (Auditorium Bruhn)

Chair: Johan Korhonen

Arithmetic Fluency and Basic Number Skills in Identifying Students at Risk for Mathematical Learning Disabilities

Heidi Hellstrand

Previous research on numerical skills has emphasized arithmetical fluency and basic number skills as key aspects in the foundation for later mathematical learning (Li et al., 2018). Arithmetic fluency (e.g., speed and accuracy in simple addition and subtraction) has commonly been used as a measurement for identifying children at risk for mathematical learning disabilities (MLD). Basic number skills (e.g., non-symbolic and symbolic number comparison) is pointed out as key component in mathematical learning and suggested to be used in measures identifying students at risk for MLD (Schneider et al., 2016). However, its ability to differentiate students with and without MLD in different age groups is not yet clear.

This study investigated the relationship between arithmetic fluency and basic number skills in identifying students at risk for MLD, more precisely if the students' performances in the basic number skills tasks could be used to classify the students to low and not-low performers based on their performances in the arithmetic fluency tasks. We conducted a cross-sectional study including 18,405 students (Grade 3: $n = 5,622$; Grade 4: $n = 4,550$; Grade 5: $n = 1,661$; Grade 6: $n = 1,552$; Grade 7: $n = 3,839$; Grade 8: $n = 818$; Grade 9: $n = 363$), from both Finnish ($n = 16,814$) and Swedish ($n = 1,591$) speaking schools. Students' basic numerical skills were assessed with a computerized, online dyscalculia test battery FUNA-DB aimed for screening MLD (Räsänen et al., 2021). First, we verified the two-dimensional structure of the FUNA-DB. Second, we secured that the two-dimensional structure was invariant across language groups, gender, and grade levels. Third, we investigated if the students' performances in the basic number skills tasks could be used to classify the students to low and not-low performers based on their performances in the arithmetic fluency tasks and whether the classification ability of basic number skills differed between the grade groups. Confirmatory factor analysis supported a two-factor structure of the test battery, with basic number skills and arithmetic fluency as the two factors ($\chi^2(8) = 1242.041$, $p < .001$; CFI = .985; TLI = .972; RMSEA = .092). The two-factor structure was invariant across language groups, age groups and grade levels. Receiver operating characteristics (ROC) curve analysis and the area under the curve (AUC) values were utilized to examine the specificity and sensitivity of the test battery. The ROC curve and the AUC values indicated that basic number skills are fair classifier of low performers in arithmetic fluency in all the grade levels (Figure 1).

Third graders profiles of math performance and emotions

Riikka Mononen

Students experience different emotions while learning math, and often positive emotions (e.g., enjoyment) are associated with better performance and negative emotions (e.g., anxiety and boredom) with lower performance. We know still rather little how these achievement emotions are experienced among primary school aged students and linked with their math performance. This study investigated what kind profiles of math performance and emotions (i.e., anxiety, enjoyment, and boredom) can be found among Norwegian third graders ($n = 220$, Mage = 8.3 y.), and further, if there are gender differences in different profiles. Students completed the Achievement Emotions Questionnaire-Elementary School questionnaire (AEQ-ES) and did tests measuring their addition and subtraction fluency (Regnefaktaprøven) and word problem solving (NMART) skills. By means of two-step cluster analysis, we found four different profiles (see Figure 1): 1) low-performance, high math anxiety and boredom (18.2%), 2) average performance, low enjoyment and high boredom (25.9%), 3) average performance, high enjoyment and low boredom (45.9%), and 4) high performance and high enjoyment (10.0%). This grouping was confirmed with ANOVA ($F[3,216] = 87.659 < .001$). Chi-squared test showed a statistically significant difference between boys and girls in the profiles ($\chi^2[3] = 11.33$, $p = .010$). Girls were shown to be slightly overrepresented, and boys underrepresented in group 3, but reaching only close to statistical significance (stand. residuals = 1.8 and -1.7, respectively). In sum, the majority of third graders (55.9%) were characterized with average or high math performance and enjoying their math learning. Every fourth student was showing less enjoyment and more boredom in their math learning compared to their peers, although their math performance was still on average level. For this group of students, teaching should focus on providing them with more interesting and challenging math activities, in order to increase their enjoyment and decrease boredom.

The most worrying, and challenging profile from the teaching point of view, was group 1, which showed both low performance and negative emotions towards math. This was also the only profile showing increased math anxiety. These students would need intensified intervention for their learning of basic math skills, and getting more positive experiences in math learning situations, might consequently boost their emotions towards enjoyment in math.