Università degli Studi di Padova

ECIDD
European Conference on Psychological Theory and Research
On Intellectual and Developmental Disabilities

DPSS
Dipartimento di
Psicologia dello Sviluppo
e della Socializzazione

12th European Conference on psychological theory and research on Intellectual and Developmental Disabilities

Silvia Lanfranchi (Ed)

Abstracts

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PADOVA CONVENTION & VISITORS BUREAU

Welcome to Padova!

We are very pleased to welcome you to the 12th European Conference on psychological theory and research on Intellectual and Developmental Disabilities, ECIDD-2018, taking place at the Department of Developmental Psychology and Socialization, University of Padova (Italy) from Thursday, June 28, until Saturday, June 30, 2018.

ECIDD was first established in 1996 in Aix-en-Provence (France) under the name PTRMR (Psychological Theory and Research on Mental Retardation). The main themes of this conference, that is held every 2 years, are psychological aspects of intellectual and related developmental disabilities. This conference offers a forum for the exchange of findings in basic and applied research on intellectual and developmental disabilities and aims to promote collaboration among researchers in this field.

The meeting will include individual paper sessions, two symposia and a poster session. Each day, the conference will begin with a keynote address. On Thursday, Herbert Roeyers, from the University of Ghent (Belgium), will address the issue of the early detection of autism spectrum disorder. On Friday Deborah Fidler, from the University of Colorado (USA), will talk about executive functions and goal-directed behavior in children with Down syndrome. On Saturday, Emily Farran, from the University College of London (UK), will talk about navigation and spatial domain in neurodevelopmental disorders.

We hope this conference will be an intellectually exciting and enriching experience, as well as a pleasant social event.

Silvia Lanfranchi

DPSS – Department of Developmental Psychology and Socialization,

University of Padova

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Keynote 1

Early detection of autism spectrum disorder: approaches, pitfalls and benefits

Herbert Roeyers

(University of Ghent)

Autism spectrum disorder (ASD) is a serious lifelong neurodevelopmental disorder that impairs a person's ability to communicate and interact with others. It also includes restricted and repetitive interests, activities and behaviours. ASD symptoms frequently present in the first two years of life, but often children are not diagnosed until four years or later. Over the past two decades there has been a growing interest in early detection of ASD, not only from the scientific world but also from professional associations and public health systems all across Europe. Early detection may result in a faster access to a wider range of resources and services, such as early intervention programmes. We will give an overview of the different screening procedures and discuss their advantages and disadvantages. It becomes increasingly clear that a multi-stage approach in early detection is most promising because it takes into account the inherent problem pertaining to age and pattern of symptom onset and intensity, as they may vary from case to case.

Prospective longitudinal studies with infants at high risk of developing ASD may be very informative to further improve the quality of early detection programmes. In the second part of the presentation we will describe recent progress in 'high-risk infants' research in ASD, with special reference to the Ghent baby study, which includes a cohort of siblings (younger brothers and sisters of children with an ASD diagnosis) and a cohort of preterm-born infants. Findings that will be highlighted include the prevalence of ASD in preterm-born children, variations in early trajectories of ASD and the association between contextual factors and later development. Implications for early detection and diagnosis as well as for early intervention will be formulated.

Session 1

Autism

Visuospatial abilities and processing styles in autism spectrum disorders with and without a perceptual reasoning peak

Ramona Cardillo, Silvia Lanfranchi, Irene C. Mammarella

(Department of Developmental Psychology and Socialization, University of Padova, Padova, Italy)

ramona.cardillo@gmail.com

Aims

The present study aimed to investigate different domains of visuospatial skills and to analyse the role of global vs local processing in individuals with ASD, taking their cognitive abilities into account and comparing them with matched typically developing (TD) individuals. The assessment focused on visuospatial processing speed, visuo-perceptual, visuo-constructive abilities and visuospatial memory. The paradigm of the BDT was used to select tasks from the literature (Caron et al., 2006), or devise new tasks ad hoc for the study.

Our objective was to 1) analyze strengths and weaknesses in the visuospatial profile of each ASD group, considering the role of their PRI level; 2) investigate whether local/global processing differently affects each visuospatial domain.
We expected that both groups of participants with ASD (-P and -NP) will show a bias towards local processing compared to participants with typical development (Caron et al., 2006; Happé& Frith, 2006; Mottron, Burack, Iarocci, Belleville, & Enns, 2003). We also hypothesized that participants in the PRI peak group will show a larger bias towards local processing than the PRI non-peak group (Caron et al., 2006; Mottron&Burack, 2001). In addition, we expected differences in performance in the visuospatial tasks according to the various levels of PRI: better performance for the groups with a peak and performance less accurate for the groups without peak.

Methods

Participants

Two groups (N=39) of participants with ASD were tested and compared with TD participants (N=38). Specifically, the groups were divided in i) ASD-NP and TD-NP with average scores in the PRI (85-111); ii) ASD-P and TD-P with a peak in that ability (115-141). The four groups were matched for chronological age [F (3, 73) = 1.21, p = .312; η^2_p = .047], and gender [$\chi 2$ (df = 3) = .249, p = .969]. Each group with ASD (-P and -NP) was also matched with the respective TD group (-P and -NP) for PRI scores [F (1, 31) <1 and F (1, 42) <1, respectively].

Materials and Procedure

Participants were tested in two single sessions lasting approximately 40 minutes. For all tasks stimuli were constructed with different level of PC. PC is a figures' property describing the extent by which different parts of a figure may be easily interconnected and ranges from a minimum (favoring a local processing) to a maximum (favoring a global processing) level (Caron et al., 2006).
The following tasks were administered:

- Visuospatial processing speed task: 7x7 grids were presented with grey and white cells. Participants were asked to look at the target figure and then choose the same configuration presented among five options, as speed as possible.
- Visuo-perceptual task: a matching computerized task consisting of two parts, the first required to match an unsegmented figure to a corresponding segmented target figure presented among three segmented distractors. Vice versa the second required to match a segmented figure to a corresponding unsegmented target figure.
- Visuocontructive BDT: a modified version of the block design subtest of the Wechsler Intelligence Scale; participants had to reproduce configurations using a series of cubes. Two versions were administered (unsegmented and segmented);
- Visuospatial short term memory task: Participants were presented with a block configuration for few seconds and then they had to reproduce it on a blank matrix.

Findings

Analysis were conducted using R and were performed using generalized linear mixed effect models.
Accuracy was analyzed for visuospatial processing speed task. The ASD-NP group was less accurate than the other three (*ps*<.04) and no other differences emerged between the groups.
Response times (RT) were analyzed for the visuo-perceptual task. The ASD-NP group's performance was slower than that of the TD-P group in the segmented condition (*p*=.004), while no differences emerged with respect to the other groups. The ASD-NP group was also slower than all the other groups in the unsegmented condition (*ps*<.001). No other significant differences emerged between the groups. Moreover, the ASD-NP group was slower than both the TD groups on the minimum level of PC (*p*=.002 and *p*<.001 respectively), but only slower than the TD-P group on the intermediate level (*p*=.001). No differences emerged between the groups for the maximum level of PC.
RT were analyzed for the visuoconstructive BDT. For the unsegmented condition, the model coefficients showed that the ASD-P group was faster than all the other groups (*ps*<.001), and the ASD-NP group was the slowest (*ps*<.01). The ASD-NP group was slower than all the other groups in the segmented condition too (*ps*<.001).
Accuracy was analyzed for visuospatial short term memory task. Both TD groups (-P and -NP) and the ASD-P group performed better than the ASD-NP group on the maximum and intermediate levels of PC (*ps*<.02 and *ps*<.04, respectively). In tasks with a minimum PC, however, only the ASD-P (*p*=.04) and TD-P (*p*=.05) groups proved more accurate than the ASD-NP group, which did not differ from the TD-NP group.

Conclusions

The results of present study showed the importance of examining different visuospatial processes in individuals with ASD, taking the level of perceptual reasoning into account. The ASD-NP group generally was slower to respond and/or less accurate in its answers than the other groups in all the domains examined. In addition, this group revealed weaker spatial integration abilities in the visuo-perceptual domain, and a diminished sensitivity to perceptual coherence in the VSWM domain. Conversely, the ASD-P group was able to use both global and local processing styles effectively, modulating their use depending on the task. It was only in the visuo-constructive domain that this group adopted a locally-oriented processing. The presence of a high cognitive potential seems to support this group, allowing it to overcome the tendency for local processing.

Finally, our study contributes to a better understanding of the visuospatial profile of children with ASD and supports the conviction that the use of a local or global processing style can vary, depending on the requirements of the task in hand and the cognitive domain involved (D'Souza et al., 2016; Dukette & Stiles, 2001).

The effects of a swimming program on social skills, autistic behaviours and aquatic skills in ASD children

Mirella Zanobini, Francesca Ottonelli, Silvano Solari

(Dipartimento di Scienze della Formazione, Università di Genova, Genova, Italy)

mirella.zanobini@unige.it

Aims

Recent research demonstrated that water exercise and swimming programs help people with autism improving their motor, social and communication skills. This study aims at verifying whether participation in a specific swimming program, i.e. "Acqua Mediatrice di Comunicazione" (Water as a mediator of communication) could reduce autistic mannerisms and improve autonomy and interpersonal skills, as well as aquatic abilities, in children with autism.

Method

Participants and procedure

The research involved 33 children aged between 3 and 8 years, diagnosed with autism spectrum disorders according to the diagnostics criteria of the ICD-10, DSM-IV, or DSM 5; three children withdrew for personal reasons. The final sample consisted of 30 children, 13 (10 males) in the experimental group and 17 (13 males) in the control group; the two groups were matched for age (M = 68.23, DS = 15.18, experimental group; M = 69.29, DS = 17.83, control group; $F_{(1,28)} = 0.01$, $p = .93$, $\eta^2 = .00$), and symptoms severity (Autism total score; M = 86.00, DS = 21.91, experimental group; M = 76.18, DS = 29.51, control group; $F_{(1,28)} = 1.01$, $p = .32$, $\eta^2 = .04$).

After a preliminary meeting aimed at presenting the project, all the parents signed an informed consent form. Each child was assessed twice, at pre-test (January 2017, T1) and post-test (May 2017, T2), with the following instruments: 1) *The Autism behaviour checklist* (ABC, Krug et al., 1978), which assesses the presence of autistic behaviours in individuals aged between 3 and 35 years. The ABC consists in 57 items distributed in five areas: sensory, relating, stereotypes and object use, language, and self-help and social. The assessment was based on parents or teacher reports. 2) *The Social Responsiveness Scale* (SRS, Constantino & Gruber, 2010) measures social ability in children from 4 to 18 years old. The questionnaire, filled by parents, is composed by 65 items for the evaluation of five areas: social awareness, social cognition, social communication, social motivation, and autistic mannerisms. 3) Only the children of the experimental group were rated in their aquatic skills with the *Humphries' assessment of aquatic readiness* (HAAR, Humphries, 2008). The checklist (32 items) is composed by five steps: mental adjustment, introduction to water environment, rotations, balance and control, and independent movement in water. Inter-observer reliability was calculated for 30% of the ABC and SRS sessions and for 60% of the HARR sessions. The agreement index among observers was always higher than 90%.

Intervention

Each child of the experimental group participated in water-related activities twice a week with one educator. In-water tests were videotaped. Children in the control group carried out weekly psycho-educational laboratories (i.e. music therapy) or different sport activities. All participants continued their regular speech-therapy sessions and psychomotor activities throughout the study.

Results

ABC

Mixed ANOVAs ($Time_{(T1;\ T2)}$ x $Group_{(experimental;\ control)}$)highlighted a statistically significant reduction in scores (Time effect, all $p < .01$) in all the subscales of the ABC (i.e. sensoriality, relationship, use of the body and objects, and autonomy), except for those related to language, across the whole sample. Both groups also registered a statistically significant decrease in the total score ($p < .001$), thus indicating an improvement in the severity of autism symptoms. A Group main effect emerged only in the ABC Sensory subscale, showing higher scores overall for the experimental vs. control group ($F_{(1,28)} = 4.237$; $p = .049$, $\eta^2_p = .13$). Furthermore, a significant Time by Group interaction for the Relating subscale of the ABC ($F_{(1,28)} = 5.476$; $p = .03$, $\eta^2_p = .16$) emerged, indicating that the experimental group improved significantly more than the control group. No other significant differences were found.

SRS

No significant Time by Group interactions were found in the subscales of SRS. Due to the limited sample size which could explain the absence of significant interaction, we run paired t-test within each group to explore tendencies in the data. The experimental group showed significantly reduced symptoms severity in the subscales of social communication (M T1 = 34.15, DS = 8.62; M T2 = 30.15, DS = 9.75; $t_{(12)} = 2.88$, $p = .014$) and autistic mannerisms (M T1 = 19.69 DS = 5.25; M T2 16.69, DS = 4.13; $t_{(12)} = 2.72$, $p = .019$). Furthermore, the total score registered a decrease close to the significance level (M T1 = 100.54, DS = 21.90; M T2 = 91.31, DS = 24.31; $t = 2.1$, $p = .058$). These results indicate an improvement in the manifestation of the symptomatology. Conversely, results for the control group showed no statistically significant differences between pre- and post-treatment.

HAAR

The advantages emerging from the participation in the program "Acqua Mediatrice di Comunicazione" also emerged when looking at the results of the HAAR. Children obtained a significantly higher score in all the subscales after treatment ($p < .05$).

Conclusions

Our findings showed that the involvement in various psycho educational activities, structured to deal with the typical autism deficits, can be efficacious in improving children's with autism condition in almost all the areas considered by the ABC,and in the total score of autism. Nevertheless, only the participation in the swimming program seemed to favour

relational behaviours as the tendency to respond to facial affect, use of eye contact, imitation, and touch. Moreover, the results shown a tendency to the reduction of the stereotyped behaviours and the improvement of expressive social communication that should be verified with a larger sample. Thanks to the buoyancy, swimming can help the individual to move more consciously and efficiently (Tirosh, et al., 2008), also favouring the reduction of the motor stereotypes of this disorder (Leopizzi et al., 2010; Yilmaz et al., 2004). Finally, all children involved in the swimming program improved their motor skills in the aquatic environment. Learning a sport activity can be very important for people with disabilities, not only by improving their physical health, but by changing what they think and perceive about themselves (Grigolon, 2017). Moreover, participation in a sport improves the child's self-esteem and sense of security (Tomiato, 2015). Although this research underlines how the aquatic training provides significant improvements in important areas of autism spectrum disorder, further investigation are needed to corroborate these findings. In this vein, a follow up study on the experimental group is in progress.

Session 2

Developmental and cognitive profiles in individuals with intellectual disabilities

Developmental course in Down syndrome – the Heidelberg study

Klaus Sarimski

(University of Education, Heidelberg, Germany)

sarimski@ph-heidelberg.de

Purpose

Longitudinal data from the "Early Intervention Collaborative Study" (Hauser-Cram et al.) and research from Fidler et al. as well as the results of several cross-sectional studies point to associations between the developmental of adaptive competence, behavioral abnormalities and family stress in children with developmental disabilities. The purpose of our study was to analyze patterns in the developmental course of children with Down syndrome in the first five years of life in order to replicate some of these results in a German sample and to explore relationships between developmental progress and parental resources.

Hypotheses

1) The domains of adaptive competence differentiate early in childhood. 2) Early communicative competencies predict later language development. 3) Behavioral abnormalities are associated with early indicators of executive functioning deficits. 4) Parental resources (and stress) contribute to the explanation of individual differences in adaptive and behavioral development.

Methods

76 parents (convenient sample) completed the Vineland Adaptive Behavior Scales-II (VABS-II), a German version of the MacArthur communicative Developmental Inventory (CDI) and a German version of the Impact on Family Scale (FaBel) each year and, in addition, the Strengths and Difficulties questionnaire (SDQ-German) and the Behavior Behavior Rating Inventory of Executive Functioning (BRIEF-P) when the children had reached the age of five years. Statistical analyses included an ANOVA with repeated measures, correlation and regression analyses.

Finding

A profile of specific weaknesses in the motor und productive language domain is already recognizable when the children are two years of age. Early nonverbal and verbal competencies in the first two years of life only predict lexicon when the children are three

years of age, but do not predict the language development in the preschool age. Results from the SDQ and BRIEF-P are strongly correlated. Correlation analysis points to the role of early parenting stress and coping resources for explaining differences in development, but we did not find a direct relationship between early family stress and later adaptive competence or behavioral problems.

Conclusions

The interrelationship of individual and social variables contributing to the development of children with Down syndrome is complex so that it remains difficult to predict developmental course.

Avoiding the floor effect in the WISC-IV (Wechsler Intelligence Scale for Children-4th Edition) using Z scores and equivalent age: average profile and factor analysis on individuals with intellectual disability

Enrico Toffalini, Cesare Cornoldi

(Department of General Psychology, University of Padova, Padova, Italy)

enrico.toffalini@unipd.it

The current definition of intelligence implies that its measurement is based on deviation scores. Thus the reference to a child's mental age that was used, for example, in the earlier versions of the Binet scales, has been progressively dismissed. In the present study, however, we suggest that the calculation of the equivalent age may still be useful when assessing children with moderate or severe intellectual disability, i.e. with an intellectual level far lower than that of the typically developing children of the same chronological age; to this purpose, the case of the Wechsler Intelligence Scale for Children-4th Edition (WISC-IV; Wechsler, 2003) was considered. Previous studies suggested that, although the WISC-IV is the intelligence battery most used to assess children throughout the world, it suffers from a floor effect and an overestimation of overall intelligence when IQ < 60 (this cutoff still includes mild intellectual disability). This happens because the WISC-IV limits scaled scores on single subtests to 3 SDs below average, and the total IQ to 4 SDs below average. One method proposed to overcome this limitation (Orsini, Pezzuti, & Hulbert, 2015) is to recalculate Z scores considering the means and SDs of the raw scores of each subtest in each age group. This method, however, poses a series of problems. First, it is unclear to which extent the Z scores allow to regain the variability within floored WISC-IV profiles. Second, it can easily be shown that the Z scores method leads to interpretive problems because the composite scores can reach values that are unlikely low (e.g., an individual who has a homogenous profile with all subtests around 3.5 to 4.0 SDs below average would easily have a negative IQ – which is not impossible, but statistically unlikely). Finally, the Z scores method recalculates scores on the basis of the normative data collected on individuals of the same chronological age, but with enormously higher intellectual functioning than an individual with intellectual disability; although this is in line with the current definition of IQ, it may lead to artifacts.

An alternative method to overcome floor effect in the WISC-IV is to calculate equivalent age in each subtest and, through averaging, in the composite scores. This can easily be done using the conversion tables down to 6 years of equivalent age. Because no normative data is available below that point (but many individuals with intellectual disability may have equivalent mental age below 6 years), the equivalent age can be estimated, at least to some degree, using extrapolation methods based on linear or quadratic functions.

To test the usefulness of the Z scores and the equivalent age methods, we examined the profiles of a sample of 240 cases diagnosed with intellectual disability. A series of individual case examples showed that both methods allow to overcome the floor effect found when using the traditional scaled scores. The equivalent age method, however, seems to offer a better differentiated profile, and has a more immediate interpretation than the Z scores method.

As regards the aggregate data, both the Z scores and the equivalent age methods suggested that individuals with intellectual disability have a relative weakness in working memory subtests as compared to the rest of the profile, independently from the severity of the intellectual impairment. This relative weakness in working memory as compared to the other indexes ranges between ½ and 1 SD using the Z scores, or between 1 and 2 years of equivalent age using the alternative method. Traditional scaled scores, on the contrary, lead to mostly flat profiles, particularly in individuals with moderate and severe disability.

Interestingly, multigroup factor analysis comparing typically developing children (i.e., the Italian normative sample of the WISC-IV) and the sample of individuals with intellectual disability suggested that the configuration of the factorial structure is the same in the two groups, with four main indexes and a superordinate *g* factor. This happened only when the equivalent age or the Z scores methods were employed, however, and not when the traditional scaled scores were analyzed. Some differences in loading emerged, however, suggesting that the perceptual reasoning index is relatively less related to the *g* factor in the intellectual disability than in the typical developing children (i.e., around .55-.60 vs. around .90). All other loading, however, were very similar.

One problem of both the Z scores and the equivalent age method is that they make an assumption on a part of the child population that was not included in the standardization sample. In particular, the Z scores method refers to a population of individuals beyond 3 SDs below average in the WISC-IV subtests, whereas the equivalent age method often refers to individuals below 6 years of age (through extrapolation methods). Despite these limitations, we showed that both methods could be used to obtain potentially useful information on individuals for whom the use of the WISC-IV would otherwise be problematic. Furthermore, we offered information on the average profile in intellectual disability, and we suggested that the configuration of the factorial structure of intelligence in cases with intellectual disability is not necessarily different from that of typically developing children; this is interesting considering the theoretical standpoint that only the *g* factor can be interpreted in intellectual disability.

Borderline intellectual functioning: analysis of subtypes

Francesca Pulina, Silvia Lanfranchi, Renzo Vianello

(Department of Developmental Psychology and Socialization, University of Padova, Padova, Italy)

francescapulina1@gmail.com

The aim of the present contribution was to explore the broad variability that characterizes BIF, in terms of the presence of possible different subgroups characterized by homogeneous cognitive profiles.
Data were collected by screening archival data of several Italian mental health services for children and adolescents, and referring to school-age children assessed for screening or diagnostic purposes, who obtained a Full-Scale IQ at WISC-IV between 70 and 85. The final sample was constituted by 204 school-age children.
The four main indexes of WISC-IV were considered to our aim.
Cluster analysis procedures suggested the presence of three different subgroups characterized by a similar Full-Scale IQ, but significant differences in their cognitive profiles.
The first subgroup was characterized by children obtaining highest scores in Perceptual Reasoning Index, which was in the normal range (i.e. higher than 85), and Verbal Comprehension, Working Memory, and Processing Speed performances in the range borderline. Verbal Comprehension showed the lower scores, in the lower end of borderline range.
Participants in the second group were characterized by a peak in Processing Speed Index, which was within the normal range, and a performance in Verbal comprehension, Perceptual Reasoning, and working Memory tasks within the borderline range, the latest characterized by the lowest scores.
Finally, participants in the third group performed significantly better on Verbal Comprehension and Perceptual Reasoning indexes, both in the normal range, than on Working Memory and Processing Speed abilities, which were in the lower end of borderline range.
After finding the three profiles associated with the three clusters, it was explored whether the three clusters were characterized by different distributions of contextual or clinical variables. Given the frequent association between BIF and other developmental disorders (e.g. Salvador-Carulla et al., 2013), and between BIF and low socio-economic status (e.g. Emerson et al., 2010; Vianello et al., 2014), the family's socio-economic status and the children's clinical diagnoses were considered. Socio-economic status (SES) was judged from the parents' educational level and occupational level. The educational level was considered as the highest level of formal education achieved by either of the parents, and classified on three levels: low (i.e. elementary school or less), medium (i.e. secondary education/middle school), and high (i.e. pre-university education or college/university). The occupational level of the family was considered as the highest level of occupation of either parent, and classified as: low (i.e. unskilled work), medium (i.e. skilled work or white collar), and high (professional work). Educational and occupational levels were then averaged, and three categories were created for our purposes: low, medium, and high SES. Information about the family's SES was available for 153 of the 204 participants. Missing data were evenly

distributed in the three clusters. Overall, 64 children were from low SES families, 45 from medium SES families, and 44 from high SES families.

The three SES levels were represented in each cluster. However, some differences emerged for the distribution of SES levels within each cluster. SES levels were not evenly distributed in the first cluster ($\chi 2 = 8.31$, $p = .016$), which consisted primarily of children from low SES families (56.3%), while 28.1% were from medium SES families, and only 15.6% from high SES families. The three SES levels were more evenly represented in cluster 2 and in cluster 3.

Similarly, the correspondence between cluster membership and clinical diagnoses was explored. A clinical diagnosis was found for 186 of the 204 cases examined.

The sample was divided into two categories on the basis of any available clinical diagnosis: with comorbidities ($n = 116$) or without comorbidities ($n = 70$). Both categories were represented in all three clusters, but they were not evenly distributed. The first cluster contained much the same proportions of participants with and without a comorbidity, and so did the second cluster. The third cluster, on the other hand, included a higher proportion of children with a comorbidity, i.e. 72.7% versus 27.3% without any known comorbidity ($\chi 2 = 15.91$, $p < .001$).

The first cluster might particularly reflect the effects of the environment. Several studies have suggested that environmental factors have a stronger effect on the crystallized than on the fluid component of intelligence. Children in the first cluster scored lower on the Verbal Comprehension index, which is more representative of crystallized intelligence.

On the other hand, the third profile may be more typical of children with BIF with a comorbid disorder. This subgroup's profile was similar to the one found in previous studies for children with Specific Learning Disorders (SLD) and ADHD (e.g. Cornoldi et al., 2014; Fenollar-Cortés et al., 2015), who had similar verbal comprehension and perceptual reasoning scores, which were higher than their scores for working memory and processing speed. It is worth noting that the vast majority of the primary clinical diagnoses in our sample were SLD and ADHD (about 81% of the comorbid diagnoses).

Overall considered, the results suggest that different subgroups characterized by homogeneous cognitive profiles may be recognized within BIF and that these profiles could be associated with different environmental and clinical conditions.

Symposium

Working memory and executive functions in individuals with intellectual disabilities

Proponent: Maria Chiara Passolunghi, Department of Life Sciences, University of Trieste

passolu@units.it

This symposium is aimed to investigate strengths and weaknesses in working memory processes and executive functions in individuals with intellectual disability. The topic is addressed according to different theoretical perspectives, analysing the performance of groups of individuals with intellectual disabilities due to genetic causes (Down and Williams Syndrome) and groups of individuals with mild intellectual disabilities and borderline intellectual functioning of unknown ethology. The performances of these groups were compared to the performance of groups of individuals matched on mental age.

Danielsson, Palmqvist and Henry did a meta-analysis of working memory in individuals with intellectual disability. The main result was that people with intellectual disability have lower working memory abilities than mental age-matched controls and that the largest difference is for the 'phonological loop' component of the working memory system.Lanfranchi, Carretti, De Mori, Mammarella and Vianello investigated spatial working memory performance in individuals with Williams Syndrome, analysing whether their impaired WM performance regards both simultaneous and sequential spatial formats. Bruns, Ehl and Grosche, investigate the developmental trajectories of two processes connected to Baddeley's working memory framework: subvocal *rehearsal* and lexical *redintegration* in individualswith mild and borderline intellectual disabilities, that often show deficits in working memory processes. The other two studies are aimed to investigate inhibition processes in individuals with Down Syndrome (Usai, Traverso, Fontana, & Passolunghi) and in individuals with intellectual disability of unknown etiology (Ikeda, Okuzumi, & Kokubun). In particular, in the study with individuals with Down Syndrome different type of inhibitory tasks was used within a framework model of inhibition that considers two inhibitory components: *response inhibition* and *interference suppression.* Response inhibition represents the capacity to suppress prepotent but inappropriate response. On the other side, interference suppressions is the ability to filter out irrelevant information. The study of Ikeda, Okuzumi and Kokubun focused on inhibitory processes in individuals with intellectual disability of unknown etiology with and without autism spectrum disorder analyzing their performance in two Stroop-like tasks: the Real Animal Size Test and the Pictorial Animal Size Test.

Overall, these studies analyze the various components of working memory (e.g. visuo-spatial and phonological loop components) and compare several types of processes: simultaneous vs sequential processing; attentional control (active vs passive); subvocal rehearsal vs lexical redintegration; response inhibition vs interference suppression, showing strengths and weakness in these individuals. The results of these studies can provide a good starting point, not only for expanding the theoretical framework, but also for stimulating working memory, executive processes and cognitive development in these individuals.

Meta-Analysis of Working Memory in Individuals with Intellectual Disability

Henrik Danielsson[1], Lisa Palmqvist[1], Lucy Henry[2]

([1]The Swedish Institute for Disability Research & Linköping University, Linköping, Sweden; [2]City, University of London, London, UK)

henrik.danielsson@liu.se

Introduction

There is a replication crisis in psychology and other sciences. Many findings have not replicated in large scale replication studies (Open Science Collaboration, 2015). Other researchers have estimated how much of the published literature that is false (e.g., half of the published literature, Ioannidis, 2005). The suggested problems are multi-faceted, some are related to statistical issues (Gelman &Loken, 2014) and some are related to questionable research practices (Simmons, Nelson, &Simonsohn, 2011). Another problem is publication bias, that significant results are much easier to publish than non-significant results which gives a biased scientific literature.

Several solutions has been proposed, for example pre-registration of studies (Nosek, Ebersole, DeHaven & Mellor, 2017) where hypotheses and analysis plans are registered before data collection. Replication of existing studies would help get a better understanding of which results that replicate and under which conditions. Another solution is to do meta-analyses.

Meta-analyses have several advantages. One is to get an overall picture of the literature in one area that generalize to a larger population. Other advantages are higher precision and accuracy of results and that the inconsistency of the results can be analyzed and quantified. Potential moderators can be investigated and estimation of publication bias can be calculated.

The literature on working memory in people with intellectual disability is heterogeneous. One reason for that could be that there are different profiles of ID (e.g., different genetic etiologies). For example, for Down syndrome compared to MA controls, Lanfranchi et al., (2004) found a Cohen's d effect size of 2.3 and Seung (2003) found a Cohen's d effect size of 0.2. Another reason for heterogeneity could be different performance on different subsystems of the Baddeley working memory model (e.g., Baddeley, 2000). For example, Rosenquist et al., (2003) found that the ID group, compared to a mental age matched control group, performed lower on tests of the phonological loop (0.6 Cohen's d), but much better on tests on the visuospatial sketchpad (3.3 Cohen's d). To get a better understanding of the overall picture and potential moderators, a meta-analysis of working memory in people with intellectual disability was conducted.

Method

Inclusion and searches

Inclusion criteria for were that the study needed to 1) include at least one typically developed control group, 2) at least one group with intellectual disability, and 3) report test results so that the effect size could be calculated. For the intellectual disability group, no participant could have an IQ of more than 70 and the mental age had to be under 19 years. The study

also needed to include some sort of working memory test. Working memory was defined in a broad sense, which meant that both short-term memory and working memory was included. Exclusion criteria were comorbidity in the ID group and failing to report IQ or mental age.
A literature search was conducted in Scopus, Pubmed, Web of Science, Psycinfo, and ERIC. The following keywords were used: (("mental retardation") OR ("intellectual disability") OR ("intellectual disabilities") OR ("mental deficiency") OR ("Down syndrome") OR ("Williams syndrome")) AND (("working memory") OR ("short term memory") OR ("short-term memory") OR ("shortterm memory") OR ("visuospatial sketchpad") OR ("visuo-spatial sketchpad") OR ("phonological loop") OR ("central executive") OR ("episodic buffer")). The search results were imported to the reference management system Zotero (www.zotero.org) where duplicates were removed. The abstracts were then scanned by two of the authors, independently, and full text was downloaded for the remaining articles. Decisions to include articles in the meta-analysis and the coding of the information in the articles were also done independently by two of the authors and differences were resolved by discussion afterwards.
Analyses
The focus on this meta-analysis was the direction and magnitude of the effects across studies, and was represented by the effect size (ES) Standardized Mean Difference (d). The analyses were conducted in R (R Core Team, 2017) in the metafor package (Viechtbauer, 2010). Three mixed effects model were performed on the calculated effect size d:s for the included studies. The first model analysed the ES of WM between ID-CA and ID-MA, the second the difference in ES in the subgroups of WM, and the third analysed the difference in the subgroups of WM in the two comparison groups CA and MA.

Results

Results showed that people with ID performed a bit less than one standardized mean difference lower on working memory tasks than their MA controls, and even lower compared to the CA controls (a bit more than one standardized mean difference). The subsystem the phonological loop had the largest difference with an ES slightly above one standard deviation for MA and CA combined. The variation between effect sizes in the included studies were large. There was also a significant difference in the WM subsystem the Central Executive when comparing the ID to the controls together. However, there were too few studies to compare how the differences differed between the two comparison groups MA and CA.

Discussion

People with ID have lower working memory than their chronological age-matched peers. This difference persists even when comparing to their mentally age-matched peers. The difference were largest for the phonological loop in Baddeley's working memory model. However, there were not so many studies in total and most of them were on the phonological loop. This contributes to a larger uncertainty about the effect sizes in the other working memory subsystems.
The variation between effect sizes were large. This indicates that there are other moderators that are influencing the results. Relatively few studies were included in the analysis which limited the number of potential analyses of moderators but finished results with analyses of more potential moderators will be presented at the conference. Anyone with unpublished data on this area are encouraged to share them so that they can be included in the analyses.

Spatial-sequential and spatial-simultaneous working memory in Williams syndrome

Barbara Carretti[1], Silvia Lanfranchi[2], Letizia De Mori[2], Irene Mammarella[2], Renzo Vianello[2]

([1]Department of General Psychology, University of Padova, Padova, Italy; [2]Department of Developmental Psychology and Socialization, University of Padova, Padova, Italy)

barbara.carretti@unipd.it

Williams syndrome (WS) is a neurodevelopmental disorder associated with an impaired capacity for visuospatial representation. Individuals with WS have a specific weakness in spatial processing, while visual components are relatively well preserved. This dissociation is apparent in working memory function too.
In the present work, we focused on spatial WM. The description of visuospatial WM originally provided by Baddeley and Hitch (1974) has since been better defined, enabling a distinction between visual and spatial components first, and then between different processes associated with the spatial component (see e.g., Lecerf & de Ribaupierre 2005; Logie, 1995). According to Pazzaglia and Cornoldi (1999), and Cornoldi and Vecchi (2003), spatial WM can be separated into two components involved in memorizing patterns of spatial locations: (i) a simultaneous component needed to recall items that are presented at the same time; and (ii) a sequential component involved in recalling items presented one after the other. Several studies have demonstrated the feasibility and utility of this distinction in TD children (Mammarella et al., 2006), older adults (Mammarella, Borella, Pastore, & Pazzaglia, 2013), and individuals with Down syndrome (Carretti, et al., 2013; Lanfranchi, Carretti, et al., 2009). The aim of our work is to shed more light on the spatial WM impairment in individuals with WS already described in the literature (e.g., Jarrold et al., 1999).

Study 1
In a first study we aimed to further investigate spatial working memory performance in individuals with WS, analyzing whether their impaired WM performance regards both simultaneous and sequential spatial formats.
To this purpose we compared visuospatial working memory performance in 18 individuals with WS and 18 typically developing (TD) children matched for nonverbal mental age.
Two presentation formats were used: (a) spatial-sequential (when items of information to be recalled were presented one after the other), and (b) spatial simultaneous (when items of information to be recalled were presented simultaneously). We also manipulated how attentional control was involved by using (a) passive tasks (when information only had to be retained) and (b) active tasks (when information had to be retained and processed; Cornoldi & Vecchi, 2003).

Results

Given the small number of participants involved, we opted to run two 2 (group: WS vs TD) x 2 (attentional control: passive vs active) ANOVA for the spatial-sequential and spatial-simultaneous tasks. For the spatial-sequential task, we found a significant effect of group, $F(1,34) = 6.02$, $p < .05$ $\eta^2_p = .15$, individuals with WS performing less well ($M = 3.69$, $SE = .44$) than TD children ($M = 5.22$, $SE = .44$). There was also a significant group x attentional control

interaction, $F(1,34)$ =15.79, p<.001 η^2_p=.32. Subsequent post hoc comparisons with Bonferroni's correction showed that the group with WS (M=4.06, SE=.44) performed as well as the TD children (M=4.22, SE=.44) in the passive task, while the performance of individuals with WS (M=3.33, SE=.56) was worse than that of the TD children (M=6.22, SE=.56) (p<.001) in the active task. For the spatial-simultaneous task, we found a significant effect of group, $F(1,34)$ =4.10, p=.05 η^2_p=.11, individuals with WS performing less well (M=2.97, SE=.49) than TD children (M=4.36, SE=.49) in both passive and active spatial-simultaneous tasks. The main effect of attentional control, and the interaction between group and attentional control were not significant.

Conclusions

These findings suggest an impairment in the spatial-simultaneous working memory of individuals with WS, together with a more generalized difficulty in tasks requiring information storage and concurrent processing, as seen in other etiologies of intellectual disability.

Study 2

In a second study we aimed to explore whether the manipulation of the arrangement might reduce the difficulties showed by individuals with WS. These issues were examined by administering simultaneous and sequential spatial tasks, in which the information to be recalled was presented in random or arranged configurations.

Data analysis

The two groups' performance was compared using a 2 (group: WS vs TD) x 2 (presentation format: simultaneous vs sequential) x 2 (configuration: random vs pattern) repeated measures ANOVA on the number of correctly recalled positions.

The changes recorded across the different levels of difficulty were analyzed to clarify the results obtained in the spatial-simultaneous and spatial-sequential tasks. A 2 x 7 repeated measures ANOVA was run on the proportion of correctly recalled positions in each trial with Group (WS vs. TD) as the between-group variable, and Memory load (2 vs. 3 vs. 4 vs. 5 vs. 6 vs. 7 vs. 8) and Configuration (pattern vs. random) as within-group factors, distinguishing by presentation format

Results and conclusions

Also in this case results showed that individuals with WS performed less well than TD children in spatial-simultaneous tasks, whereas their performance was comparable with that of TD children matched for mental age in spatial-sequential tasks. Our findings would seem to indicate that it is wrong to speak of a general deficit in the spatial domain in WS, as suggested by the literature (e.g. Vicari et al., 2006), since the sequential component of spatial WM seems to be less impaired than the simultaneous one. Moreover our WS group showed the same benefit of the spatial-sequential over the spatial-simultaneous condition as in TD populations (e.g. Allen et al., 2006), and in other genetic conditions such as Down syndrome (Carretti et al., 2013). So, despite an impaired spatial component, the architecture of the spatial WM in WS has the same characteristics as in typically-developing individuals.

The effect of configuration on group differences varied, depending on the presentation format. In the spatial-sequential tasks, the WS group benefited from a pattern to much the

same extent as the TD children. In the case of spatial-simultaneous tasks, the WS group again showed that it gained from a patterned configuration, but differences between the two groups remained. The intra-group comparisons showed that the presence of a pattern in the spatial-simultaneous task prompted a persistently good performance in the group of TD children, while the WS group's performance gradually deteriorated as the task became more demanding.

Investigating Working Memory in Students with Mild Intellectual Disabilities and Borderline Intellectual Functioning using Developmental Trajectories

Gunnar Bruns, Birgit Ehl, Michael Grosche

(University of Wuppertal, Institut für Bildungsforschung, Bergische Universität Wuppertal, Wuppertal, Germany)

gbruns@uni-wuppertal.de

Aims: Students with MID/BIF have consistently been shown to be deficient in working memory at least to some degree (Mähler, 2007; Mähler & Hasselhorn, 2003), but it remains unclear whether this deficit poses a developmental delay or a qualitative difference, i.e. if their lower performance in working memory is in line with or even goes beyond the general cognitive impairment (as indicated by lower IQ). The aim of this study is to investigate two processes connected to Baddeley's working memory framework (1986; 2003; Hasselhorn et al. 2012) that serve the purpose of refreshing fading memory traces during word-span tasks. On the one hand, *rehearsal* as a phonological process repeats the content of the phonological store through subvocal articulation; on the other hand the trace can also be restored from long-term memory (LTM) via lexical *redintegration*. While there is already some knowledge on the role of rehearsal, only few studies have investigated redintegration (Grube, Lingen & Hasselhorn 2008; in typically developing children), and to our knowledge there are no studies on redintegration in MID/BIF (Hasselhorn, Schuchardt & Mähler, 2010 for specific learning disabilities).

A common design to investigate the deviance/delay issue is the use of two control groups: one is classically matched for chronological age (CA) and another for mental age (MA); this latter group is usually younger but shows the same performance in a relevant standardized task (e.g. reading level or cognitive ability). If the disorder group performs at a similar level as the MA-group in the target task, a delay can be concluded since the deficit is in line with the general limitations. A lower performance than the MA-group, in contrast, reflects a qualitative deficit, because the target-task deficit even exceeds the general impairment. However, Thomas et al. (2009) point out limitations in this approach, as it only offers comparison based on group means and is restricted in terms of a rather narrow age-range; furthermore, the choice of mental-age variables is less flexible. Therefore, they suggest Developmental Trajectories as a regression-based approach with one typically developing (TD) group spanning from youngest mental age to oldest chronological age in the disorder group to account for variance within the groups and thus determine different patterns of development in more detail. This is done by adding (mental) age into the regression model as a predictor. While the traditional group-matching approach can only distinguish two scenarios (delay and deviance) in comparing group-means, trajectories offer at least seven scenarios to depict forms of developmental difficulties by using intercept as indictor for *delayed onset* and slope for a *slower rate* of development; and in addition non-linear curves and zero-trajectories.

Methods: In total, n = 207 students (87 MID/BIF aged 10-17 years, 102 MA, 18 CA) completed word-span tasks in four conditions (2 (length) x 2 (lexicality): short (1-syllable)

and long (3-syllable); real words and pseudowords). The word-length effect (WLE; difference between short and long words) constitutes the phonological *rehearsal* process, as more short words can be rehearsed in a limited amount of time (Hasselhorn et al. 2000; 2012); the lexicality effect (real vs. pseudowords) reflects lexical *redintegration*, as real words can be reconstructed from LTM, while there is no such benefit for pseudowords. As variables for mental-age matching, a measure of cognitive capacity (CFT 1-R; Weiß & Osterland, 2012) and vocabulary (picture naming: WWT; Glück 2011) were administered. Developmental Trajectories are reported graphically and their underlying models and coefficients tested for significance.

Findings: Results can best be depicted in the figure 1: for each condition there is a scatter plot with age as predictor and performance in the span-task as criterion variable. All variables (Length and Lexicality, Group and (mental) Age) are entered into the model to obtain the coefficients for each trajectory and to test for effects in intercept and slope across conditions and groups. Word-length produced a consistent reliable main effect ($F(1, 203) = 139.95$; $p < .001$), and there were differences in intercepts between groups concerning WLE (Length × Group: $F(1, 203) = 5.385$; $p = .021$), however slopes did not differ across groups (Length × Group × Age: $F(1, 203) = 1.581$; $p = .210$). For Lexicality there was only a significant main effect ($F(1, 203) = 156.35$; $p < .001$) but there was no interaction with Age nor Group (all $F < 1$). The interaction between word conditions (i.e. WLE for real vs. pseudowords) significantly covaried with Age ($F(1, 203) = 9.50$; $p = .002$) but was similar across groups (both $F < 1$). Overall, there was a significant effect for Group ($F(1, 203) = 16.48$; $p < .001$) and for Age ($F(1, 203) = 78.08$; $p < .001$), but the Group × Age interaction failed significance ($F(1, 203) = 3.36$; $p = .068$).

Conclusion: We found that the MID/BIF group is generally performing below the TD group and that age overall is a significant predictor across groups (with no significant Age × Group interaction). There seems to be a delayed onset for WLE (i.e. rehearsal), but no slowed rate, while there are no differences for lexicality (i.e. redintegration), at all. The interplay between rehearsal and redintegration seems to vary with age; a pattern that appears similar across groups. Therefore, we can conclude a developmental delay in onset for rehearsal, but no impairment in redintegration for the group of students with MID/BIF of a wider age-range from 10-17 years. This is in line with previous findings (Mähler & Hasselhorn, 2003; Mähler, 2007). The finding on unimpaired redintegration is encouraging, as it may offer a potential strength and resource in students with MID/BIF. Using other variables as mental age predictors (namely cognitive capacity and vocabulary) may shed additional light on the particular patterns of development in MID/BIF.

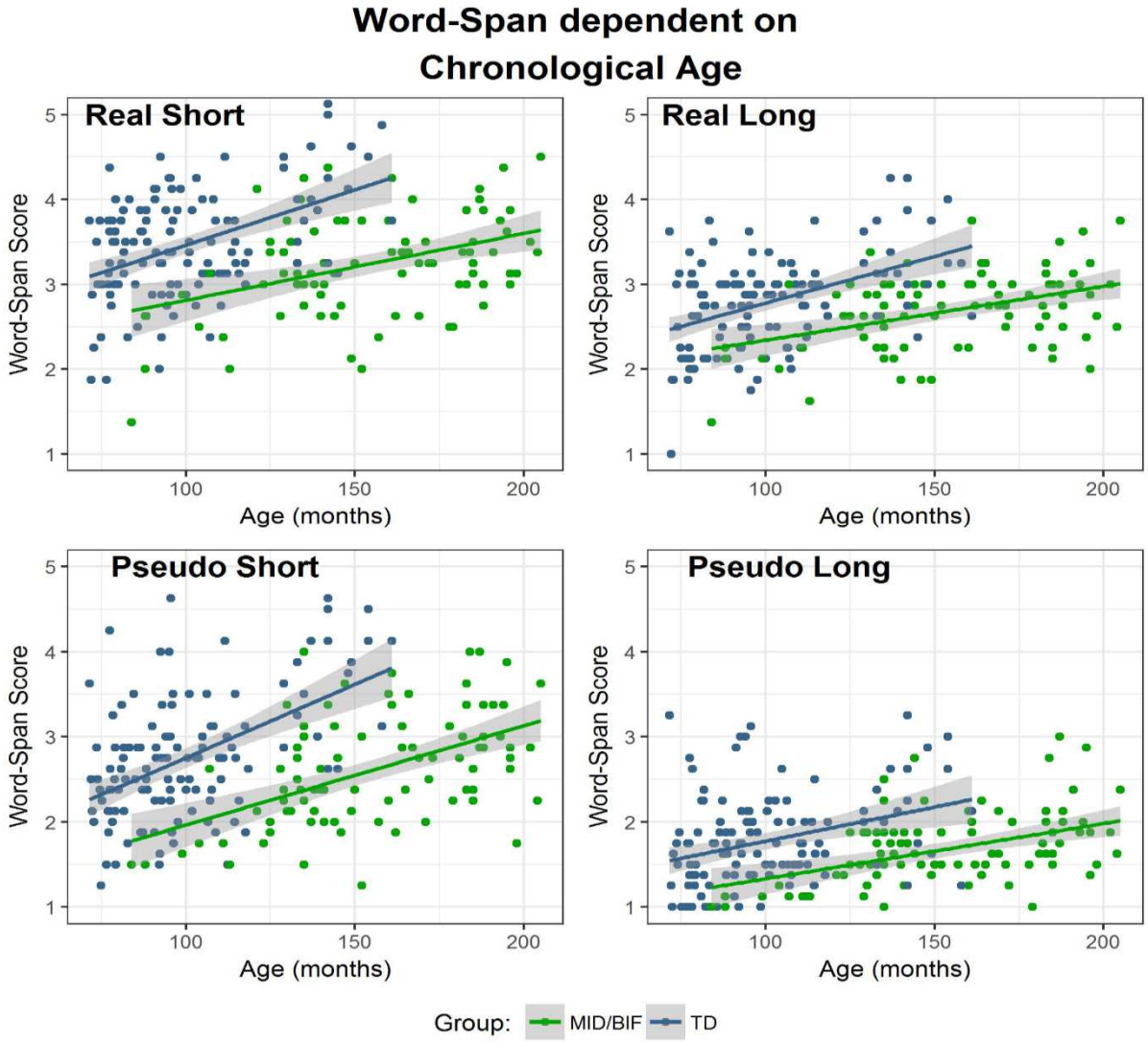

Word-Span dependent on Chronological Age
Real Short
Real Long
Pseudo Short
Pseudo Long
Word-Span Score
Age (months)
Group:
MID/BIF
TD

Figure 1

Response inhibition and interference suppression in individuals with Down Syndrome

Maria Carmen Usai[1], Laura Traverso[1], Martina Fontana[2], Maria Chiara Passolunghi[2]

([1]Department of Education, University of Genova, Genova, Italy; [2]Department of Life Sciences, University of Trieste, Trieste, Italy)

maria.carmen.usai@unige.it

Introduction

Previous studies aimed to investigate inhibition in individuals with Down Syndrome (DS) reported contradictory results. Some studies reported significant differences between individuals with DS and controls in inhibition task performances (i.e., Borella, Carretti, & Lanfranchi, 2013; Shott & Holdfelder, 2015); while no difference emerged in other studies (i.e., Carney, Brown, & Henry, 2013; Cornish, Scerif, & Karmiloff-Smith, 2007). Moreover, several theorists argue that inhibition may have a multicomponential nature (Diamond, 2013; Nigg, 2000). Nevertheless, there are no previous studies in which a theoretical model that allows focusing on diverse inhibition components is considered (see for an exception Borella et al., 2013). Finally, previous results are difficult to compare given the different type of inhibitory tasks used.

The present study aims to investigate inhibition in individuals with Down Syndrome compared to typical developing children. Specifically, in the present study a multicomponential framework of inhibition was used considering two inhibitory components: response inhibition that is the capacity to suppress prepotent but inappropriate responses, and interference suppression that is the ability to filter out irrelevant information (Gandolfi, Viterbori, Traverso, & Usai, 2014).

Method

Thirty-two individuals with Down Syndrome (DS) with a mean age of 14 years and 4 months (M_{age}173.75 in months, S.D. 65.17, range: 73 to 299 months, 22 girls) constitute the DS group. Thirty-five typical developing children, with a mean age of 5 years and 6 months (M_{age}67.37 in months, S.D. 2.85, range: 62 to 71 months, 18 girls) constitute the typical developing control group of five years of age (TD5). Thirty typical developing children with a mean age of 6 years and 2 months (M_{age}74.40 in months, S.D. 4.42, range: 72 to 84 months, 13 girls) constitute the typical developing control group of six years of age (TD6). No difference emerged though the three groups in gender distribution or in fluid intelligence evaluated with Coloured Progressive Matrices Test (CPM, Raven, 1947). Participants completed a battery of inhibition tasks. The Go/No-Go task (Berlin & Bohlin, 2002) and the Preschool Matching Familiar Figure Task (Traverso, Mantini, Usai, & Viterbori, 2016) were used to evaluated response inhibition. The Fish Flanker Task (Usai, Traverso, Gandolfi, & Viterbori, 2017) and the Dots task (Diamond et al., 2007; Usai et al., 2017) were used to assess interference suppression.

Results

Descriptive analyses on inhibitory measures were executed. Univariate analysis of variance showed no significant difference in CPM scores. Then, an exploratory factor analysis (EFA), using principal axis factoring as extraction method and varimax rotation of the factor structure, was performed on the TD groups inhibitory tasks scores to explore the characteristics of inhibition construct in early childhood. Two different components were identified (response inhibition and interference suppression). On the basis of the EFA results, composite scores were calculated as the mean of the inhibitory z scores to represent the two inhibition components. The results of an ANOVA, executed with the two composite inhibitory measures as dependent variables and group membership as the between-subjects variable, showed that the three groups differed both in response inhibition, $F(2,96) = 8.363$ $p < .001$, and interference suppression, $F(2,96) = 10.530$ $p < .001$. The TD6 group outperformed the 5TD group in both response inhibition ($p = .008$, $d_{Cohen} = .94$) and interference suppression ($p = .001$, $d_{Cohen} = .83$) components. No differences were found in either inhibition component between the SD and TD5 groups. In contrast, the TD6 group outperformed the DS group on the response inhibition component score ($p = .001$, $d_{Cohen} = .96$) and the interference suppression component score ($p < .001$, $d_{Cohen} = 1.15$).

Conclusion

Results show that performance of individuals with Down Syndrome were similar to that of youngest children considering both response inhibition and interference suppression. Differently, the oldest TD group outperformed the Down Syndrome group in both the inhibition components. Moreover, the oldest TD group outperformed the youngest TD group both inhibition component scores. Summarizing, in this study two inhibition components (response inhibition and control interference) were considered in individual with Down Syndrome and typical development. The findings suggest that individual with Down Syndrome show a developmental delay in these to inhibition components.

Inhibitory control in children with intellectual disabilities with and without autism spectrum disorders

Yoshifumi Ikeda[1], Hideyuki Okuzumi[2], Mitsuru Kokubun[2]

([1]Joetsu University of Education, Niigata, Japan; [2]Tokyo Gakugei University, Tokyo, Japan)

yosifumi@juen.ac.jp

Introduction

Inhibitory control plays an important role in various aspects of child development. For children with intellectual disabilities (ID), few investigations have examined inhibitory control in children with ID of unknown etiology. Based on an investigation of inhibitory control along with other processes of executive function, one report has described that children with ID had impaired inhibitory control in comparison with mental age (MA)-matched children and chronological age (CA)-matched children (Danielsson et al., 2012). Further research, however, is necessary to accumulate sufficient data for meaningful conclusions.

There has been more investigation of inhibitory control in children with autism spectrum disorders (ASD). Although the repetitive and stereotyped behaviors seen in people with ASD are considered to link with inhibitory difficulties, many studies have demonstrated that inhibitory control is intact in children with ASD (e.g., Ozonoff and Jensen, 1999). However, the findings are limited for more-able children (IQ>70). Deb and Prasad (1994) reported that the occurrence of repetitive and stereotyped behaviors is more common in people with ASD and ID versus ASD alone. Therefore, it is necessary to investigate the influence of intellectual disabilities on inhibitory control in children with ASD.

The aim of this study was to compare inhibitory control of children with intellectual disabilities (ID) of unknown etiology, children with ID and autism spectrum disorders (ASD), and typically developing (TD) children.

Methods

This study examined 41 children in three groups: 11 children with ID of unknown etiology, 9 children with ID and ASD, and 21 TD children who were matched for mental age. Two Stroop-like tasks were administered: the Real Animal Size Test and the Pictorial Animal Size Test. In these tests, participants are presented with pictures of animals (large animals such as an elephant, a giraffe, and a whale vs. small animals such as a frog, a bird, and a squirrel) printed as either big or small images that are mismatched with the animal's real size. Participants must decide the size of the animals (big vs. small) based either on the size in real life or the size of the picture, resisting interference of irrelevant sizes in real life or in a picture. Each test had both the control condition and the incongruent condition. For each condition, each participant was asked to respond as quickly and accurately as possible to a series of 24 stimuli displayed on the monitor after performing three pre-trials.

Results

Analysis of RT was conducted only for the correct response. A 3 (group) × 2 (task) × 2 (condition) mixed analysis of variance was conducted for RTs. The analysis showed

significant main effects for the task ($F_{1,38} = 71.51$, $p < 0.001$; partial $\eta^2 = 0.65$; $1-\beta = 1.00$), for the condition ($_{1,38} = 71.36$, $p < 0.001$; partial $\eta^2 = 0.65$; $1-\beta = 1.00$), for the two-way interaction of task and condition ($F_{1,38} = 18.46$, $p < 0.001$; partial $\eta^2 = 0.33$; $1-\beta = 0.99$), for the two-way interaction of group and task ($F_{2,38} = 4.24$, $p < 0.05$; partial $\eta^2 = 0.18$; $1-\beta = 0.73$), and for the two-way interaction of group and condition ($F_{2,38} = 3.61$, $p < 0.05$; partial $\eta^2 = 0.16$; $1-\beta = 0.66$). Neither the main effect of group nor the three-way interaction between group, task, and condition was significant. With respect to the two-way interaction between task and condition, post hoc Bonferroni tests showed that the observed interference was greater in the Pictorial Animal Size Test (104 ms) than in the Real Animal Size Test (31 ms). With respect to two-way interaction between group and condition, post hoc Bonferroni tests showed that the difference between conditions was greater in the ID alone group (97 ms) than in the ID and ASD group (55 ms) or the TD group (50 ms).

Discussion

The results indicate that the ID alone group showed greater interference than the TD group did. In other words, the ID alone group are inferred to have impaired inhibitory control compared to the TD group. This result is consistent with the study of Danielsson and colleagues. To understand how inhibitory control differs between these groups, the followings should be considered. First, traditional intelligence measures, such as Binet's, do not seem to tap inhibitory control (Friedman et al., 2006). Therefore, MA did not explain what extent of inhibitory control individuals have. Second, inhibitory control is an important component of intelligent and adaptive behaviors (Friedman et al., 2006). Thus, inhibitory deficit may be a core disorder of children with ID of unknown etiology that has not been evaluated adequately for a long time.

In contrast, the ID and ASD group had unimpaired inhibitory control compared to the TD group. The interference observed was comparable between these groups. This is consistent with results of earlier investigations (Ozonoff and Jensen, 1999). The repetitive and stereotyped behaviors may not be strongly related to inhibitory difficulties but other executive functions, such as cognitive flexibility or shifting.

Conclusion

Results of this study suggest that inhibitory control is unimpaired in children with ID and ASD but impaired in children with ID of unknown etiology, relative to mental-age matched TD children. Results also suggest that traditional intelligence measures, such as Binet's, do not tap inhibitory control.

Session 3

Executive functions and Motor coordination

Executive functions and pre-literacy in kindergarten children at risk for Developmental Coordination Disorder

Marianna Alesi, Donatella Pecoraro, Annamaria Pepi

(Dipartimento di Scienze Psicologiche, Pedagogiche e della Formazione, Università di Palermo, Palermo, Italy)

marianna.alesi@unipa.it

Introduction

Developmental Coordination Disorder (DCD) is an umbrella term for a neurodevelopmental disorder generally characterized by motor deficiencies which significantly or persistently hamper daily living and school activities (Vaivre-Douret, Lalanne & Golse, 2016).Children with DCD, compared to typically developing (TD) children, usually show clumsiness in their behaviors, such as dropping or bumping into objects; as well as slowness and inaccuracy in their performances on motor tasks, such as catching an object, using scissors and cutlery, handwriting, riding a bike, or participating in sport activities (Missiuna et al, 2014; Summers, Larkin & Dewey, 2008; Wang et al.,2009; Zwicker et al., 2011).
Children with DCD have impairments is Executive Functioning (EF) across working memory, shifting, inhibitory control. However, very little known about the EF of pre-school children with DCD, during this important stage in their development. Although, Shoemaker et al. (2012) have suggested that these pre-schoolers have deficits in top-down control of cognitive processes, especially inhibition.
Moreover, as concern the preliteracy skills, research has demonstrated significant relationships between motor proficiency and literacy development (Bedard et al., 2017; Bedard et al., 2018). At a later time, children with DCD also are likely to face problems in school achievement and have specific problems with learning at school such as dyslexia, dyscalculia and dysgraphia (Biotteau et al., 2017; Nicolson & Fawcett, 2011; Prunty et al., 2016).
Given theoretical premises we tested the hypothesis that children at risk for DCD would show worse performance on tasks measuring EF (working memory, fluency and inhibitory control tasks) and pre-literacy abilities compared to TD peers.

Methods

Participants
Participants were 36 Italian children, 18 at risk for DCD (9 boys and 9 girls who had a mean chronological age of 4.6 years old (± .9; age range: 3-6) and 18 with TD (9 boys and 9 girls) who had a mean chronological age of 4.6 (±.9; age range: 3-6).

Children at risk for DCD were identified, scoring at or below the 15th percentile on the MABC-2 indicating significant coordination impairment. All the TD children scored at or above the 16th percentile on the MABC-2 indicating typical coordination skills.

Measures

Motor Coordination was assessed by the MABC-2 (Henderson et al., 2007).

Executive functions were assessed by a battery of standardized or experimental tasks composed of Working Memory Task (Lanfranchi, Cornoldi & Vianello, 2004), Animal Stroop Task (Wright et al., 2003), BVN-5-11 Verbal Fluency Test (Bisiacchi et al., 2005). Pre-literacy skills were measured by the PRCR2 battery (Cornoldi, Miato, Molin & Poli, 2009).

Results

Multivariate analysis of variance (MANOVA) was performed to compare EF and pre-literacy outcomes in the two groups. The independent variable was the group (children at risk for DCD and TD), whilst the dependent variables were the scores on EF and pre-literacy tasks. For the working memory abilities, there was a significant effect of the group on forward word recall [$F_{(1, 35)}$= 5.32; p=.022; η^2 =.135] and selective word recall [$F_{(1, 35)}$= 3.95; p=.05; η^2 =.104], but not on the dual task. Moreover, in the visuospatial working memory tasks, there were significant differences for pathway recall [$F_{(1, 35)}$= 10.97; p=.002; η^2 = .244], selective pathway recall [$F_{(1, 35)}$= 4.57; p=.040; η^2 = .118] and visuo-spatial dual task [$F_{(1, 35)}$=13.23; p=.001;η^2 =.280].

There also were significant group differences on the total Verbal fluency score [$F_{(1, 35)}$= 22.92; p=.000;η^2 = .403] and for each semantic category: animals [$F_{(1,35)}$= 15.66, p=.000;η^2 = .315], colors [$F_{(1,35)}$= 11.79, p=.002η^2 = .258], fruits [$F_{(1, 35)}$= 7.96, p<.008;η^2 = .190] and toys [$F_{(1, 35)}$= 10.18, p=.003;η^2 = .231]. Thus, children at risk for DCD showed worse performance on all the fluency assessments compared to TD children.

For inhibitory control, there was a significant effect of group on the accuracy of responses to congruent stimuli [$F_{(1, 35)}$=9.74; p=.004; η^2 = .223] and incongruent stimuli [$F_{(1, 35)}$=14.02; p=.001; η^2 = .292]with the group at risk for DCD having worse performance, although there was no significant difference in reaction times. Finally there were significant group differences on shape copying [$F_{(1, 35)}$= 16.72; p=.001] and letters identification [$F_{(1, 35)}$= 41.14; p=.000]

Discussion

Significant differences were found for most of the tasks which involved working memory, fluency and inhibitory control. In the tasks that assessed working memory, children at risk for DCD were significantly worse than the TD peers on the most verbal and visuospatial measures (forward word recall, selective word recall pathway recall, and selective pathway recall). This is a result well document in the literature showing a poorer performance on the working memory in children with DCD or at risk for DCD (Houwen et al., 2018; Vaivre-Douret et al., 2011; Wilson, 2013).

In relation to inhibitory control, the group at risk for DCD exhibited significantly lower performance compared to TD in the number of congruent and incongruent stimuli that they correctly identified. A developmental delay in the inhibitory control has been demonstrated in children with DCD (Michel, Molitor & Schneider, 2018; Ruddock et al., 2016).

The kindergarten children at risk for DCD in our investigation also showed significantly worse performance on all the verbal fluency and preliteracy tasks compared to the TD group. This could be linked to their lower performance on working memory tasks as verbal fluency competence requires the short-term memory of phonological information in order to allow the subvocal rehearsal and retrieve of cue words (Miller, 1984).

On the whole, the findings of our study suggest that at a relatively early age, children at risk for DCD not only have impairments to their motor system, but they also have impaired EF and literacy readiness on measures that would not be expected to be directly affected by motor difficulties.

The relationship between executive function and language in children with motor difficulties and Developmental Coordination Disorder

Marialivia Bernardi[1], Hayley C. Leonard[2], Elisabeth L. Hill[3], Nicola Botting[1], Lucy A. Henry[1]

([1]Division of Language and Communication Science, City, University of London, UK; [2]School of Psychology, University of Surrey, Surrey, UK; [3]Department of Psychology, Goldsmiths, University of London, UK)

Marialivia.bernardi@city.ac.uk

Background and aims

Executive function (EF) is an area of cognition that has received particular attention for its contribution to the development of language skills (Kuhn et al., 2014), and vice versa for its dependence on language skills (Petersen et al., 2015). However, the relationship between EF and language is still a largely unresolved matter. Given the consistent evidence of EF difficulties in children with language impairments (e.g., Henry et al., 2012), Bishop and colleagues (Bishop et al., 2014) have recently suggested three possible pathways towards the understanding of this relationship: 1) an EF deficit leads to language impairments; 2) language drives EF outcomes; 3) a third factor is implicated in determining both EF and language. A recent longitudinal study investigating the first two potential pathways has found little evidence for either of the models (Gooch et al., 2016). Given the strong concurrent relationship identified in young children in their study authors concluded that a third unmeasured factor could contribute to both EF and language (supporting the third suggested pathway).

There is some evidence to support the hypothesis that this third factor may be motor coordination, considering the reciprocal links between movement and both language and cognition (Hill, 2001; Piek, Dawson, Smith, & Gasson, 2008; Bernardi et al., 2018). Thus, motor coordination is a factor that, interacting with both cognitive and language development, may contribute to explain how EF impacts language ability or, vice versa, how language impacts EF.

The aim of the current study is to explore the role of motor coordination as a moderator of the relationship between EF and language. Two research questions were put forward: the first research question (RQ1) investigated whether motor coordination moderates the effect of EF on language; the second research question (RQ2) investigated whether motor coordination moderates the effect of language on EF. These questions were exploratory given the novelty of this research. However, considering the links between motor coordination and EF it was expected that the interaction between EF and motor coordination would significantly predict language outcomes.

Method

Participants were 7-11 year-old children (N=151) with varying levels of motor skills assessed through The Movement Assessment Battery for Children (MABC-2; Henderson et al., 2007). The Clinical Evaluation of Language Fundamentals 4th Edition (CELF-4-UK; Semel et al., 2006) was used to assess language abilities using two subtests: word classes

(receptive language) and formulated sentences (expressive language). A comprehensive assessment of EF was administered including a verbal and a nonverbal measure of all the following EF constructs: executive-loaded working memory, cognitive flexibility, planning, fluency and response inhibition. Children were excluded from the study if they scored more than two standard deviations below the mean on measures of intellectual ability, language and reading, or if they had any diagnosis other than developmental coordination disorder.
For both research questions, moderation models were tested using motor coordination as the moderating variable. Expressive Language and Receptive Language were used as two separate language variables, and similarly, composite scores of Verbal EF and Nonverbal EF were used as two separate EF variables. Moderation models explored the interaction effect of EF x motor skills on language outcomes (RQ1), and the reverse – the interaction effect of language x motor skills on EF outcomes (RQ2). When an interaction was found to be significant, the effects of the moderation were investigated in each model using slope analysis, by considering the relationship between EF and language at different levels of motor skills (Field, 2013).

Results

Moderation effects were significant when EF was the predictor of language outcomes, but not when language was the predictor of EF outcomes. Specifically, the interaction between motor coordination and *verbal* EF had a significant effect on both expressive (p=.037) and receptive language (p=.015), while the interaction between motor coordination and *nonverbal* EF had a significant effect on expressive language only (p=.021). In all these three models, the relationship between EF and language was positive and significant at low (ps<.003) and moderate (ps<.025) levels of motor skills, but not at high levels of motor skills (ps>.541). The relationship between nonverbal EF and receptive language was significant at all levels of motor skills (ps<.050), hence the moderation effect was not significant for this model.

Discussion

Language skills in children with low and moderate levels of motor skills were significantly predicted by their EF ability, while EF skills did not have any effect on the language abilities of children with high motor skills. Therefore, poor to moderate motor coordination skills could represent a risk factor for language ability, with EF skills acting as a potential protective factor in these children. Numerous studies support the concept of poor motor skills as a risk factor for lower levels of social, language, academic and cognitive functioning (Son & Meisels, 2006; Leonard, 2016; Leonard & Hill, 2014). The concept of EF as a protective factor has been proposed by Johnson (2012), who argues, based on individual variability, neuroimaging and genetic evidence, that EF acts as a compensatory system in the presence of atypical development. This view is partly supported by the significant genetic origins of individual differences in EF, which would indicate EF skills are largely independent from the development of other domains of functioning (Friedman et al., 2008).

Conclusions

EF predicted language at low and moderate levels of motor skills, suggesting that EF skills may be specifically relevant to language when a risk factor such as poor motor coordination is present.

Keynote2

Executive function and goal-directed behavior in children with Down syndrome

Deborah Fidler

(University of Colorado)

Executive function (EF) refers to the cognitive skills necessary for goal-directed behavior. An increasing body of research has demonstrated that EF is essential for many important adaptive outcomes throughout the lifespan. For individuals with Down syndrome, EF has been linked to academic outcomes, functional performance, and employment in adulthood. In this presentation, we will examine the development of EF during early and middle childhood with a focus on identifying patterns of relative strength and challenge. We will also discuss potential targets for intervention during the infant and toddler years in DS in order to promote positive developmental cascades and adaptive outcomes.

Session 4

Profound Intellectual and Multiple Disabilities (PIMD)

Assessment of voice discrimination in children with Profound Intellectual and Multiple Disabilities (PIMD)

Geneviève Petitpierre[1], Juliane Dind[1], Claudine Gremion[2]

([1]University of Fribourg, Département de Pédagogie spécialisée, Fribourg, Switzerland; [2]Direction de l'instruction publique de la culture et du sport, Service de l'enseignement spécialisé et des mesures d'aide, Fribourg, Switzerland)

genevieve.petitpierre@unifr.ch

Introduction

Research in developmental psychology opens several new methodological perspectives in the study of the cognitive and psychological functioning of people with PIMD (Chard, Roulin and Bouvard, 2013). Self-awareness is a topic which had never been empirically studied in this population before Dind (2017). In her research thesis, Juliane Dind built a standardized observational battery based on the theoretical models of Saulus (2011, 2009) and Rochat (2011, 2009, 2003). Her results on a group of 18 children with PIMD (7-12 years; mean = 9 years 4 months) allowed her to identify three clusters that were contrasted in the way children manifested self-awareness. This research is linked to Juliane Dind 's study. It aims to present the results of an experimental, currently unpublished, sub-study.

Objective

This study aims to observe whether children with PIMD are able to discriminate between two auditory stimuli, i.e. their own voice and the voice of a peer. We assume that the children's behaviors will differ according to their self-awareness abilities. Method: The setting is inspired by Legerstee, Anderson & Schaffer's (1998) experimental study in infants and consists of a simplified procedure of the Head-Turn Preference Paradigm for Auditory Perception (Kemler Nelson & al., 1995). Participants were recruited in five special schools in the French part of Switzerland. All met the definition of multiple disabilities proposed by Nakken and Vlaskamp (2007) and presented the characteristics described by Special Interest Research Group in Profound Intellectual and Multiple Disabilities-SIRG-PIMD (2001). Their hearing abilities were checked. Each participant (N=17) was presented alternately with a one-minute recording of their own voice and with a one-minute recording of the voice of a peer (close friend). The situation was repeated 3 times (7-21 average interval days) and videotaped. Procedural reliability of the setting has been calculated on 35% of the data with 5 indicators (child's position/place; instructions; interferent stimuli; operation sequence; stimuli) and averaged 86.6%. The children's videotaped behaviors were coded in accordance with the operational definitions of the dependant variables. The four DVs, coded along frequencies and durations (in seconds), were: facial expressions (smiles), vocalizations, active alert behaviors and head/trunk orientation. 40% of the data were coded by a second

annotator with an inter-observer reliability between 85% and 93% depending on the indicator (mean=89%). The protocol of the study has been approved by the Commission vaudoise d'éthique de la recherche sur l'être humain. We conducted nonparametric tests at two different levels: whole sample and cluster (subgroups) levels. Results: Wilcoxon tests showed a significant difference of the smile duration in the whole sample when the children were exposed to the voice of their peer in comparison to their own voice (V=85, z-value=-1.995, p-value=0.046). At the cluster level, a difference was also found in the group of children with the best self-awareness profile (Dind, 2017). In this group, children manifested a longer average active alert time behavior when they were exposed to the peer voice than when they were exposed to their own voice (V=40, z-value=-2.064, p-value=0.039). A significant interaction between cluster and exposition (peer/self) was also found with the "active alert" behavior for the subgroup with the best self-awareness abilities.

Discussion

Results show that it is possible for certain participants to discriminate between the two stimuli. This discrimination seems more obvious in the group of children with the "best self-awareness" profile (measured with the test built and validated by Dind (2017). While the results of this study cannot confirm with absolute certainty that participants recognize their voices as their own voice, it does confirm however that they can distinguish a difference between the two stimuli, a difference whose nature remains to be explored more precisely and in greater depth. Indeed, when we are confronted with our own voice in the form of a recording, the situation generally seems strange to us because we are deprived of the proprioceptive percepts that always accompany our oral expression. The parallels between the awareness profiles suggest that recognition abilities are probably present in some of the participants. It would have been interesting to use other stimuli, such as the voice of an unknown child, in order to broaden the points of comparison. In any case, showing the ability to react to the voice of a well-known friend is important insofar as this skill is very adaptive.

Finally, our research also highlights several issues relating to methodological constraints and conceptual backgrounds in this population. We noted in particular that smiles and active alertness behaviors seem to be better indicators than head/trunk orientation, which is under the influence of motor skills constraints. These observations may be useful in order to optimalize future experimental research with people with PIMD.

Identification of the expressions of self-awareness in children with profound intellectual and multiple disabilities (PIMD): creation of an observation tool based on developmental psychology research

Juliane Dind

(Département de pédagogie spécialisée, Université de Fribourg, Switzerland)

juliane.dind@unifr.ch

Introduction

The development of self-awareness is an important topic of research in developmental psychology: the first level of self-awareness, called "primary self-awareness" or "ecological self-awareness[1]" (ESA), plays a critical role in the psychological and intellectual development of the infant. This topic is nevertheless rarely investigated in research on children with disabilities, especially children with PIMD. Professionals face problems in observing S-A expressions of these children for lack of knowledge and instruments.

Aims

The aim of this doctoral research is to validate empirically two theoretical models[2] on self-awareness development, testing their predictions on a sample of children with PIMD. The research question is: how does ESA manifest itself in children with PIMD? Both theoretical models allows to postulate three hypotheses:

H1. The study of ESA manifestations enables to differentiate subgroups in children with PIMD

H2. The level of complexity of the behavioural manifestations of ESA distinguishes these subgroups

H3. The manifestations of ESA are expressed heterogeneously inside each subgroup

Method

Setting: The procedure consisted in two main stages: apreexperimental stage in order to test and stabilize the instrument (N_{part}=5), and the experimental stage (N_{par}t=18) in order to validate the instrument and to gather the data.

Participants: 23 children with PIMD aged between 4 and 12 years participated to the research, in four facilities of the French speaking part of Switzerland. 18 professionals (special needs education teachers) participated also.

Instrument: A situation-based list of 34 inducing tasks and 27 natural observation situations on ESA indicators has been created. Both kind of items have been distributed in five subscales. A part of the items have been selected in existing tools and adapted to children with PIMD; another part have been created, inspired by studies on self-awareness

[1]ESA refers to the infant's experience of his own body as a differentiated, organized, active, situated and animated entity

[2]Rochat(2000, 2006, 2011,2012); Saulus(2009, 2011, 2013)

development in infancy. The expected critical behaviours (2 points), emergent behaviours (1 point) and non-critical behaviours (0 point) are described in each item and are scored on a three-level score system. A global mean score has been calculated, and also a mean score per subscale. The analysis of the psychometrics qualities of the instrument shows a good internal consistency (α=.897) and interobserver agreement (81% of agreement on 50% of the data) and a high fidelity test-retest (the average measure ICC is .950). Procedural reliability is also high: 93%.

Intervention: The natural situations were observed in classrooms by the special needs education teacher; the inducing situations were administrated by the researcher during videotaped 8 to 13 sessions per participant. All the items were presented three times (during distinct sessions), resulting on 180 measures per child.

Type of analysis: a cluster analysis has been lead on the scores of the participants in each subscale. In order to compare the performances (mean scores) of the clusters, the results of a T test and of the complexity indexes have also been analysed.

Findings (Results)

The cluster analysis leads to the distinction of three clusters: one cluster of 10 participants, one of 7 participants, and one “cluster” of one participant. An analysis of the central tendency shows that mean scores of the clusters differ significantly ($p<.05$), the same with the complexity index (proportion of critical behaviours manifested in each cluster). A comparison of the standardized scores in each cluster shows that performances are not homogeneous inside the subgroups. These results validate the three hypotheses of the research.

Discussion

Results confirm the predictions of both theoretical models: ESA manifests itself in a multidimensional way in children with PIMD, following a very slowed developmental pathway. Children with PIMD manifest three distinct forms of (self)awareness: one form is ESA; the two other forms refer to more basic, rudimentary forms of awareness activities.

Conclusion

Developmental psychology research and existing instruments form a precious methodological and theoretical basis to investigate abilities of children with PIMD. My research shows that the creation of reliable direct observation tool for this target-group is possible, despite the need of adaptation to each child. Moreover, the study of ESA in children with PIMD enables to bring to light all the micro-stages of its development.

Session 5

Executive functions in learning and intellectual disabilities

The development of executive functioning in preschoolers with developmental disorders: ADHS Symptoms, Specific Language Impairment and Intellectual Disabilities

Claudia Mähler, Kirsten Schuchardt

(Institute of Psychology, University of Hildesheim, Hildesheim, Germany)

maehler@uni-hildesheim.de

Difficulties in executive functions (EF) are well known in children with several diagnoses, suggesting that EF problems might be an underlying factor of several developmental disabilities. The focus of the present study therefore was on investigating children with specific and isolated developmental disabilities without any comorbid diagnoses. Children with specific language impairments (SLI), children with intellectual disabilities (ID) and Attention Deficit Hyperactivity Disorder Symptoms (ADHD) usually all show difficulties in executive functioning (eg. Alloway, 2010; Henry et al., 2012). With regard to the EF model by Miyake et al. (2000) EF comprises different aspects of cognitive functioning, namely children´s abilities in updating, shifting and inhibition. Updating is the ability to store and manipulate information at the same time, shifting is needed to react to new information or new rules and adapt strategy use and inhibition indicates the ability to stop and control cognitive or behavioral reactions. The aim of the study was to find out if children with the diagnoses mentioned above show typical and definable abnormalities in EF, and if the development of EF follows the same or a different developmental course compared to typically developing children. To this end we first investigated children´s abilities in updating, shifting and inhibition tasks and second, we analyzed if the preschool teachers reported any problems in self-regulation.

Method

We investigated a group of preschool children using a longitudinal design at two assessment points: At the first assessment point (t1), we administered tasks on language development (expressive vocabulary: AWST-R; grammar: SETK 3-5), ADHD (FBB-ADHS), intelligence (CPM), and EF tasks at the age of five years. At the second assessment point (t2) when children were 6 years old, we assessed children's EF again and asked preschool teachers for a rating of self-regulation of the children using a questionnaire. To assess the three subcomponents of executive functioning children worked individually on a test battery (Updating: Wordspan backward, Complex span; Inhibition: Head-Toes-Knees-Shoulders Task (HTKS); Shifting: Dimensional Change Card Sort Test (DCCS)).

In a larger longitudinal study of preschool development we recruited 198 children from 15 day-care centers located in areas with different social backgrounds. Using the above mentioned tasks of language development, intelligence and attention problems a subsample

of 106 children was selected for the present longitudinal study: 22 children with ADHD Symptoms, 24 children with SLI and 24 children with ID and 35 typically developing children (CG).

Results

All collected data of the different executive functioning tasks were analyzed in a 4 (group) by 2 (age) factorial design. The results of the different subsystems were calculated separately.

	Group		age		group x age		Post-hoc
	$F(1,102)$	η_p^2	$F(1,102)$	η_p^2	$F(1,102)$	η_p^2	
Updating							
Wordspanbackward	2.62*	.102	16.19**	.190	<1	.041	ADHD>ID*; SLI>ID*;CG>ID*
Complex span	4.28**	.143	16.65**	.178	<1	.024	ADHD>ID*; SLI>ID*;CG>ID*
Inhibition							
HTKS	7.61**	.218	82.00**	.500	5.78**	.175	CG>ADHD*; CG>SLI**; CG>ID*
Shifting							
DCCS	3.80*	.104	32.29**	.275	1.81	.060	CG>ADHD*, CG>SLI*; ID>ADHD*; ID>SLI*
Teacher report							
Self-regulation	9.13**	.278	-	-	-	-	CG>ADHD**; SLI>ADHD**; ID>ADHD**

Note: **=p<.01; *=p<.05.

Our results showed that some abnormalities in executive functioning overlap between the groups of children with developmental disorders, but there are also definable and specific patterns of abnormalities for every specific disorder.

While children with ID have a specific deficit in updating, children with ADHD Symptoms have predominantly problems in the inhibition and shifting component of executive functioning. Children with SLI showed most problems in the shifting component. The preschool teachers only rated the self-regulation abilities of ADHD children as deficient. Our results indicate that a deficit in is not necessarily observed as overt behavior in all children. Inhibition problems may be visible for caregivers, whereas updating and shifting problems may escape their perception. Therefore, deficits in EF should be examined by measurements of executive performance. EF deficits lead to constant information processing deficits underlying SLI, ADHD and ID. Any schooling or treatment should keep that in mind and

help children not only to improve inhibition (ADHD), but also to improve the regulation of information processing with regard to updating and shifting (SLI, ID).

Meta-analysis of Executive Functions in Intellectual Disability

Malin Spaniol[1], Henrik Danielsson[2,3]

([1]Cognitive Science, Osnabrück University, Osnabrück, Germany; [2]Department of Behavioural Sciences and Learning, Linköping University, Linköping, Sweden; [3]Swedish Institute for Disability Research, Linköping, Sweden)

mspaniol@uos.de

Introduction

Executive functions (EF) is an umbrella term for different kinds of cognitive processes resulting out of a complex interaction between many brain areas. There is a consensus in the literature that EF consist of separated but related cognitive processes. A widely used EF model treats inhibition, shifting and updating as the target EF (Miyake et al., 2000).
EF are related to different cognitive processes, needed in every-day life, which are impaired in people with intellectual disability (ID). Theoretically seen, EF might therefore be the core concept in the studies about ID (Henry, Cornoldi, & Mähler, 2010). Some cognitive impairments seem to be common to different disorders, others are syndrome specific. Again others are not of permanent nature but can be explained by a cognitive delay (Kirk, Gray, Riby, & Cornish, 2015).
In the current study, EF abilities of individuals with ID were examined and meta-analytically juxtaposed with a mental-age-matched comparison group, to get a better understanding of EF in individuals with ID.

Methods

To identify relevant studies, a literature search was conducted in Scopus, PsycINFO, PubMed and Web of Science. The following key words were used:
“intellectual disability" AND ("executive functions" OR updating OR inhibition OR shifting).
Studies had to meet the following criteria to be included in the present meta-analysis:
(1) IQ or mental age was reported, the IQ in the experimental group was below 70, results for at least one of the following ID groups were reported: mixed ID, Down-Syndrome (DS), Prader-Williams-Syndrome (PWS) and Fragile-X-Syndrome (FXS), but no dual diagnosis; *(2)* a control group with matched mental-age was tested; *(3)* a minimum of 10 participants per group was examined; *(4)* results pertaining to at least one out of the three EF (inhibition, shifting and updating) were reported; *(5)* enough information was reported to calculate an effect size.
The collection of studies was conducted in four distinct stages, based on the PRISMA model (Liberati et al., 2009). Figure 1 illustrates the respective steps.

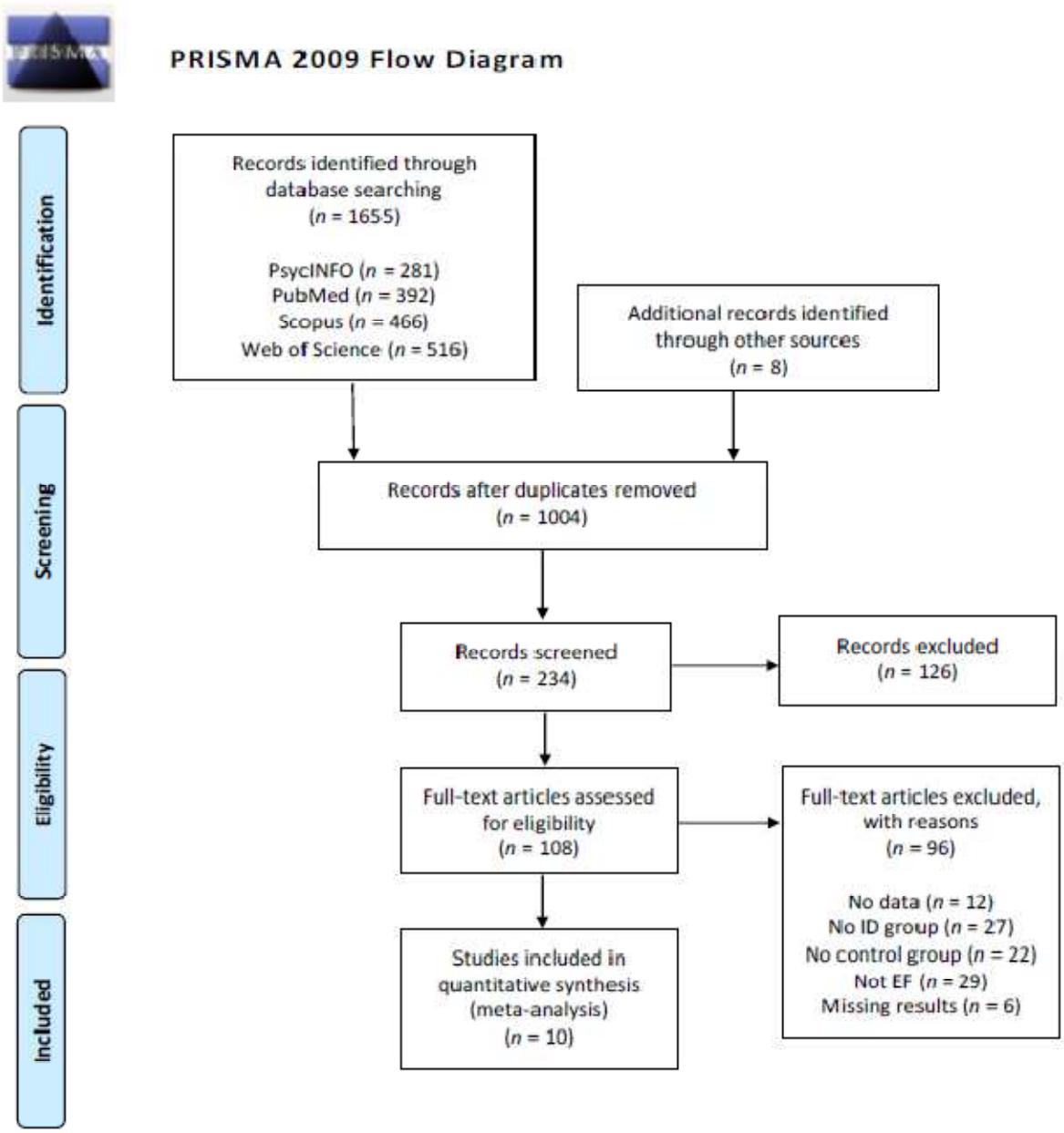


Figure 1. PRISMA flow diagram for the current meta-analysis

Analyses

The present meta-analysis includes 33 different effect sizes from 10 different studies. The effect size measure Hedge's *g* was chosen, because the number of participants per study was quite small and the group sizes differed. *g* refers to the standardized mean difference corrected for small group sizes. The analyses were conducted with the metafor package version 3.4.1 in R (Viechtbauer, 2010). A three-level meta-analysis was performed to account for data dependency due to multiple effect sizes within one study. *g* was estimated using the restricted maximum likelihood approach. Several moderator analyses were conducted, based on the coded variables (such as chronological age, mental age, IQ, sex percentage, EF type).

Results

Out of the total number of 33 effect sizes, 17 measured inhibition, 9 measured shifting and 7 measured updating. In total, data from 480 participants was included. The overall effect is small, but statistically significant, $g = -0.32$, $95\%\ CI = -0.61, -0.04$ and $p = 0.024$. The

mean effect size indicates that people with ID performed significantly worse on the EF tests than the mental-age-matched comparison group. However, individual effects ranged from *g = -2.20* to *g = 1.65*. The heterogeneity of the effect sizes was also statistically significant *Q (df = 32) = 245.037, p < .001* and *I2 = 85,8 %. 83,4%* of it could be attributed in order to true differences within-studies, only *2,4%* reflected the between-study variance. Moderator analyses were carried out to explain the heterogeneity, however, no significant moderator variables emerged. As there

were only 10 studies included in the analysis, a meta-regression model with multiple moderator variables was not feasible. The subgroup-analyses for inhibition and shifting was not significant *(g = -0.31, 95% CI = -0.727, 0.108), (g = -0.159, 95% CI = -1.015, 0.697)* but the heterogeneity in the model was significant *Q (df = 16) = 125.12, p<.001, Q (df = 8) = 86.416, p<.001*. For the updating subgroup, a significant effect was found *(g = -0.571, 95% CI = -0.993, -0.149)*, and the heterogeneity was not significant *Q (df=) = 11.191, p = 0.083.*

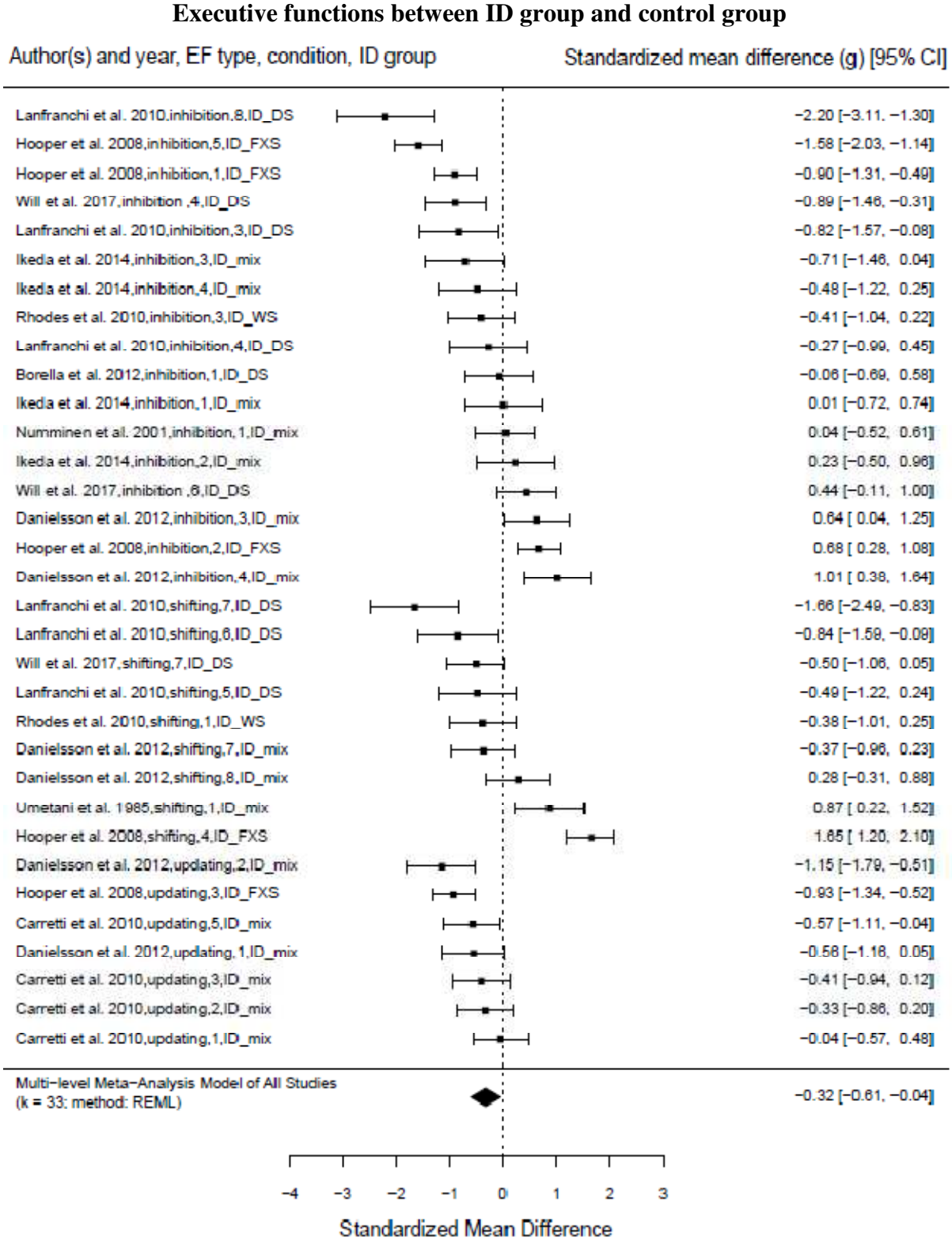


Figure 2. Forest plot for the present meta-analysis

Discussion

A three-level meta-analysis was used to compare individuals with ID to mental-age-matched people. This meta-analysis provides further evidence that people with ID perform below their mental-age expectation. However, the proportion of true heterogeneity in the data was large, indicating that the mean effect size should be interpreted with caution. No significant moderator variables could be identified. This could be due to the small number of studies included (10). When looking at the sub-groups, the significant effect has been found only for the updating measures. This indicates that the extent to which people with ID perform worse

than mental-age-matched people depends on the type of assessed EF. As different EF tap different areas in the brain (Happaney & Zelazo, 2004), some EF can be more impaired than others. For the inhibition and shifting measures, it seems that the ID group does not perform below the mental-age-level. Thus, further studies are needed to confirm our preliminary findings. The differences between effect sizes found in the present meta-analysis indicate that research dedicated to EF is very heterogeneous. One reason for this could be that different tasks are used to gauge a particular EF across studies. Indeed, it has been acknowledged in the EF research field that the ecological validity is quite low, as there are many different EF tasks (Ardila, 2008). Moreover, updating is rarely assessed independently of WM. However, according to Miyake and Friedman´s model (Miyake et al., 2000), WM and updating are not equal. Furthermore, only few studies measured all three EF. Some researchers only examined one of the three EF types. Therefore, we encourage other researchers to systematically compare people with intellectual disability with mental-age-matched individuals on several EF types.

Variables associated with Planning Ability in Children with and without Intellectual Disability

Lisa Palmqvist[1,2], Henrik Danielsson[1,2], Arne Jönsson[3], Jerker Rönnberg[1,2]

([1]Department of Behavioural Sciences and Learning, Linköping University, Linköping, Sweden; [2]Swedish Institute of Disability Research, Linköping, Sweden; [3]Department of Computer and Information Science, Linköping University, Linköping, Sweden)

lisa.palmqvist@liu.se

Introduction and aims

Planning in everyday life is related to being able to divide complex everyday tasks into smaller tasks into smaller subtasks and organize them in time and space. One needs to be able to see what needs to be done and in what order. Planning involves several cognitive abilities and is defined as a complex executive function involving several executive functions: inhibition, working memory, and cognitive flexibility (Diamond, 2013). Intellectual disability affects the individuals' cognitive, behavioural, and adaptive functioning, including deficits in several cognitive domains such as executive functioning and planning (American Psychiatric Association., 2013). Impaired executive functions have been observed in people with intellectual disability (e.g. Danielsson, Henry, Messer, & Rönnberg, 2012; Danielsson, Henry, Rönnberg, & Nilsson, 2010). Thus, everyday planning is an area where difficulties occur for individuals with intellectual disability. However, research investigating the relationship between everyday planning and cognitive abilities is sparse. This study aimed to fill this gap by studying whether planning ability could be associated with group belonging, mental age, working memory capacity, fluency, and cognitive flexibility.

Methods

Materials and assessment

Planning ability was tested in a pen-and-paper version of the test The Children's Cooking Task developed by (Chevignard, Catroppa, Galvin, & Anderson, 2010). The participant is asked to sort and convert a recipe in the correct order and aims to measure ecologically valid planning. The total number of correct order recipe-steps was used as a raw score.

The participants' *mental age* was measured using Raven's Coloured Progressive Matrices (RCPM; Raven, Raven, & Court, 1998). The total number of correct responses was used as a raw score to match the two groups.

Non-verbal working memory capacity (WMC) was measured using backwards Corsi span. The test was administered using the open software PEBL test battery on a computer (Mueller & Piper, 2014). The mean span for correct sequences was used as a raw score.

The *semantic category fluency* task was used to measure verbal fluency (Delis, Kaplan, & Kramer, 2001). The participant was encouraged to name as many different items as possible in four categories for minute, one category at the time. The raw score for fluency was total number of correct answers in all three categories together.

To test *cognitive flexibility* the subtest Playing Cards in BADS-C (Emslie, Wilson, Burden, Nimmo-Smith, & Wilson, 2003).) was used. The test was performed two times, with different rules. The total number of wrong answers in the second run was used as a raw score for cognitive flexibility. Note that a high score equals a lower performance.

Participants

A total of 130 participants were included in this study. Participants with ID (n = 67) were recruited from schools for children with special needs and mental age-matched typically developed children (TD; n = 63) from regular schools. The mean age of the children with ID was 18.61 (SD = 1.35) years and for children with TD was 8.05 (SD = 0.74) years. To match on mental age 18 participants were removed. We excluded participants with a score below 15 on RCPM and participants with one or more missing values. The groups were then compared on mental age, $t(128)= 0.79$, p = .43. This indicated that the groups were reasonably well matched on mental age.

Data analysis

An independent t-test was used to investigate if the two groups differed on mental age. A robust multiple regression analysis was performed (Field & Wilcox, 2017). The robust regression was chosen because some variables did not have a normal distribution and works better than a traditional regression analysis in these situations. The dependent variable was planning ability, and the predictor variables was group, mental age, WMC, category fluency, cognitive flexibility, and the interaction terms mental age*group, WMC*group, cognitive flexibility*group, and fluency*group.

Results

Children with ID performed slightly better than TD at planning, cognitive flexibility, and fluency. TD had higher scores in WMC, and mental age. Descriptive values of the variables included can be found in Table 1.

Table 1.

Mean (M) and standard deviation (SD) of the variables included in the regression

	Planning		WMC		Cognitive flexibility		Fluency		Mental age	
	M	SD	M	SD	M	SD	M	SD	M	SD
ID (n = 67)	10.97	2.56	3.38	1.15	3.06	3.1	38.16	12.1	24.27	5.3
TD (n = 63)	10.3	2.08	3.98	0.98	2.79	3.05	36.84	8.75	24.98	5

Note. WMC = Working Memory Capacity, ID = Intellectual Disability, TD = Typically Developing.

Regression

The result from the analysis predicting planning can be found in Table 2. The significant predictors were cognitive flexibility and group, indicating that the higher score on cognitive flexibility, the better planning and if you were in ID group the better you planned. WMC, the

interaction term mental age and group and the interaction term cognitive flexibility and group were close to significant ($p < .01$).

Discussion

The results from this study show that planning is associated to cognitive flexibility, as well as group belong (ID vs, TD). Planning in everyday life involves being able to handle an ever-changing world and shift one's behaviour. Cognitive flexibility might thus be important when planning. The results also showed that the ID group performed better on the planning task, suggesting they have had time to learn planning a recipe as they have higher chronological age than the TD group. The nearly significant predictors mental age*group and cognitive flexibility*group signals that different variables can be more important in the two groups, this must however be further investigated.

Table 2.

Regression coefficients predicting planning ability. $R^2 = 0.36$

	B	*SE*	*p*	
Mental age	0.02	0.06	.719	
Working Memory Capacity	0.50	0.29	.079	
Cognitive flexibility	-0.28	0.09	.003	**
Fluency	0.01	0.02	.506	
Group (Typical Developing= 1)	-6.30	2.47	.012	*
Mental age*Group	0.13	0.07	.082	
Working Memory*Group	-0.15	0.39	.704	
Cognitive flexibility*Group	0.21	0.11	.075	
Fluency*Group	0.05	0.03	.172	

Note. ** = $p < .01$, * = $p < .05$

Behavioural Patterns in a Computerized Training Program for Individuals with Intellectual Disabilities

Arne Jönsson, Lisa Palmqvist, Henrik Danielsson

(The Swedish Institute for Disability Research, Linköping, Sweden)

arne.jonsson@liu.se

Introduction

Children with intellectual disabilities (ID) has problems with many aspects of executive functions including inhibition (Danielsson, Henry, Messer, & Rönnberg, 2012). It is reasonable to think that problems with those abilities would affect the behaviour in computer games. More specifically, we think that it would lead to more time to succeed, more irrelevant mouse clicking, and more mistakes. This leads to less learning in the game and a lower playing pace (van de Sande, Segers, & Verhoeven, 2015). The present study sought to investigate patterns which would help designing an application for individuals with intellectual disability (ID) to better handle such behaviours. Several aspects of behaviour of individuals with ID were investigated, including non verbal intelligence, cognitive flexibility and playing performance. We compared the patterns of the ID group to the data of a control group of typically developing (TD) children with approximately the same mental age.

The Application

The application PlaneraMera[1] is a game that helps the user train planning by helping an alien to learn how to plan everyday tasks such as making breakfast or doing the dishes. For example, to make breakfast you need to collect juice, bread, butter and cheese. They are then to be ordered correctly, such as putting butter on the bread, not the bread on the butter. The tasks had different levels of difficulty, from collecting and sorting two items up to six. Solving a number of such task gives the player an item to put in the alien's rocket. These item scan be inspected at all times.

Participants

Seventeen individuals with ID, from different schools in Sweden participated in the study. The mean age of the participants was 18.1 years (SD = 1.54). The study also included 27 TD children as a control group. The mean age of the TD group was 8.02 years(SD = .79). The TD group were matched on mental age. All participants played the application for 15 minutes every school day for one month.

[1]Planeramera is Swedish for plan more.

Playing behaviour

We explored two types of playing behaviour by analysing log data. Activity level were measured by looking at how many clicks per minute the participant performed in the beginning compared to the end of the training period. Learning in the application was measured as the improvement rate for each sorting condition. A comparison within each group was made. The mean error-rate of the last 25% was subtracted from the mean error-rate of the first 25% and then divided by the mean error rate of the first 25%. This was done for two different difficulty levels.

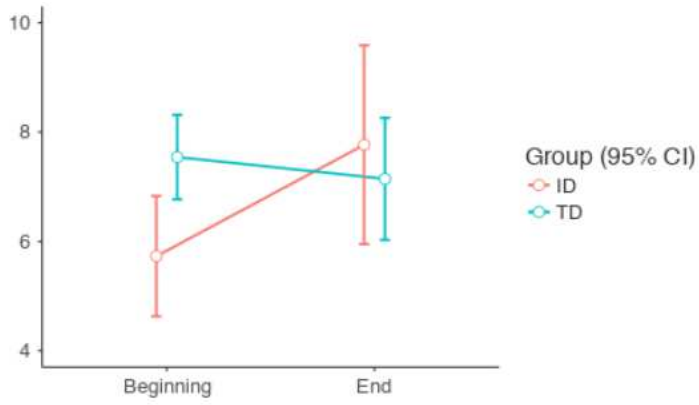


Figure 1: Clicks per minute for the intellectual disabilities (ID) and typically development (TD) groups in the beginning and the end of the training period

Results and discussion

Three repeated measures ANOVAs were conducted. The first showed a non-significant main effect for group ($F(42, 1) = 0.61, p = .44$), and a significant effect on clicks per minute in the beginning and in the end($F(42, 1) = 4.42, p = .04$), and a significant interaction time between group and time ($F(42, 1) = 9.75, p = .003$).The participants with ID started with less clicks per minute than TD, but in the end, they were using the same amount of clicks per minute, see Figure 1. This tells us that the participants with ID are more careful and play less actively than the TD participants in the beginning but catches up in the end of the training period.
A second repeated measures ANOVA investigating learning on the easier Level 1 showed a close-to, but non-significant group effect ($F(42, 1) = 3:65, p = .063$), a significant effect on error rate in the beginning and in the end ($F(42, 1) = 40.93, p<.001$), and a non-significant interaction time between group and time ($F(42, 1) = 1.85, p = .18$). The ID participants solve on average slightly less tasks than the TD participants, and both groups improved in the end of the training period, see Figure 2.
The same pattern can be seen in the third ANOVA on the more difficult Level 3, with a smaller, still non-significant group effect ($F(37, 1) = 0.31, p = .58$), a significant effect on error rate in the beginning and in the end ($F(37, 1) = 5.66, p = .02$), and a non-significant interaction time between group and time($F(37, 1) = 0.01, p = .91$). Both groups improved in the more difficulty level, see Figure 2.

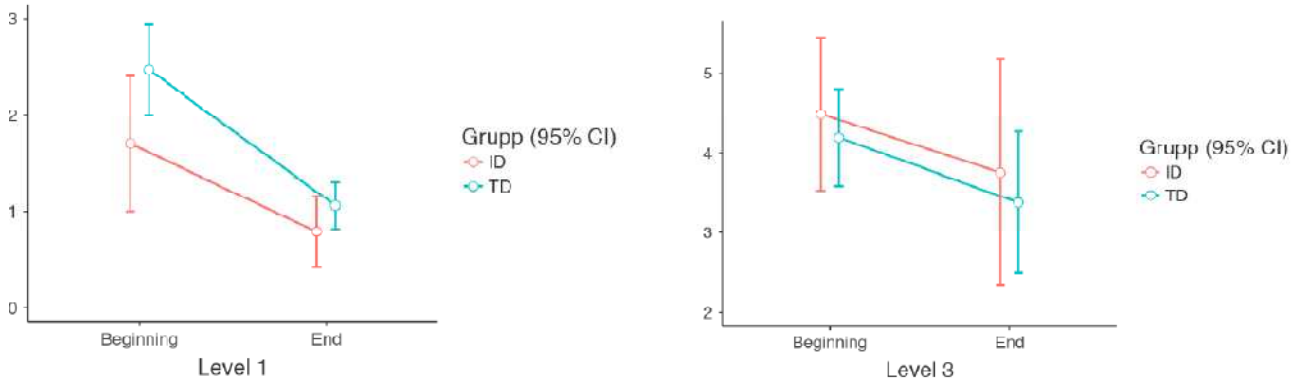


Figure 2: Error rate level 1, left and error level 3, right, for the intellectual disabilities (ID) and typically development (TD) groups in the beginning and the end of the training period

For learning in the application, we can conclude that both groups did improve on most of the tasks, but mostly in the easier tasks. Both groups improved as much. There was also a change in how actively the ID
group played which could be a sign of adapting a new strategy of trail-and-error. The results from the study helped to create a better understanding of how individuals with ID behave in applications, and will contribute to the design and development of applications that aim to provide aid to these individuals in their everyday life.

Session 6

Math in learning and intellectual disabilities

Math Intervention Using Tablets for Children with Intellectual Disabilities

Daniel Schöld, Ulf Träff, Rickard Östergren, Anna Levén

(Department of Behavioural Sciences and Learning, Linköping University, Linköping, Sweden)

daniel.schold@liu.se

Aims

Individuals with an intellectual and/or developmental disabilities (IDD) struggle to learn even the basics of mathematics (e.g., Bashash, Outhred & Bochner, 2003). Therefore it is important to work on didactic tools that can help most, if not all, of the individuals with IDD who are attending special education classes. In order for more children with IDD to reach the goals of the curriculum, more insight into the underlying mechanisms of how they learn basic mathematics must be obtained. The main purpose of our study was to examine the effectiveness of a computerized intervention, to help children with IDD learn basic mathematics.

A problem with this is that basic mathematics is not a single skill, but rather a collection of different skills and abilities (e.g., Rittle-Johnson, Siegler & Alibali, 2001). For some time, there has been some consensus regarding how typically developing (TD) children learn basic mathematics (e.g., Gelman & Gallistel, 1978; Liebeck, 1984). Due to the lack of research, such a consensus does not exist (to our knowledge) when it comes to children with IDD.

Method

Our study included four participants, two boys labelled P1 and P4 (14 and 16 years old) and two girls labelled P2 and P3 (both 13 years old). They all attended special education school in Sweden, with one of the girls attending a special needs class for children with more severe disabilities.

Our testing can be divided into three parts: pre-test, testing during intervention (repeated measures), and post-test. During pre- and post-tests, we tested counting ability, number-object correspondence, number naming, non-symbolic number comparison (NSNC), and symbolic number comparison (SNC). Counting ability was divided into two parts, the first was counting aloud to 20, and the second part was to count from a given number and five up (e.g., from 3 to 8). The number-object correspondence test was conducted by using 20 wooden cubes, and the participants were asked to give the tester a certain number of them. For number naming, participants were shown numbers on a computer screen, and asked to name the number. The numbers shown were 1 through 9, each appearing twice, and 10 through 20, with each appearing once. The order was the same for all participants, and the order was randomized prior to testing. The number naming test was timed. NSNC was performed using Panamath (v.1.21), and here the participants had to quickly determined

which coloured dots (yellow or blue) there were more of. Four different ratios (1.28; 1.46; 1.75; 2.75) were presented 12 times each, resulting in 48 trials. Surface area varied on half of the trials, along with dot size. This was to control for confounding variables and ensure attention to numerosity. Panamath recorded response time and accuracy, and generated an estimated of acute number sense (ANS) acuity (*w*), which is based on accuracy at each of the four ratios. Lastly, testing SNC was performed using SuperLab PRO (v.4.5). Here the participants were presented with two numbers, and quickly had to determine which was numerically larger. Two numerical distances were used: 1 (e.g., 4 vs. 5) and 4-5 (eg., 2 vs. 6 and 4 vs. 9). Sixteen unique pairs of single-digit numbers were presented, and each pair was presented twice in a reversed position (e.g., 1 vs. 2 and 2 vs. 1). This resulted in 32 trials for each participants for each participant. Response time and accuracy for each trial was recorded by SuperLab.

Testing during intervention was performed three times per week, on Monday, Wednesday, and Friday. These repeated measures were a test of basic arithmetic fluency, and the participants were asked to solve as many arithmetical problems as possible within 2 minutes. The problems were 32 addition problems, and 16 subtraction problems. The addition problems were split into two blocks. The first consisted of 16 problems where the correct answer is single-digit, and the second block was 16 problems where the answer was double-digit between 10 and 14. All the subtraction problems have single-digit numbers as the correct answer. The order these blocks were presented was first the 16 addition problems with single-digit answers, then the subtraction problems, and then the last 16 addition problems.

Findings

P1 went from having a reverse numerical distance effect during pre-test to a classic numerical distance effect at post-test. He also had a significant (Tau-U = .8846, p = .0092) improvement when it came to giving correct answers during intervention. P2 improved her counting ability and speed from pre-test to post-test. She also had a significant (Tau-U = .7917, p = .0212) improvement in total answers given during intervention. P3 (who attended special needs class) improved somewhat in terms of speed from pre-test to post-test, and had no improvement during intervention. P4 performed the best at pre-test, with little room for improvement, but did improve somewhat in terms of speed. He also had a significant (Tau-U = .9091, p = .0195) improvement for total answers given, and approached significance (Tau-U = .6970, p = .0734) for correct answers given.

Conclusions

As the purpose was to evaluate an app's usability for children with IDD, one has to look at the results from both pre- and post-tests as well as the repeated measures. Overall, the results points to the app being effective – as 3 out of 4 participants had significant improvements and improved in areas they had practiced while playing the app. The one participant who did not improve had a severe IDD, but it is important to not rule out that the app or similar training can be effective for other individuals with severe IDD.

The number race: an adaptive videogame to improve basic numeracy in children with Down Syndrome

Silvia Lanfranchi[1], Francesco Sella[2], Marco Zorzi[3]

([1]Department of Developmental Psychology and Socialization, University of Padova, Padova, Italy; [2]Department of Experimental Psychology, University of Oxford, Oxford, UK; [3]Department of General Psychology, University of Padova, Padova, Italy)

silvia.lanfranchi@unipd.it

Basic numerical skills are fundamental for daily living in the modern society, and support school mathematics achievement. Several studies have shown difficulties of children with Down Syndrome (DS) in this area and particularly in discriminating numerosities (e.g. Sella et al., 2013), counting (e.g. Gelman and Cohen, 1988; Nye et al., 2001) and numerical estimation (e.g. Lanfranchi et al., 2015).

The present work aims to explore the possibility to train basic numerical skills in children with DS trough play with an adaptive videogame, "The Number Race" (Wilson et al., 2006; the Italian version by Berteletti et al., 2010), that is aimed at enhancing number sense, cementing the links between representations of number, conceptualizing and automatizing arithmetic, and maximizing motivation. The player competes against the software in a numerical comparison task by choosing the larger between two numerical quantities that range from 1 to 9. The quantities can be represented either as object sets (i.e., non-symbolic), digits, or as the result of small additions or subtractions. An adaptive algorithm modulates the difficulty of the task in order to keep it at an optimal challenging level for each child, thereby working in the individual "zone of proximal learning" (Vygotskij, 1978).

Method

A group of children with DS (age 7-14 years) took part to the study. Half of it was trained on basic numerical skills (experimental group) while the other half (control group) was trained on basic reading abilities (letter, syllable and small words reading). For both groups, training was administered individually and lasted ten weeks, with two weekly sessions of 20-30 minutes each.

An ABA design has been used to evaluate the success of the cognitive training. The first A phase was the baseline, the B phase the treatment (training), and the second A phase the post-treatment baseline. At pre and post-test several aspects of basic numeracy were assessed such as numerical intelligence (lexical, semantic and syntactic representation of numbers), counting, the ability to map numbers on a number line, the ability to compare quantities and digits. Moreover letter detection, syllable, word and nonword reading were assessed in order to verify the effectiveness of the control training. Finally general intelligence was assessed.

Results and Conclusion

Preliminary results showed that, compared to the control group, the experimental group had a great improvement in the ability to choose the larger between two digits presented in the auditory form, in the estimation ability, particularly in the small number range (up to 4), calculation and counting. Children that received the numerical training also seem to improve

in their semantic representation of numbers, in their ability to map numbers in a number line task, with lines intervals of 10 and 20, in their ability to compare digits, and generally in their global numerical intelligence score. Small improvements can be seen in presyntactic numerical knowledge. Taken together these results suggested the efficacy of using the number race, an adaptive videogame, to train basic numerical abilities in children with DS.

Mathematical ability in subtypes of readers

Åsa Elwér, Ulf Träff, Stefan Samuelsson

(University of Linköping, Linköping, Sweden)

asa.elwer@liu.se

Background

Based on the Simple View of Reading, a deficit in reading comprehension is the result of a specific problem in one (or both) of the two skills involved in reading comprehension (i.e., decoding or linguistic comprehension) (Catts, Adlof, & Weismer, 2006). Individuals defined as poor comprehenders often show depressed vocabulary, verbal memory, grammar, inference making and metacognitive skills (Hulme & Snowling, 2011). Individuals with compromised decoding indicating dyslexia or specific reading difficulties show compromised phonological processing skills, retrieval and spelling (Vellutino, Fletcher, Snowling, & Scanlon, 2004). The cognitive and language profiles of the subtypes of reading difficulties could be based on processes that are either domain specific to reading or domain general, such as working memory affecting a range of school subject including the development of in mathematics. In math, poor decoders are mainly characterized by compromised arithmetic fluency, but also depressed arithmetic ability and problem solving (Träff & Passolunghi, 2015). The few studies that have examine mathematic skills in poor comprehenders report compromised mathematical reasoning and problem solving (Pimperton & Nation, 2010; Vukovic et al., 2010).

Aims

The aim of the present study is to examine mathematical abilities in subtypes of readers in grades 4 and 7/8, and examining domain general vs. domain specific abilities connected to language and reading performance. Few studies have examined mathematical ability of poor comprehenders and most studies have focused on the early years of school. Our aim was to study how mathematical skills are developed in later grades for different types of readers.

Methods

The present study has used data from the international longitudinal twin study (ILTS) (Byrne et al., 2002; 2005; Samuelsson et al., 2005; Olson et al., 2011). The ILTS includes a population sample of twins, with parallel data collected in four different countries. In the present study, the Swedish sample of ILTS including 200 twins assessed in grades 4 and 7/8 were examined. The cognitive and language battery included rapid naming (CTOPP: Wagner et al., 1999), decoding efficiency (TOWRE: Torgesen, Wagner, & Rashotte, 1999), spelling (WRAT; Jastak & Wilkinson, 1984) and listening comprehension (WJ-III; Woodcock, McGraw, & Mather, 2001). Reading comprehension was assessed using two tests (Woodcock, 1987; MacGinitie & MacGinitie, 1989) as was vocabulary (Kaplan, Godglass, & Wintraub, 2001; Dunn & Dunn, 1997).

Three tasks were used to assess mathematical ability. The fluency task assessed arithmetic fluency using a speeded test were children are asked to solve as many arithmetic problems as

possible in three minutes. This subtest includes addition, subtraction and multiplication (Woodcock et al., 2001). The problem solving task from the same test battery consist of 62 word problems, with increasing difficulty. The problems were read by the experimenter, but were also available for the children to read by themselves. The test assessing arithmetic ability (WRAT-3:Wilkinson, 1993) consisted of 26 items which includes computation tasks in all four basic operations, fraction comparison, time conversions between hours and minutes and square of a single digits. The difficulty of the problems was increasing.
The groups were selected from the ILTS Swedish data set including 348 twins in grade 4, but only those 200 twins that had participated in the follow up 3-4 years later were included. In accordance with the simple view of reading three subgroups were selected based on decoding ability and listening comprehension, using- 1 SD as a cutoff criteria (Elwér, Keenan, Olson, Byrne, & Samuelsson, 2013). *Typical readers* (N =141) showed performance above cut off on both dimensions, *poor decoders* (N = 19) exhibited below cutoff performance in decoding but above in listening comprehension. The opposite profile, were exhibited by the *poor oral comprehenders* (N = 26). No students exhibited below cut off on both tests.

Results

As the subgroups were defined, skills associated with phonological processing and retrieval speed were compromised in poor decoders, and abilities associated with general language skills were compromised in poor oral comprehenders (Table 1). These patterns were consistent between grade intervals of three/four years. As for mathematical ability, the poor decoders showed depressed results in problem-solving in grades 7/8. The fluency task was consistently low in this group of poor decoding readers. The poor oral comprehender subgroup showed compromised arithmetic ability at grade 4 and depressed problem-solving skills compared to typical readers across grades.

Table 1.
Group comparisons, mean Z-scores and standard deviations for reading groups

	Poor decoders (*N*=19)	Poor oral comprehenders (*N*=26)	Typical readers (*N*=141)	F (2, 183)
Language and reading				
RAN				
Grade 4	-1.29(1.37)$_a$	.42(.87)$_b$	.12(.79)$_b$	25.06**
Grade 7/8	-1.19(.96)$_a$	.16(.80)$_b$	.08(.96)$_b$	25.06**
Decoding				
Grade 4 $_{(gs)}$	-1.44(.35)$_a$	.19(.69)$_b$	.34(.75) $_b$	52.27**
Grade 7/8	-1.69(.77)$_a$	.06(.72)$_b$	.24(.87) $_b$	43.72**
Spelling				
Grade 4	-1.00(.70)$_a$	-.14(.66)$_b$	.27(.79)$_c$	24.30**
Grade 7/8	-1.41(1.08)$_a$	-.08(.56)$_b$	.24(.90)$_b$	29.44**
Vocabulary				
Grade 4	.32(.78)$_b$	-1.35(1.24)$_a$	.37(.80)$_b$	43.05**
Grade 7/8	.27(.76)$_b$	-1.34(1.06)$_a$	.25(.80)$_b$	40.32**
Reading comprehension				
Grade 4	-.44(.85)$_a$	-.69(.60) $_a$	.48(.85)$_b$	29.52**
Grade 7/8	-.47(.95)$_a$	-1.02(.88)$_a$	.32(.83)$_b$	31.77**
Listening comprehension				
Grade 4 $_{(gs)}$	.32(.63)$_b$	-1.67 (.46)$_a$	.47(.77)$_b$	96.38**
Grade 7/8	.31(.72)$_b$	-1.00(.83)$_a$	.19(.91)$_b$	21.09**
Mathematics				
Arithmetic ability				
Grade 4	-.20(1.02)	-.19(.63)$_a$	0.20(.93)$_b$	3.27*
Grade 7/8	-.35(.79)	-.33(1.05)	.14(.96)	4.32*
Arithmetic Fluency				
Grade 4	-.68(.567)$_a$	.14(1.06)$_b$	.16(1.01)$_b$	6.09**
Grade 7/8	-.90(.82)$_a$	.05(.95)$_b$	.12(.99)$_b$	9.18**
Applied problems				
Grade 4	-.26(.69)	-.32(.77)$_a$	.25(1.06)$_b$	5.09**
Grade 7/8	-.41(.74)$_a$	-.45(.84)$_a$	.20(.99)$_b$	7.77**

Gs = group selection variable

*.05, ** .01

Subscripts a, b, c denote group differences, groups with significantly different results have different subscripts.

Conclusions

The results suggest that compromised reading and language skills selectively impair mathematic abilities. Compromised decoding skills are associated with depressed arithmetic fluency. Over time this may influence problem solving ability, as the problem solving skills of the poor decoders was depressed compared to typical readers in grade 7/8 These results are in line with theories suggesting impaired verbal number codes and /or access to the number codes in children with dyslexia (Träff et al., 2017). Poor comprehenders show compromised problem solving skills, possibly a result of problems in building mental representations of mathematical problems (Kintsch & Greeno, 1985).

Counting and subitizing abilities in Williams syndrome and Down syndrome: Evidence from eye tracking

Erica Ranzato, Jo Van Herwegen

(Kingston University, London, UK)

e.ranzato@kingston.ac.uk

William syndrome (WS) and Down syndrome (DS) are two genetic disorders which share the same IQ range but differ in their relative cognitive abilities, in particular their visual-spatial and language skills (Paterson et al., 2006). Previous studies have shown that both individuals with WS and DS exhibit several mathematical difficulties when compared to typically developing (TD) individuals (Paterson et al., 2006; Sella et al., 2013). Nonetheless, the investigation of their basic numerical skills – such as subitizing and counting - is scarce and
the existing evidence is not entirely conclusive. Subitizing is the ability to enumerate accurately small sets of items without counting them (Kaufman et al., 1949). Two types of subitizing have been identified: perceptual subitizing and conceptual subitizing (Clements, 1999). Perceptual subitizing is supported by the Object Tracking System, it is present from early infancy onward and it is limited to 3 items (4 items for adults). Conceptual Subitizing is a more advanced ability based on patterns and attentional mechanisms and its limit is related to the mean that is used – i.e. it is limited to 6 in the case of a die but goes up to 10 in the case of hand fingers. Both subitizing and counting are implicated in numerical development (Benoit, 2004).

Previous researches have shown that subitizing abilities are impaired in individuals with DS (Sella et al., 2013) and are preserved in children with WS, but delayed in adulthood (Paterson et al., 2006). As for the counting abilities, and in particular the understanding of cardinality, it is delayed in individuals with WS (Ansari et al., 2003), while for individuals with DS this is still unclear (Abdelahmeed, 2007).

These studies focus on Response Times (RTs) and Error Rates, but omit considerations related to the temporal aspect of the task. RTs and error rates only provide information about the already completed task (Mock et al., 2016).

In order to gain on-line information on cognitive processing involved in subitizing and counting, this study used eye tracking methodology. This allowed us to examine how attention and visual scanning may affect counting and subitizing behaviours on these two populations, especially as previous studies have suggested that those with DS have sustained attention difficulties which may impact on counting abilities (Karmiloff-Smith et al., 2012). With regard to individuals with WS, their gaze-behaviour is characterised by "sticky fixation" (Van Herwegen, 2016), i.e. by the inability to disengage attention from a previously fixated target to a new target.

The first aim of this study was to examine:

a) Whether participants with WS and DS are able to perform both perceptual and conceptual subitizing. Based on previous studies, we predicted that those with DS would show a deficit in subitizing and that they would show slower RTs than the control. As for WS, we did not expect any significant difference in RT.

b) Whether participants with WS and DS show impaired counting abilities. Because of their alleged superficial understanding of counting, we expected both DS and WS to show greater RTs and lower accuracy rates than TD.

The second aim was to investigate whether qualitative differences in the gaze-behaviour of DS and WS populations could be observed when subitizing and counting. To pursue this issue, we looked into fixation count, the fixation ratio, and the average fixation duration.

Given the known sustained attention issues that affect individuals with DS, we expected to observe shorter fixations in DS participants.

As for WS, we expected to observe longer fixation duration.

Seventy participants took part in the experiment: 23 TD, 23 individuals with DS and 24 individuals with WS. Participants were recruited through local charities and preschools.

Participants were evaluated in a quiet room in the laboratory. The session started with assessment of mental age (RCPM), followed by visuospatial abilities (Pattern Construction, BAS-II), mathematical knowledge (Numerical Operations – WIAT- II, Number Familiarity) and computerized dot-counting task. Here, participants were presented with 1 to 6 dots for an unlimited duration over 12 trials and were asked to report ‘‘how many’’ dots were presented on the screen, as rapidly as possible, while remaining accurate. In half of the trials these dots were presented in a random pattern, in the other half they were presented as a dice pattern.

Thus, the experiment consisted in 4 experimental conditions: 2 Patterns (Random vs Dice) x 2 Numerosity Levels (below subitizing range vs above subitizing range).

In the examination of data, participants for which the eye tracking data were not recorded for more than 50% of the total duration of the trial were excluded. We analysed accuracy, RT, fixation duration and the fixation ratio in a 2 [Pattern] x 2 [Numerosity] x 3 [Group] mixed ANOVA with Numerosity and Pattern as within-subjects factors and Group as between-subjects factor. When analysing RT, fixation ratios and fixation count, data from incorrect responses were not considered.

Analyses of RT and error rate suggest that individuals with DS and WS are not impaired when subitizing and counting. As expected, we found a main effect of Numerosity and Pattern on RT and error rate but the main effect of Group was not significant nor for RT $F(2, 61) = 1.467$, $p = .239$, or for error rate $F(2, 61) = .492$, $p = .614$.

Preliminary analyses of the fixation behaviour show qualitative differences between DS and TD populations. In particular, we found a main effect of Group on fixation ratio. Follow-up comparison showed a greater fixation ratio for DS and shorter fixation durations in all experimental conditions. Also, in DS the number of fixations was even larger than the number of dots itself, indicating frequent corrective eye movements during the counting process.

In summary, our results suggest that RTs and error rates are not sensitive enough to gain information on cognitive processing of subitizing and counting, as eye tracking data suggest subtle differences between the groups that the above mentioned measures did not detect. Thus the impact of attention issues during these task in DS and WS needs to be taken into account as it could underpin processing difficulties that cannot be identified otherwise.

Session 7

Language in learning and intellectual disabilities

Developmental dyslexia: How taxonomic and thematic long-term memory organization affect recall

Carmen Belacchi[1], Caterina Artuso[1], Francesco Bellelli[2]

([1]University of Urbino, Urbino, Italy; [2]UOMI Riabilitazione Giugliano ASL Napoli/2 Nord, Napoli, Italy)

carmen.belacchi@uniurb.it

Aims

The two main forms of semantic organization, taxonomic and thematic, differ in their level of complexity: thematic organization is more basic and context-dependent, and is acquired earlier. Taxonomic organization is attained later in development; once acquired, the taxonomic organization would enhance memory recall, given its more abstract format and its meaningful organization. By contrast, in children with developmental dyslexia, considering their difficulty in abstract reasoning and higher conceptualization, we hypothesize that the taxonomic organization might not overcome the thematic one, and they both should only show a general semantic superiority effect at recall (over arbitrarily associated items) but not specific for the taxonomies.

Methods

A group of 65 LD participated in the present study (males: 44). Of these, 34 attended primary school (mean age 9.25, *SD*: 0.78), and 31 attended secondary school (mean age 12.13, *SD*: 1.06). All participants had received a diagnosis of developmental dyslexia in a clinical developmental centre, on the basis of standard Italian criteria. This requires that a child has a performance at least 2 SDs below the mean score of the normative sample, in at least a standardized reading decoding tests (i.e., a battery for word/non word decoding speed and correctness), and with exclusion of a primary role of other external factors such as low intelligence, sensory handicaps, family and/or emotional problems, sociocultural disadvantage and poor teaching. Within the diagnosis of LD, they presented mixed cognitive profiles of dyslexia associated mainly to dysorthography (70%), dyscalculia (20%) or text comprehension (10%). They were compared with a control group of 66 participants matched for age, schooling, gender (males: 45) and intelligence profile. Of these, 35 attended primary school (mean age 9.50, *SD*: 0.98, and 31 attended secondary school (mean age 12.40, *SD*: 0.76). Mean age between groups did not differ, $F < 1$.In a single session, lasting about 40 minutes, the LD sample was administered a semantic working memory (WM) task. The task comprised 60 four-word lists, created on the basis of three different types of associative semantic link (i.e., taxonomic, thematic, or none; 20 word lists for each kind of link). Each list included a word representing a digit (one to nine), which never appeared in the final position. The word lists were arranged into sets containing an increasing number of lists (two to six), such that participants were required to recall from two to six words at a time, and 3

trials were administered for each span. Participants were asked to listen to the 4 words and to tap on the table whenever they heard a digit. After hearing a full set, they were required to recall the last word of each list, in any order among lists. Recall accuracy and intrusion error were measured for each recall span and for each type of semantic organization, and were then entered in ANOVAs. An example of a three-list set is: List 1: shop-drugstore-five-*café* (taxonomic); List 2: party-eye-five-*city* (arbitrary); List 3: light-eight-heat-*fire* (thematic). Here, the words to be recalled are café, city, and fire.

Findings

A mixed ANOVA with Semantic Relationship (taxonomic, thematic, arbitrary) as within-subjects factors, and Group (LD, control) and Age (primary school, secondary school) as a between-subjects factor was conducted on the correctly recalled proportion of words. The difference between Groups was significant (p<.001), with a moderate effect size, whereby the proportion of correctly recalled words decreased in the LD group (compared to control). Specifically, participants recalled a mean proportion of 0.54 words; the control group participants recalled a mean proportion of 0.63 words. The difference between Ages was not significant, F < 1, showing that primary and secondary school groups did not differ.

In addition, there was a significant and large main effect of Semantic Relationship (p<.001). Recall accuracy was significantly greater for the taxonomically-related and thematically-related word lists than for the arbitrary lists (p< .001). The two-way interaction between Semantic Relationship and Group wielded significance as well (p< .001), with a moderate to large effect size. Paired-sample t-tests showed that in the control group taxonomically related words wielded grater recall than thematically-related (p< .001), and of arbitrary (p< .001). In addition, thematically-related words were better recalled than arbitrary relationships (p = .036). On the contrary, in the LD group, taxonomically-related words recall did not differ from thematically-related recall (p = .10). Moreover, both taxonomically-related words and thematically-related wielded greater recall than arbitrarily associated words (p< .001). In addition, a mixed ANOVA with Semantic Relationship (taxonomic, thematic, arbitrary) as within-subjects factors, and Group (developmental dyslexia disability, control) and Age (primary school, secondary school) as a between-subjects factor was run on the proportionate rate of intrusion errors observed in the task. The difference between Groups was not significant, F< 1, with all groups (i.e., LD and control) incurring a similar proportion of intrusion errors. There was a moderate effect of Semantic Relationship (p = .005). Internal intrusions rate was significantly greater for the taxonomically-related and thematically-related word lists than for the arbitrary lists (p = .011). There were no other significant interactions among the variables, F< 1.

Conclusions

Both taxonomic and thematic associations supported recall (compared to arbitrary associations) in the two groups of children. More specifically, data showed that in typically developing children the taxonomic association boosted WM recall (vs. the thematic one). On the contrary, children with developmental dyslexia performed poorly (compared to control) on a task requiring recall of semantically associated words. Whereas in typical development taxonomies favour LTM organization and WM performance, in dyslexic do not. Results could be interpreted in the light of a possible lack of integration between intelligence

(abstract reasoning) and language in developmental dyslexia (linguistic abstract representation).

Bilingualism in individuals with developmental disabilities, hindrance or benefit? A case-study of a simultaneous English-Spanish bilingual with Prader-Willi Syndrome

Estela García-Alcaraz[1], Juana Munoz Liceras[1,2]

([1]Department of Modern Languages and Literatures, University of Ottawa, Ottawa, Ontario, Canada; [2]Facultad de Lenguas y Educación ,Universidad Nebrija, Madrid, Spain)

egarcia@uottawa.ca

The goal of this study is to analyze the narrative abilities of a 33-year-old English (majority language)-Spanish (heritage language) bilingual with Prader-Willi Syndrome (PWS). PWS is a congenital rare neurodevelopmental disorder that tends to present deficiencies with speech (poor speech-sound development, reduced oral motor skills) and language development (grammar, morphology, narrative abilities and pragmatics) (Lewis 2006). The study of the linguistic capacities of individuals with PWS remains practically unexplored and restricted to monolingual speakers. Previous studies on monolinguals with PWS have primarily focused on their narrative abilities and have shown that narrating is an especially demanding task for this population (it implies integrating information from different linguistic and non-linguistic domains) and improves over the lifespan (adults with PWS produce more elaborated narratives than younger individuals) (Lewis et al. 2002). Individuals with developmental disabilities (DDs), as is the case of PWS, are often discouraged to become bilingual or to have access to an L2 under the baseless assumption that to do this will have a negative impact on their first language development (Paradis et al. 2011). However, previous research has questioned this extended practice by showing that bilingual individuals with DDs, such as Down Syndrome or William Syndrome do not differ much from their monolingual peers (Kay-Raining Bird et al. 2016, Perovic & Lochet 2016). Following this line of research, this study represents the first attempt to analyze the narrative abilities of an English-Spanish bilingual individual with PWS. Being more specific, we intend to answer the following three research questions: (1) Does an English-Spanish bilingual with PWS show poor narrative abilities in terms of *narrative structural coherence*, *narrative process complexity* and *narrative content diversity* as previous research has revealed in the case of Spanish monolingual individuals with PWS?; (2) Are the narrative skills of an English-Spanish bilingual with PWS comparable in both languages? and (3) How are the narrative skills of an English-Spanish bilingual with PWS compared to a typically developing (TD) English-Spanish bilingual?

Two wordless picture books (*A boy, a dog and a frog and Frog where are you?*) (Mayer 1967,1969, respectively) were used as the data elicitation method. The PWS participant produced four oral narratives (two in English and two in Spanish over two different experimental sessions), which were compared to four analogous narrative texts produced by a 25-year-old English-Spanish typically developing (TD) bilingual with comparable linguistic background and proficiency level in both languages. In the first experimental session both participants were asked to narrate *A boy, a dog and a frog* in English and *Frog, where are you?* in Spanish. During the second session, the narration languages were reversed. That is *A boy, a dog and a frog* was asked to be narrated in Spanish and *Frog, where are you?* in English. Between these two sessions there was an average of two-and-a-

half-month gap. Following Gonçalves and collaborators' narrative evaluation protocol (see Garayzábal-Heinze et al. 2012 for details), the narratives were analyzed according to three dimensions: *structure and coherence*, *process and complexity* and *content and multiplicity*.

Overall, the results revealed that the PWS bilingual, different from the TD bilingual, but in line with Garayzábal-Heinze et al. (2012) results for monolingual speakers with PWS, showed a poor narration quality in the three narrative dimensions under analysis. Both participants showed better performance, –which is evidenced by richer narratives– during the second session of data collection. However, this improved performance did not go in the same direction for both participants. While the TD bilingual showed better lexical richness in session two than in session one, the bilingual with PWS exhibited, independently of the language variable, more extensive narratives in session two, greater MLU and a better control of the narrative skills in the three analyzed dimensions. The narrative skills of the bilingual with PWS could be described according to the following gradation scale in both English and Spanish: *narrative content diversity >narrative structural coherence >narrative process complexity*. These findings lead us to conclude that bilingualism does not have a negative effect, which, in turn, implies that, rather than being discouraged, it should be encouraged and special attention should be given to the development of narrative skills in the PWS' school curriculum, particularly with regard to discourse coherence and complexity.

Keynote 3

Navigation and the spatial domain in neurodevelopmental disorders

Emily K. Farran

(UCL Institute of Education, University College London, London)

Our understanding of the development of spatial cognition has largely centred on specific questions. For example, in typical development, there has been extensive investigation regarding the existence of a geometric module, whilst in neurodevelopmental disorder research, the functions of the ventral and dorsal visual streams, and their potential dissociations, have received a lot of attention. Current research highlights that the notion of intact vs. spared spatial functions is simplistic. I am interested in *how* a task is completed. This analytical question can be approached with reference to a number of methodological techniques. For example: by taking into account the developmental influence of early impairments on later function; by using cross-syndrome comparison; and by considering interactions across genes, behaviour, environment and the brain. I will present research, predominantly in relation to the ability to navigate large scale space, in which we have taken these methodological considerations into account.

The ability to navigate successfully in large scale space is crucial to everyday living. For people with learning difficulties, the ability to learn their way around environments has a significant impact on daily life and independence. First, I will discuss findings from a series of cross-syndrome comparisons of the navigation abilities of individuals with Down Syndrome and individuals with Williams Syndrome, using desktop virtual reality. Both groups demonstrate impaired large-scale spatial cognition, yet comparison between the groups reveals syndrome-specific differences in the strategies employed, and the mechanisms which drive spatial performance for each group. Second, I will explore the relationship between motor ability and large-scale spatial cognition in three groups who have impaired motor performance: Cerebral Palsy, Attention Deficit Hyperactivity Disorder and Williams Syndrome. Findings so far suggest that, whilst the achievement of motor milestones is related to spatial cognition in typical development, impaired motor abilities do not necessarily lead to impaired spatial cognition in neurodevelopmental disordered groups. This has implications for our understanding of the use of alternative developmental pathways with respect to the development of spatial cognition.

Session 8

Learning and intellectual disabilities

Environment learning from virtual exploration in individuals with Down syndrome: perspective, sketch maps, and individual differences

Chiara Meneghetti[1], Enrico Toffalini[1], Barbara Carretti[1], Silvia Lanfranchi[2]

([1]Department of General Psychology, University of Padova, Padova, Italy; [2]Department of Developmental and Social Psychology, University of Padova, Padova, Italy)

chiara.meneghetti@unipd.it

Reviews in the extant literature suggest that visuospatial ability may represent a relative strength within the cognitive profile of individuals with Down syndrome (DS). Visuospatial ability, however, has been shown to be a complex construct comprising different sub-factors, rather than a single skill. One particular competence closely related to the visuospatial ability is that of acquiring environmental information. This is fundamental to everyday adaptation, and it is a crucial goal for the personal autonomy of individuals with DS.

In the present study we examined how individuals with DS acquire configural knowledge on new fictitious environments through virtual exploration, presented from either a survey (i.e., viewed from above) or a route (i.e., through within-environment movements) perspective, and with or without the aid of a sketch map examined before learning. Configural knowledge was operationalized as the ability to correctly locate seen landmarks on a layout representing the environment viewed from above. Additional information on the ability to re-navigate through the environment (pauses and errors) was also collected. Furthermore, the role of individual differences in verbal and visuospatial measures of intelligence was examined.

Because learning about an environment is expected to be improved when it is presented from a perspective that is consistent with the information to be acquired, survey perspective was hypothesized to facilitate learning as compared to route perspective. Furthermore, presentation of a sketch map before learning was also expected to be a factor facilitating the performance. Because individuals with DS are known to have more difficulty than TD children in handling simultaneous (rather than sequential) information, and in integrating elements from different sources, however, it is possible that the survey perspective and the aid of a sketch map do not improve performance in individuals with DS as compared to the alternative conditions, or that they do so to a lesser degree in comparison to matched typically developing (TD) children. With regard to the role of individual differences, higher level of visuospatial intelligence was expected to predict better location accuracy.

Participants were 29 individuals with DS (mean age 13 years) and 29 TD children (5-6 years of age), matched on both a measure of verbal (Peabody Picture Vocabulary Test-Revised, a measure of receptive vocabulary) and visuospatial (Raven's colored progressive matrices) intellectual level. Four environments (a zoo, a farm, a playground, and an amusement park) were shown through virtual exploration either in a survey or a route perspective. All environments had a square layout and included five typical landmarks (e.g., chicken in the

farm), which were located on the four corners and along the top or the bottom side. Participants were asked to 1) recognize viewed landmarks; 2) locate the landmarks on a square cardboard representing the studied environment. Furthermore, measures of the ability to re-navigate through the environments using a joystick (i.e., pauses and errors) were also collected. As regards the location task, data was analyzed using mixed-effects ordinal regression models, with both participants and environments as the random effects. Accuracy was on an ordinal scale (0<0.5<1). Results in general showed that in all presentation conditions, both groups performed well above the chance level on all tasks.

The survey perspective significantly facilitated the performance as compared to the route perspective, odds ratio = 2.16, $p < .001$. Exploring with a sketch map also facilitated the performance as compared to exploring without it, odds ratio = 1.48, $p = .002$. On the contrary, group had no significant main effect on location accuracy, odds ratio = 1.32, $p = .34$. Crucially, however, group showed significant interactions with both perspective, odds ratio = .38, $p < .001$, and learning condition (map vs. no map), odds ratio = .46, $p = .002$. Both interactions reflected the fact that the conditions that improved performance on the location task (i.e., survey rather than route perspective; exploring with rather than without a sketch map), benefited the TD group more than the individuals with DS. Additional analysis revealed that individuals with DS made significantly more pauses and errors than TD children, but this was not moderated by any exploration condition.

As regards the role of individual differences, it was found that both visuospatial intelligence, odds ratio^{SD} = 1.65, $p < .001$, and verbal intelligence, odds ratio^{SD} = 1.89, $p < .001$, were significantly associated with higher location accuracy in both groups.

Overall, the study suggested that individuals with DS are able to acquire configural information on new environments through virtual navigation both in the survey and route view. Importantly, however, individuals with DS are not as able as matched TD children to benefit from additional configural information and facilitating conditions (i.e., exploration through survey rather than route view, and the support of a sketch map). Possible explanations involve the difficulty of individuals with DS to manage information presented simultaneously (rather than sequentially), the ability to effectively integrate information from different sources, and the limited ability to use recall strategies (which may reduce the ability to benefit from facilitating conditions). Finally, the analysis on the role of individual differences suggested that a verbal measure of the cognitive level may be the best index that predicts the ability of an individual with DS to learn an environment, whereas the same cannot be say of TD children.

Text comprehension in individuals with Down syndrome: Effectiveness of a short intervention on inferential skills for individuals with Down syndrome

Maja Roch, Laura Mattera

(Department of Developmental Psychology and Socialization, University of Padova, Padova, Italy)

maja.roch@unipd.it

Introduction

Text comprehension is a complex activity that involves a series of components, both linguistic and cognitive, that integrate the linguistic information contained in a text with both previously processed textual information and general knowledge, the purpose being to construct a semantic representation, also known as a situation model (Kintsch, 1998). Studies documented for individuals with Down syndrome a relative weakness in text comprehension (Roch & Levorato, 2009). Difficulties in text comprehension were related to both poor linguistic abilities, such as receptive vocabulary and sentence comprehension, but in particular to higher level cognitive abilities to produce the necessary inferences for integrating the information within the text and to previous knowledge (Levorato, Roch, & Beltrame, 2009). The literature on Down syndrome is lacking evidence based interventions targeting text comprehension and in particular inferential skills that are essential for allowing the integration of the information of the text in a coherent mental model.
The current study was aimed to develop and test the effectiveness of a short intervention targeting inferential skills. In particular, the training concerns teaching people with Down syndrome to use appropriate inferences for solving everyday life problems and to infer solutions to unexpected situations presented as short texts. Secondly, it is hypothesized that the ability to make inferences is related to text comprehension, as suggested by previous literature (Roch & Levorato, 2009).

Method

Participants were 22 individuals with Down syndrome (mean age=22 years): 11 were assigned to the intervention group and the remaining 11 to the control group. The two groups were matched for chronological age (M=22), non verbal reasoning (M=16 on Coloured Raven Matrices) and Text comprehension (M=7 on TOR 3.8, Levorato & Roch, 2007).

Materials

All participants were tested before and after the intervention which was delivered to half of participants, using materials targeting independently different components of inferential skills with different materials than the one used during intervention.

1. Knowledge based inferences and Text based inferences (Florit, Roch & Levorato, 2014). Children are asked to connect two information provided in a 3 sentences long text and with previous knowledge.

2. Inferences on the story sequence: 4-6 picture stories are presented in random order and the participants are asked to order the story.

The intervention

The intervention consisted of 11 weekly 30 minute long sessions. In each session, 4 activities were delivered by two postgraduate trained students. Participants of the intervention group were divided in two subgroups (5 vs. 6 participants): all the activities were carried out in small groups and all participants discussed decisions about appropriate solutions (i.e. correct strategies and inferences).

1. Sequence ordering of a picture story having a negative ending. 3-5 pictures are presented in a random order. Participants have to create a correct order. Example. Pic 1. Giulia works as a porter in a company. Usually she takes a bus. Pic 2. Today the bus is in delay. Giulia went home. Pic. 3. The postman comes to the company but nobody is there to open the door and take the letters.
2. Retelling the ordered story: all the group is participating to story telling.
3. Competition of a story having a positive ending. A similar picture story is presented in which the central part is missing, and the end is changed (pic 3. The postman comes to the company and Giulia is there to take the letters). The activity consist of inferring and choosing among 3 options, the one that represents a strategy that makes possible to have a different end of the story (ex. Giulia remains waiting the bus).
4. Retelling the ordered story: all the group is participating to story telling.

Results

In order to verify the effectiveness of the training, the two groups were compared through 2 mixed ANOVA 2 groups (intervention vs. control) x 2 time points (pre-intervention and post intervention). The two ANOVA concerned the generalization of the acquired skills to different tasks targeting inferential skills measured pre and post intervention. Regarding the results involving the task of inference skills (text and knowledge based) the interaction group x time yielded significance [$F(1,20)=6{,}13$, $p<.05$, $\eta 2=,235$] indicating that the group that took part to the intervention improved in inferential skills after the intervention. Also the ANOVA run on the sequence ordering showed an interaction time x group [$F(1,20)=4{,}4$, $p<.05$, $\eta 2=,179$] indicating the improvement for the intervention group after the training. Overall, the results indicated that individuals who participated to the intervention improved inferential skills, in different components and tasks. A regression analysis having text comprehension as dependent variable showed that inferential skills accounted for by determining individual differences in text comprehension.

Conclusions

The results suggested that the intervention based on inferencing correct solutions to everyday problems presented as short stories was effective in determining, after only 11 weeks, improvement in the ability to make different types of inferences. In particular, the tasks measuring inferential skills were completely new and independent from the materials adopted during the intervention indicating that the participants have at least in a short period, generalized the learned abilities to produce new inferences in different situations. Moreover, according to previous literature on typical development, (Kintsch, 1998), it emerged that inference making is a crucial component of text comprehension also for individuals with Down syndrome. Making inferences allows the information in the text to be integrated and connected with previous knowledge determining also a better text comprehension.

The current study demonstrated that individuals with Down syndrome benefited from a short intervention on inferential skills. Future studies will have to determine to which extent these improvements are maintained for a longer period. This study shed light on an important, and innovative issue related to text comprehension in Down syndrome which is relevant form both theoretical and practical point of view.

Meta-analysis of Cognitive and Linguistic Variables Associated with Reading Ability in Individuals with Intellectual Disabilities

Karin Nilsson[1], Åsa Elwér[2], David Messer[3], Henrik Danielsson[1]

([1]The Swedish Institute for Disability Research & Linköping University, Linköping, Sweden; [2]Linköping University, Linköping, Sweden; [3]The Open University, UK)

karin.a.nilsson@liu.se

Introduction

Earlier research has shown that individuals with ID exhibit severe difficulties with both decoding and reading comprehension (Lemons et al., 2013). One study showed that one-third of the participants with ID (aged 6-21 years) decoded words, letter by letter (Ratz & Lenhard, 2013), which corresponds to the early phases of decoding in typical reading development (Ehri, 2005). Another study found that children with ID had the lowest performance on reading comprehension assessments, compared to other disability groups (Wei, Blackorby, & Schiller, 2011). Despite relevant findings, our understanding of how cognitive and linguistic variables interact to produce reading skills in this group is low. This is partly because of the limited number of studies, but also because it can be difficult to obtain an overall picture of the most important variables because of differences between studies in the choice of variables. As a result, a meta-analysis is needed to obtain a comprehensive picture of the predictors of reading in this group.

There is a large body of research conducted regarding variables associated with reading abilities in the typically developing population. The most important variables identified that explain decoding abilities are phonological awareness, rapid automatized naming (RAN), and letter-sound knowledge (Hulme & Snowling, 2013; Landerl & Wimmer, 2008; Scarborough, 1998; Schatschneider, Fletcher, Francis, Carlson, & Foorman, 2004). For reading comprehension, the variables identified are decoding, listening comprehension, IQ, vocabulary, executive-loaded working memory, and grammatical skills (Braze, Tabor, Shankweiler, & Mencl, 2007; Cain, Oakhill, & Bryant, 2004; Christopher et al., 2012; Hulslander, Olson, Willcutt, & Wadsworth, 2010; Kim, 2016; Lervåg, Hulme, & Melby-Lervåg, 2017; Muter, Hulme, Snowling, & Stevenson, 2004; Ouellette & Beers, 2010).

The aim for this meta-analysis was to investigate whether the variables associated with decoding and reading comprehension in individuals with ID are similar or different to those identified in previous research on typically developing children.

Method

The inclusion criteria for this review were the presence of: 1) measures of decoding and/or reading comprehension; 2) correlational data; 3) participants with mean IQ under 70 and a maximum IQ of 80; 4) minimum sample size of 10 participants; 5) participants with non-specific ID, Down Syndrome, Willams Syndrome, or mixed etiology. Articles were excluded if their main focus was another syndrome, if the ID group were reported to also have autism, or if the article failed to report measures of IQ.

A literature search was conducted in PubMed, PsycInfo, Web of science, and ERIC. The following key words were used: ((reading OR literacy OR decoding OR "word recognition") AND ("intellectual disability" OR "intellectual disabilities" OR "mental retardation" OR "mental deficiency" OR "mental deficiencies" OR "intellectual developmental disorder" OR "mentally disabled persons" OR "developmental disabilities" OR "developmental disability" OR "intellectual developmental disorders") AND (relationship OR relate OR relation OR relations OR predict OR prediction OR predicted OR correlation OR correlated OR correlations OR regression OR regressions OR association OR associated OR associations)). All identified articles were imported to the reference management system Zotero (www.zotero.org) where duplicates were removed. The abstracts were screened independently by two of the authors. Full text were downloaded for the included articles, and the final decisions on which articles to include and coding of information were also done independently by two of the authors. Any differences regarding inclusion were discussed and resolved.

The focus of this meta-analysis was direction and magnitude of effect sizes across studies, and was represented by the effect size correlational coefficients (*r*). The analyses were conducted in R (R Core Team, 2017) in the metafor package (Viechtbauer, 2010). A number of random effect models were performed on the calculated effect sizes (*r*) for all the correlations of interest (e.g. phonological awareness and decoding, IQ and decoding, vocabulary and reading comprehension, language comprehension and reading comprehension etc.).

Results

When interpreting the data, Cohen's (1988) guidelines about what constitutes a small, medium, and large effect have been used as a rule of thumb. For Pearson's correlation coefficient, the following thresholds have been suggested: r =.10 (small), r = .30 (medium), and r = .50 (large). Preliminary findings indicate that phonological awareness has a strong correlation to decoding (r=.59 (large ES)), whereas RAN, phonological short-term memory, vocabulary, and IQ shows a correlation in the medium range (r = .49, r = .48, r = .33, and r = .30 respectively). For an overview of the mean effect sizes for decoding, see Figure 1.

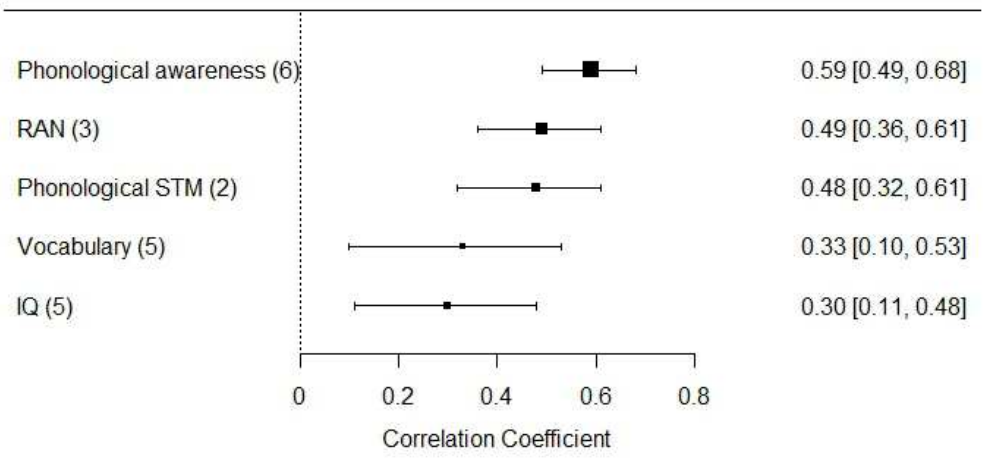


Figure 1. Mean effect sizes (r) for variables correlated with decoding, namely phonological awareness, rapid automatized naming (RAN), phonological short-term memory (STM), vocabulary, and IQ. Parenthesis indicate the number of studies included in each meta-analysis.

Preliminary findings further indicates that decoding correlates strongly with reading comprehension (r =.63 (large ES)), whereas IQ, listening comprehension, and vocabulary shows medium correlations to reading comprehension (r = .44, r = .41, and r = .31 respectively). For an overview of the mean effect sizes for reading comprehension, see Figure 2.

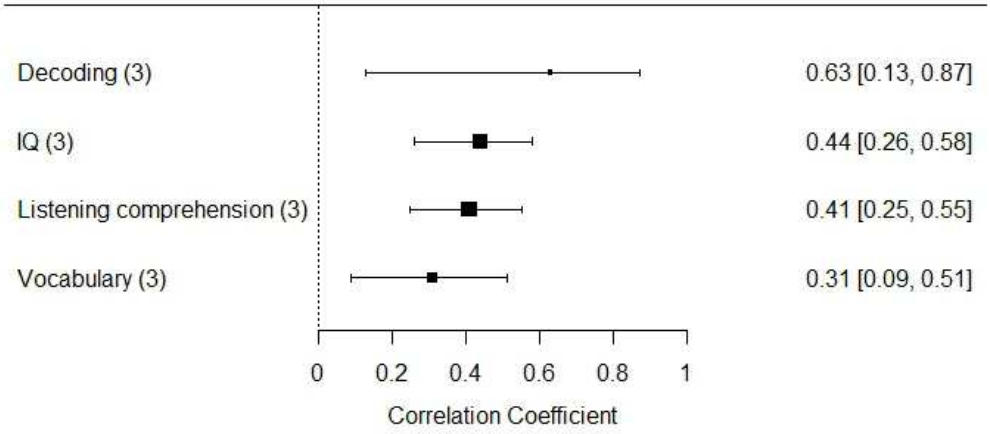


Figure 2. Mean effect sizes (r) for variables correlated with reading comprehension, namely decoding, IQ, listening comprehension, and vocabulary. Parenthesis indicate the number of studies included in each meta-analysis.

Conclusion

The relationships between reading abilities and linguistic and cognitive abilities in individuals with ID mainly appears to be similar to those of typically developing individuals. Phonological awareness seems to be the most important variable associated with decoding, and decoding seems to be the most important variable for reading comprehension. However, the mean effect size for the correlation between decoding and reading comprehension shows a very large confidence interval, indicating a large variance in this group. One plausible explanation for this heterogeneity might be that this review focusses on ID in general, and not on ID with a specific etiology (e.g. Down syndrome, Williams syndrome). The main difference between individuals with ID and previous research on typically developing children appears to be that IQ shows a medium effect size in relation to decoding for the ID population, whereas IQ and decoding is not related for the typically developing population (Stanovich, 2005). In summary, the variables associated with reading abilities in individuals with ID are mainly the same as those found in previous research on typically developing children.

Symposium

Social cognition and inhibition: How to support emotion regulation and social adjustment in children?

Proponent: Nathalie Nader-Grosbois, Université Catholique de Louvain, Louvain-la-Neuve, Belgium

How better understand social competences and maladjustment in children with developmental disorders? From a heuristic model to research studies

Nathalie Nader-Grosbois

(Université Catholique de Louvain, Psychological Sciences Research Institute, Louvain-la-Neuve, Belgium)

nathalie.nader@uclouvain.be

Introduction of the symposium

This presentation introduce an integrated scientific approach of emotional and social competences of typically and atypically developing children, in referring to a heuristic model of social competences (Nader-Grosbois, 2011), inspired from Yeates et al. (2007). It structures research studies about hypotheses, targeted relevant variables to assess and interpretations of results, in order to better understand the development of social cognition, emotion regulation in social interactions and social adjustment, and their dynamic links. It allows examining in which measure executive function, individual characteristics (age, developmental age, diagnosis…) and parental characteristics and psychoeducative practices or intervention could induce variability in these social competences. This integrated approach helps to coordinate studies targeting socio-emotional competences and social cognition in my research team, led toward children with intellectual disabilities, with autism spectrum disorders and with externalizing behavior disorders. Some studies test the efficiency of inhibition and social cognition trainings toward children with externalizing behavior disorders (Marine Houssa & Alexandra Volckaert), or compare effect of Theory of Mind and social information processing in children with intellectual disabilities (Emilie Jacobs). Other studies examine how parents socialize emotions toward their typically developing children and with autism spectrum disorders (Stéphanie Mazzone). In these studies, recent adapted instruments to these children are used, both direct and indirect measures of inhibition, social problem solving, ToM abilities in several mental states, emotion regulation *versus* dysregulation, socio-affective profiles and social adjustment. Several questionnaires are also completed to evaluate parents' reactions toward their child's emotion and conversations about emotions. The goal of these studies is to better guide interventions toward these children and their parents to improve their efficiency.

Inhibition and social cognition in preschoolers with externalizing behavior

Marine Houssa, Alexandra Volckaert, Nathalie Nader-Grosbois, Marie-Pascale Noël

(Université Catholique de Louvain, Psychological Sciences Research Institute, Louvain-la-Neuve, Belgium)

marine.houssa@uclouvain.b

Aims of the study

During childhood, externalizing behaviors (EB) are displayed as agitation, hyperactivity, impulsivity, opposition, emotional instability, provocation, resistance, aggressiveness, or irritability.

A high level of EB has usually been related to dysfunction in social cognition (SC) and to deficits in social problem solving situations. Furthermore, EB problems is associated with emotion regulation in children, skills in social interactions with peers and adults and also with social adjustment. There is a necessity to detect EB in preschoolers and intervene during the preschool period. Indeed, it is known that emotion regulation difficulties could explain EB in preschoolers, and EB could predict antisocial behaviors, social maladjustment and mental health problems in later years.

Beside, several researches have shown a significant link between poor executive functions (EF) and EB in both typically developing and preschoolers with EB. Two meta-analyses showed that symptoms of inattention or hyperactivity disorders or of EB are associated with poor attention-vigilance, interference control and inhibition capacities (more precisely, it is mainly inhibition that correlates with EB). For instance, a higher error rate in inhibition tasks is generally observed in EB populations.

The goal of the present study is to compare the impact of two very targeted child-oriented trainings, one centered on SC and the other on EF, on the increase of social competences and the decrease EB in preschoolers. These two trainings were compared to a waiting-list control condition in a pseudo-randomized trial concluded on 48 preschoolers presenting clinically relevant levels of EB. More specifically, we examined the impact of these trainings on the child's behavior, emotion regulation and social adjustment. We also wanted to identify the impact of one training on the other cognitive domain. Indeed, as suggested by Kloo and Perner (2007), the interdependence in the development of EF and Theory of Mind might lead to a positive impact of an executive function training on social cognition and vice versa.

Methods

Data were collected from 48 preschoolers aged between 3 years and 6 years old. Parents were informed about the study thanks to the media, pediatricians, and schools. Parents who wanted to participate and who had problems with their child's behavior had to fill in an online questionnaire including items of the Child Behavior Checklist (CBCL).

Three phases composed this research. For the first phase (pre-test session), the intellectual quotient and the EB level of each child were assessed. Moreover, parents completed several questionnaires. Then, during the phase 2, children were randomly allocated to one of the three groups: 16 children received training on executive functions, 16 other children took

part in training on social cognition abilities, and 16 others children were allocated to an eight-week waiting list. Except for the sessions content, the same procedure was followed in the two experimental groups. During 8 weeks, children participated in small groups (3-4 children) in 15 training sessions of 45 minutes. Within each group, sessions were administered by the two same experimenters. At the end of the trainings, parents completed the same questionnaires as in pre-test and children's behavior was assessed through an observational paradigm.

To measure the training effects, repeated measures ANOVA were calculated on each of the dependent measures with one within-subject factor, the time (pre-test and post-test) and one between subjects factor, the group (SC, EF and control). Furthermore, as we were especially interested to see how much children improved from pre-test to post-test in each of the three groups, paired *t*-tests comparing pre- and post-training measures were systematically computed.

Findings of the study

The targeted functions of the trainings

Paired-samples *t* tests revealed that only children of the SC group are perceived by their parents as better understanding mental states after the training. The same analysis revealed significantly less working memory errors after the training for the EF group only.

Profiles of social competences

The repeated measure ANOVA calculated on the angry-tolerant scale showed a significant group by time interaction. Paired-samples *t* tests revealed that this interaction was due to a significant improvement in the SC group after the training, but not in the two others. The repeated measure ANOVA calculated on a social competence global component and calculated on the social adjustment score also showed significant group by time interaction. Paired-samples *t* tests revealed that children in the SC group showed significantly better social competences in the post-test than in the pre-test.

Emotion regulation

A significant time by group interaction was observed as regards the emotion regulation score. While emotion regulation abilities significantly decreased from pre-test to post-test for control children, they significantly increased in the EF training group.

Externalizing behavior

The repeated measure ANOVA conducted on the EB scale revealed a significant effect of time ($F(2,45) = 36.11$, $p = .00$, $\eta^2 = .44$) and a tendency for an interaction time by group. Paired-samples *t* tests indicated that each group significantly decreased their EB level. Finally, repeated measures ANOVA made on the different scores of the UCG showed a significant group by time interaction only for the agitation score. Paired-samples *t* tests indicated that only the EF group showed a significant decrease in agitation after the training.

Conclusion

As expected, the research highlights that the SC experimental group outperformed the others in Theory of Mind competences, while the EF experimental group outperformed the

others in EF. This research highlights that stimulating EF in preschoolers with EB has a larger impact on the level of EB (reported through several measures), while stimulating SC competences has a larger impact on children' social adjustment and socio-affective profile. Finally, psychologists or preschoolers teachers could be trained to implement those two types of trainings to prevent or intervene with preschoolers. Moreover, train parents to several techniques used in both trainings when games, visual supports, the three characters, etc. are used could help to consolidate some acquired skills and reinforce their efficacy.

Theory of Mind and Social information processing Intervention in children with in intellectual disabilities

Emilie Jacobs, Nathalie Nader-Grosbois

(Université Catholique de Louvain, Psychological Sciences Research Institute, Louvain-la-Neuve, Belgium)

emilie.jacobs@uclouvain.be

In children with intellectual disabilities (ID), researches emphasized "*limitations in adaptive behavior*" (AAIDD, 2011), including social maladjustment and in emotion dysregulation. Surrounding and professionals are preoccupied about behavior disorders, difficulties in social interactions and in socio-emotional situations. In fact, children with ID have less opportunities of social interaction, as being rejected (Guralnick, 1997). They display signs of trouble in new social situation (Baurain & Nader-Grosbois, 2013). Moreover, social and emotional difficulties could increase the risk of externalizing or internalizing behavior, as well as social maladjustment (Dekker, Koot, Ende, & Verhulst, 2002;Whitaker& Read, 2006). These troubles impede their social inclusion and increase their reject.

These difficulties has been studying in link with deficit or delay in socio-emotional domain, notably in Theory of Mind (ToM) or Social information processing (SIP) (Barisnikov, Van der Linden, & Detraux, 2002; Baurain & Nader-Grosbois, 2013; Nader-Grosbois, Houssa, & Mazzone, 2013; Thirion-Marissiaux & Nader-Grosbois, 2008c; Van Nieuwenhuijzen et al., 2006). The ToM competences is the capacity to attribute mental states in others: beliefs, intentions, desires, emotions… (Flavell, 1999; Nader-Grosbois, 2009) whereas the SIP is a process used by children when they are faced with social interactive situations. This process is composed of five steps: encoding of other people's social cues, interpretation of social cues, clarification of goals, response access and response decision (Dodge & Crick, 1990; Dodge & Pettit, 2003; Mize & Pettit, 2008).

In the present study, we test causal contribution of ToM or SIP on social (mal)adjustment. Concretely, we explore which effects have a ToM or SIP training in children with ID, on ToM and SIP competences, social (mal)adjustment and emotion regulation.

We recruited 45 children with ID in special schools, from French –speaking Belgian area. Those children have a developmental age between 3 and 6 years old. Subjects are allocated to a control group, a ToM training group or a SIP training group. Before and after trainings, we evaluate the children's competences in ToM (ToM-emotions and ToM-beliefs, Nader-Grosbois & Thirion-Marissiaux 2011; ToM Task Battery-vf, Nader-Grosbois & Houssa, 2016; ToMI-vf, Houssa, Mazzone & Nader-Grosbois, 2014), in SIP (RES, Barisnikov et al., 2004), in social adjustment (EASE, Hughes & Soares-Boucaud, 1997; PSA, Dumas, Lafrenière, Capuano & Durning, 1992), and in emotion regulation (ERC-vf, Nader-Grosbois & Mazzone, 2015). During the pretest session, we evaluate the children's developmental verbal and non-verbal age that were obtained with 4 subscales of WPPSI-III (Wechsler, 2004), in order to insure that children met inclusive criteria.

Trainings are done by group of 3 children, during 45 minutes and focused either ToM or SIP. The goals are to improve the children's abilities either (a) to talk and to infer mental states (emotions and beliefs), to understand people's perspective, the causes and consequences of

mental states (Howlin et al., 2011) for ToM training, or (b) to respond to critical social situation using five steps of the SIP process (Crick & Dodge, 1994), for SIP training. In these two trainings, some similar routines are used such as feedback provided after each response, asking children's explanation about their response, experimenters' explanation of the correct response or the general principle. However, when using routines such as open-ended questions or conversations, experimenters target either, in ToM training, mental states like emotions and beliefs, or, in SIP training, critical social situations and the five step of the SIP process. Finally, experimenters try to make connections between training situation and real life events. The material for the two trainings was quite similar. In ToM training, cartoons or picture cards on social situations such as those on "What are they thinking?", "Feeling", "Mental Simil" are used whereas in SIP training, scripts illustrated by short videos from STEP-P (Schultz et al. 2010) and social stories from SIPI-P (Ziv&Sorogon, 2010) are applied.

Thanks to ANOVA on repeated measures and comparison on the progression of the group, we examine the differentiate effects of ToM or SIP training on the comprehension of mental states, on social problem solving competences, on social adjustment, and on emotion regulation vs. dysregulation. At this time, we run preliminary t-test analysis on the two training groups. Results show that children with ID trained in ToM improve significantly their comprehension of affective and cognitive mental state whereas children trained in SIP improve significantly in cognitive mental state. Both groups trained in ToM or SIP show significantly better competences in social problem solving skills, at post-test. Finally, children trained in SIP seem to be perceived significantly more socially adapted, with better emotion regulation competences and less aggressive. However, children trained in ToM appear to their parents and teachers to have significantly better emotion regulation competences.

Finally, we discuss improvements caused by ToM or SIP trainings compared to the control group. We present also implications of interventions in social cognition in children with ID and the importance of this kind of interventions to limit the risk of social maladjustment in different life contexts and to support social integration.

Emotion-related socialization behaviors in ASD children

Stéphanie Mazzone, Nathalie Nader-Grosbois

(Université Catholique de Louvain, Psychological Sciences Research Institute, Louvain-la-Neuve, Belgium)

stephanie.mazzone@uclouvain.be

In their Parental Socialization of Emotions model, Eisenberg, Cumberland and Spinrad (1998) defined Emotion-Related Socialization Behaviours (ERSBs) as parents' behaviours that tend to promote their children's emotional and social abilities. They distinguish three types of ERSBs in parents: their reactions to their children's emotions, their emotion-related conversations and their emotional expressiveness. When parental ERSBs are favourable for the children's development, they are considered as being supportive, while when they are not, they are considered as being non-supportive. About parents' supportive reactions, they may help the child to solve the socio-emotional problem, or encourage the child to express emotions. During conversations on emotions, parents may explain and ask questions about emotions felt by the child, or another person, or a character in a story. Many studies have been conducted with parents of typically developing (TD) children. The results indicated that parents who react in a supportive way and who discuss about emotions may foster their children's Theory of Mind (ToM) abilities, emotional regulation and social adjustment. However, few studies have investigated these relations in parents of children with an Autism Spectrum Disorder (ASD). As ASD children show deficits in socio-emotional competences, it is important to explore how parents could support their development.

Two studies have been conducted to examine the relation between parents' ERSBs (parental reactions and conversations) and ToM abilities, emotional regulation and social adjustment in ASD children. The goal of these studies is to explore how parental reactions to their children's emotions (Study 1) and emotion-related conversations (Study 2) support ASD children's socio-emotional competences, by taking into account the effect of children's characteristics (chronological and developmental age).

In Study 1, participants are 39 mothers and 31 fathers and their ASD children (35 boys and 4 girls). In Study 2, participants are 23 mothers and their ASD children (20 boys and 3 girls). For the two studies, children's ToM abilities are assessed by direct measures (ToM-emotions and ToM-beliefs tasks, Nader-Grosbois & Thirion-Marissiaux, 2011) and by a questionnaire (Theory of Mind Inventory, Hutchins, Prelock & Bonazinga, 2012). Children's emotional regulation (Emotion Regulation Checklist, Shields & Cicchetti, 1997)and social adjustment (Social adjustment Scales, Hughes, Soares-Boucaud, Hochmann, & Frith, 1997) are assessed by a questionnaire completed by the teacher. In Study 1, mothers and fathers independently completed a questionnaire about their reactions toward their children's emotions (Parental Reactions toward Positive and Negative Emotions, Daffe & Nader-Grosbois, 2009). For the negative scenarios, six alternative parents' reactions are suggested: comforting, encouragement of expression of emotion, problem-focused, minimizing responses, punitive and distress. For the scenarios illustrating joy, four types of parents' reactions are suggested: socialization, encouragement, reprimand and discomfort. In study 2, mothers completed a questionnaire about their emotion-related conversations (Questionnaire of Parent-Child Conversations about Emotions, Mazzone, Roskam, Mikolajczak, & Nader-Grosbois, 2017).

We obtained a score for supportive strategies displayed by the parent during conversations about emotions and a score for the number of emotional terms usually used by the parent.

To examine the percentage of variance of ASD children's ToM abilities explained by both individual children's characteristics and parental ERSBs, several linear regression analyses by the stepwise method have been performed. For parental reactions, we entered children's chronological age and children's global developmental age in Step 1. In Step 2, we entered each parental reaction to children's (-) emotions, and parental reactions to children's (+) emotions were added in step 3. For maternal emotion-related conversations, we entered children's chronological age and children's global developmental age in Step 1. In Step 2, we entered the score of emotion-related conversations and the number of emotional terms.

Two separate models of maternal and paternal reactions are presented. For the two models, our results highlighted several links that were distinct according to children's abilities. Some of these links were similar between mothers and fathers, while others were different. For children's ToM abilities, significant results were obtained for both parents. Our results suggest that protective factors for the development of ToM abilities in ASD children are parental reactions which help children to understand how they can solve the problem (problem-focused responses) and in which situations they may express their emotions (reactions of socialization), or which help children to self-regulate their intense emotions (reprimand). Conversely, risk factors are parental reactions which deprive children of an opportunity to explore their feelings (comforting), or which may generate excessive emotions that become difficult to self-regulate (encouragement). For children's emotion regulation and social adjustment, no significant result were obtained for maternal model. As for ToM development, paternal problem-focused responses seems to be a protective factor for children's social adjustment. While, comforting reactions are negatively related with children's emotion regulation and social adjustment and minimizing reactions are negatively related with children's social adjustment. Concerning maternal emotion-related conversations, significant results were obtained for children's ToM abilities and social adjustment. The number of emotional terms used by the mothers is positively associated with children's ToM abilities and maternal emotion-related conversations are positively related with children's social adjustment.

Our results provided new information about how parental ERSB's are related to ASD children's ToM abilities, emotional regulation and social adjustment. The identification of supportive or non-supportive strategies as protective or risk factors should be considered in individualised intervention program toward parents having an ASD child. Indeed, given our distinct results in comparison with studies led with TD children,, it seems crucial to adapt the parental program depending on the specific characteristics of each population: a protective factor for TD children may be a risk factor for ASD children, and vice versa.

Posters

1. Motor proficiency in Children with Down Syndrome

Marianna Alesi, Giusppe Battaglia, Antonino Bianco, Annamaria Pepi, Antonio Palma

(Dipartimento di Scienze Psicologiche, Pedagogiche e della Formazione, Università degli Studi di Palermo, Palermo, Italy)

marianna.alesi@unipa.it

This study aims to analyze gross motor development as a function of different intellectual profiles by comparing locomotion and object control skills endorsed by children with Down Syndrome (DS), children with Borderline Intellectual Functioning (BIF) and typically developing children (TDC).
Increasing research has demonstrated the relationship between motor competence and intellectual functioning proving how children with mild or moderate Intellectual Disability (ID) show a delay on gross motor development with important impairments in daily functioning (Frey and Chow, 2006; Simons et al., 2008). In children with Down Syndrome the milestones of motor development are not normally reached and show gap increasing with the growth and the complexity of motor tasks (Pereira et al., 2013). For example, Malak and coll.(2013) examined the motor skills in 79 children with DS aged between 4.6 and 6.3 years old. They found that the skill of stand up was developed between 3 and 6 years of age and the skill of walking after 3 years; only 10% of the children reached the milestone of standing before 3 years, whilst TDC develop the standing skills at about 9–10 months old and walking at about 12-15 months. On the whole, from early age, children with DS showed impairment in early postural control, motor speed and balance as well as gross movements slow, not fluent and abrupt (Cardoso et al., 2015).
Nevertheless, poor research has been produced on gross motor skills endorsed by children with Borderline Intellectual Functioning (BIF). Recent research has highlighted delays in walking, deficits in fine motor skills, writing difficulties and low manual dexterity abilities in this population (Vuijk et al., 2010; Westendorp et al., 2011).
Following hypotheses will be tested in this research:
Hypothesis 1. DS children would show worse gross motor skills compared with BIF and TDC by having lower performance on locomotion (e.g. walking, running, hopping, galloping, jumping, sliding and leaping)and object control tasks (e.g. throwing, catching, striking, bouncing, kicking, pulling and pushing).
Hypothesis 2. Children with BIF would perform poorly on locomotion and object control tasks, compared with TDC on locomotion and object control tasks.
Hypothesis 3. Children with DS and BIF would have lower scores on object control tasks than locomotion.

Method

Participants
Participants were 54 children subdivided into three groups. Group 1 was composed of 18 DS children (13 boys and 5 girls) with a chronological age of 8.22 ± 2.82 years and a body mass

index of (BMI) of 23.39 (weight: 31.05 ± 10.66 kg; height: 1.19 ± 0.18 m). Group 2 was composed of 18 BIF children (9 boys and 9 girls) with a chronological age of 9.32 ± .61 years and a BMI of 18.83 (weight: 38.06 ± 8.22 kg; height: 1.40 ± 0.82 m). Group 3 was composed of 18 Typically Developing Children (9 boys and 9 girls) with a chronological age of 9.28 ± .81 years and a BMI of 17.82 (weight: 36.28 ± 9.40 kg; height: 1.40 ± 6.45 m).
All subjects were from average socioeconomic backgrounds and attended primary school.

Measures

Gross motor skills were measured through the TGMD- Test of Gross Motor Development (Ulrich, 1985). This is a criterion-referenced test, composed of two subtests aimed at measuring two skill sets: 7 locomotion and 5 object control skills. Locomotion tasks required children to run as fast as possible for 15 meters (L1), gallop for ten meters (L2), hop on one leg for five meters (L3), jump forward (L4), do a long jump (L5), skip forward (L6) and slide laterally (L7). Whilst object control tasks required children to catch a ball with a tennis racket (OC1), bounce off the ball (OC2), catch a ball (OC3), kick the ball running (OC4) and throw a ball with the hand (OC5).

Results

Analyses of covariance (ANCOVA) were performed to compare locomotion and object control outcomes for ID, BIF and TDC groups. The independent variable was the intellectual level (ID, BIF or TDC) and the covariate was the participants' BMI because significant differences between groups were found as concern this variable [$F(2, 53)= 10.798$; $p <.001$, $\eta^2p= .30$]. DS children (M= 23.39) got higher BMI compared with BIF (M= 18.83) and TDC (M= 17.82).
On the wholeanalyses revealed significant differences for gross motor quotient [$F(2, 53)= 86.433$; $p <.001$, $\eta^2p= .78$], locomotion [$F(2, 53)= 46.953$; $p <.001$, $\eta^2p= .66$] and object control skills [$F(2, 53)= 61.420$; $p <.001$, $\eta^2p= .71$] between the three groups.

Discussion

DS children got a Gross Motor Quotient significantly below the mean value. They performed poorly on Locomotion and Object Control tasks, compared with TDC and BIF children. In turn, BIF children got an impaired Gross Motor Quotient by underscoring on Locomotion and Object Control tasks compared with TDC.
as concern the locomotion, in DS group strengths were found on run and slide skills, in BIF group strengths were on run, long jump and slide skills and in TDC group strengths were on run and slide skills.
Whilst, as concern the object control, for all of the three groups strengths were on catching a ball and weakens on bounce off the ball.
Findings, while preliminary, suggest some interesting implications for further practice to develop targeted evidence-based programs aimed to enhance gross motor development in individuals with ID and BIF. Researchers and practitioners address increasing attention to implement exercise motor programs aimed to decrease DS children motor impairments and enhance together specific cognitive abilities such as executive functions.

2. Focus on a co-construction process of contexts promoting self-determination and civic engagement of individuals having an intellectual disability (ID)

Barbara Fontana-Lana, Geneviève Petitpierre

(Institut de Pédagogie curative, University of Fribourg, Fribourg, Switzerland)

barbara.lana@unifr.ch

The aim of the presentation is to highlight the procedure which has enabled the successful implementation of a training programme on self-determination and active citizenship[1]. The underlying assumption was that a participatory process would promote the implementation, transfer and maintenance of abilities over the medium to long term.

The collaboration has been analyzed under its procedural dimension, according and in relation to the recommendations on implementation in the scientific literature (Rogers, 2003) which reminds that encouragement has to be given to translate newly acquired knowledge into action (Beidas et al., 2013). Rogers (2003) suggests analyzing the process into five stages -information, persuasion, decision, implementation, confirmation. Information and persuasion stages involve all measures encouraging the potential adopters of the information to form a favourable opinion. The mere fact of providing new knowledge or information is normally insufficient to bring about changes in practices or behaviour. People basically accept an innovation if they think it will be of use to them or their work (Tveden-Nyborg, Misfeldt, & Boelt, 2013). The system needs to create opportunities to experience the innovation (Greenhalgh et al., 2004). The decision stage involves room for experimentation and reflexion. The implementation (utilisation) and confirmation (maintenance and consolidation) stages only come in at the end. Abandoning the old ways of doing things in favour of innovative knowledge and practices is also more likely to be achieved through a collective process than an individual one. The planned and orchestrated communication of a new concept tends to be based on vertical relationships, whereas informal dissemination is achieved through horizontal relationships (Greenhalgh et al., 2004). The results show that, in the procedure, a sustained collaboration took place during the phase covering the launch of the research: The social care establishment and the University worked conjointly to develop the objectives, and the procedure for taking into account the needs on the ground and compliance with the requirements of the scientific process. The financial support of the Foundation responsible for the establishment attested to the scale of the commitment of the entire system to the attainment of the desired objectives and also represented a vertical endorsement of the approach. The theoretical lines for the structure of the training programme were largely developed by the research team and subsequently endorsed by the management of the institution. The content and the method of transmission, i.e. how it is translated into practical activities, the teaching and the didactic process used to promote

[1]The content of the training, as well as the results that followed for participants at individual level, have been presented at the 11th ECIDD conference held in Lille in 2016.

Fontana-Lana, B., Angéloz Brügger, P., Gobet, L., &PetragalloHauenstein, I. (2016). Tools to train self-determination and civic engagement for adults with an intellectual disability. In Y. Courbois (Ed). 11th ECIDD Conference (pp.100-104). Lille, France: MESHS.

learning, the material, such as for example, the use of images, videos, educational scenarios, and finally, subjects for discussion, were, however, developed in consultation with the participants, including those with an ID. Basically, a considerable amount of time was devoted to dialogue with the recipients of the training, discussions and development of joint decisions during the sessions or between the sessions within the research team.

On the whole, the results showed that the steps to promote good implementation were all followed. The training has not only had profound results at the individual level but it profoundly changed the system and provoked the creation of an intra-institutional structure of self-represented people, as well as knowledge dissemination activities under the control of the participants themselves.

3. Are cognitive and affective special needs in autonomy enough compensated in learning and academic examination in pupils with mild intellectual disability and autism in French elementary schools?

Agnès Gouzien-Desbiens

(Laboratory PSITEC, EA 4072, University of Lille, and ESPE Lille North of France, Villeneuve d'Ascq, France)

agnes.desbiens@univ-lille.fr, agnes.desbiens@espe-lnf.fr

Many papers have illustrated how the capacities of persons with mild intellectual disabilities (MID) are not recognized for their real value, because of the bias of static evaluation to call up effectively their apprenticeship and the difficulty to mobilize self-regulation/ executive processes (Büchel, Paour & coll., 1998, Magnin de Cagny, 2010, Nader-Grosbois, 2007, Gaumer & coll., 2015). This lack of valorization affects the professional integration of MID persons (Nuss, 2008). A recent research (Gouzien-Desbiens & Mengue-Topio, 2018, in press) on 636 mild intellectual deficient pupils aged 6 to 20 attending special classes underscores academic examination should be better adapted to allow a most equitable approach, leading to sustain the needs in intellectual autonomy, especially on the long-term goal attribution criteria and the self-evaluation criteria, not compensated in 1/2 MID pupil, the same proportion failing to pass their internal and academic exams. To measure the weight of autonomy needs not compensated in other populations, we replicate this study with 82 MID children aged 7 to 11 and compare them to 15 autistic pupils with the same developmental age, all evaluated on the same criteria, in the three fields of autonomy with an observation grid. We hypothesize a stronger difficulty to adapt or compensate the autonomy special needs in academic exams in ASD children than in MID children (both disorders are known to be affected by dysregulations, Nader-Grosbois, 2007, and dysregulation could be negatively bound to the IQ of autistic children, Blanc et al., 2005), although the autonomy needs could be well upheld by special teachers in internal evaluations, thanks to their knowledges and formation received about the special needs of their pupils.

This study relates to investigate how much mild intellectual deficient pupils and autistic children from elementary schools have their special autonomy needs not compensated or not enough adapted to reach their academic school level, resulting in not obtaining their appropriate degree. Specifying those needs would allow us to confirm the requirement to include the long-term goal attribution criteria and the self-evaluation criteria to help MILD pupils in the examination situations to recover most easily their knowledges and validate an adequate degree. Furthermore, we would identify the criteria of the ASD needs to support in examination tasks.

Method

The special teachers who work with MID or ASD pupils complete an observation grid, about the abilities of their pupils in affective, physical and cognitive/intellectual autonomy (criteria of Blache, 2010) related to their academic achievement or failure in passing exams leading to a degree and not. They also specify the needs not possibly compensated or not objects of adaptations in classrooms and exams that would lead to eventual failures. The task consists in answering to 3 kinds of questions for each topic of the autonomy (physical, cognitive and

affective): specify the actual needs, the needs not compensated. To specify the needs, the teachers should write:

-in physical autonomy, whether pupils can: move in the classroom to get materials/ find one's way inside the school to go alone to the toilets- school cafeteria-other places/ go alone from home to school and school to home, by bus or on foot.

-in cognitive autonomy (or self-regulation, Brown, 1987, Nader-Grosbois, 2007), whether pupils can: identify the goal of the task (at short and long term)/remember the instructions for the tasks/ represent the task/ find in memory other useful tasks connected/ plan the task/ check the result of one's reasoning compared to the goal announced before/ evaluate themselves/ look for useful organizer referents and use the referents suggested by the teacher.

-in affective/ relational Autonomy, whether pupils can: begin alone a task/ perseverate on a task/ specify efficiently the achievements and errors/ accept to show one's abilities in inclusion situations/ work with unknown persons/ interact with other pupils.

We hypothesize:

-a relation between the adequate helps furnished to MID and ASD pupils (in examination situations, in learning situations) and the obtainment of an appropriate degree, especially for the long-term goal attribution and the self-evaluation criteria.

-a stronger difficulty to adapt/ compensate the autonomy special needs in academic exams in ASD children.

The proportions of pupils having their needs in autonomy not enough upheld in exams situation (academic and internal school assessments) are compared by chi-Square to the part of pupils failing to pass their assessments and their autonomy scores compared by a pair t-test.

Main results

As found by Gouzien-Desbiens et al., 2018, physical autonomy needs are still mostly compensated in classrooms and in exams, leading to apparently low aftermath in both MID and ASD pupils. Despite cognitive autonomy needs are the most numerous in MID pupils, they are objects of efficient adaptations in learning situations for 1/2 pupils, and in academic exams situation, leading to fail to pass his degree. Affective and relational autonomy needs are twice less numerous than cognitive autonomy needs but are also compensated or adapted for one pupil on two. 50% of subjects fail to pass their exams (internal or academic's) among pupils which needs in affective and cognitive autonomy haven't been objects of adaptation.

In ASD pupils, autonomy scores are lower than MID pupils in the three fields of autonomy. Affective autonomy needs are important, 2 pupils on 3 can't begin alone a task nor pursue the task (3/4), they are very sensitive to new situations. 2/3 ASD pupils don't have their cognitive and affective autonomy needs fully compensated in examination situations.

Discussion

Autonomy needs should still be upheld in academic examination situation, especially cognitive and affective autonomy of MID and mostly ASD pupils. Namely, an approach

inspired by educational cognitive psychology could be helpful in learning situations and dynamic evaluation (Dias, 1991) in academic examinations, inducing to: best represent the task, search in memory for closed tasks, plan and check one's proceedings, look for useful organizer referent (Gagné, 2004, Nader-Grosbois, 2007…). Thus, MID and ASD pupils should be more efficient in showing their real abilities. Obtaining degrees is not the only problem to get a job, these pupils should be also accompanied while being evaluated.

4. Motor planning and manual dexterity in adults with intellectual disabilities

Shogo Hirata[1], Risa Komatuzaki[1], Hideyuki Okuzumi[2]

([1]Department of Elementary Education, Ibaraki Christian University, Ibaraki, Japan; [2]Faculty of Education, Tokyo Gakugei University, Tokyo, Japan)

r093002g@st.u-gakugei.ac.jp

Aims

Empirical studies have revealed the existence of motor skill impairment in persons with intellectual disability (ID). Especially, difficulty with manual dexterity is the most frequently reported problem. Factors restricting the manual dexterity of persons with ID, however, have not been well investigated. Anticipatory motor planning, i.e., end-state comfort (ESC) effect, is a current hot topic in the field of motor control. Reportedly, a typical adult will grasp an object with an initial grasp posture that can produce a comfortable and controllable position at the end of the movement. Few studies have assessed anticipatory motor planning in persons with ID. Moreover, no report of the literature has described a study examining the relation between problems of manual dexterity and anticipatory motor planning in persons with ID. This study was conducted to investigate this relation in adults with ID.

Methods

Participants were 22 adults (15 male, 7 female) with ID free from severe sensory and motor impairments such as blindness, low vision, deafness, and cerebral palsy. Their mean chronological age was 36.8±11.9 years. This study assessed two aspects of intellectual abilities such as verbal and nonverbal abilities. The Japanese version of the picture vocabulary test-revised (PVTR) was administered to assess participants' verbal ability. In addition, the Raven color progressive matrices (RCPM) examination was applied to assess the nonverbal ability of participants.

The bar-transport task (BTT), an internationally accepted task, was used to assess anticipatory motor planning. Participants were instructed to take hold of a bar with one white and one black end, which was suspended horizontally on two supports, and then to place it in a vertical position with either its white or black end onto the bottle on the table surface. In addition, participants were instructed to grasp the bar using a power grip and preferred hand, but they were not instructed how to grasp the bar (i.e., overhand or underhand). Participants performed two trials per condition, resulting in a total of 8 trials comprising the 2 start orientation of the bar (white end to the left or white end to the right) and 2 end orientation (white end inserted to the bottle or black end inserted to the bottle). In the BTT, the correct response was defined by initial grasps that resulted in comfortable thumb up postures at the end of the movement. For example, participants must choose the underhand grip in the "white end to the left and inserted to the bottle" condition to satisfy this definition. Completing the BTT correctly requires choosing the initial underhand grip four times (underhand condition) and the initial overhand grip four times (overhand condition). The numbers of correct responses in the two conditions were analyzed.

The Purdue pegboard, a famous and internationally accepted assessment, was used to evaluate each participant's level of manual dexterity. A picking and placing test was

administered. In this test, participants were required to pick up and place pins within 30 s for the preferred hand. The number of pins that participants can move from a cup and place sequentially into pinholes located in the pegboard were analyzed.

Findings of study

The correct response of the BTT underhand condition (2.23±1.57) was significantly lower than that of the overhand condition (3.64±1.04; t (20) = 4.07, p< 0.001, partial η^2 = 0.441).
Performance of the Purdue pegboard test was correlated significantly and positively with the correct response of the BTT underhand condition (r = 0.543, p = .009), i.e., higher performance of the Purdue pegboard test was associated with higher correct response of the BTT underhand condition. However, the correct response of the BTT overhand condition was not correlated significantly with the performance of the Purdue pegboard test (r = 0.014, p = .952). Participants' nonverbal ability (RCPM score) was correlated significantly and positively with the correct response of the BTT underhand condition (r = 0.552, p = .008), but was not correlated with the correct response of the BTT overhand condition (r = 0.091, p = .686). Moreover, participants' verbal ability (PVTR score) was not correlated with correct responses of the BTT (underhand condition, r = 0.302, p = .172; overhand condition, r = 0.230, p = .304). Performance of the Purdue pegboard test was correlated significantly and positively with the RCPM score (r = 0.606, p = .003) and the PVTR score (r = 0.423, p = .050). In partial correlations, significant positive correlation was found between the BTT underhand condition and performance of the Purdue pegboard test, while controlling for the PVTR score (partial r = 0.481, p = .027). However, this correlation was less clear after controlling for the RCPM score (partial r = 0.314, p = .166).

Conclusions

In the BTT, adults with ID showed difficulty in choosing the underhand grip. Our simple observation shows that participants for whom correct responses of the underhand condition were low seemed to respond more rapidly and tended to choose overhand grip, resulting in an uncomfortable thumb-down end position in this condition. This observation suggests that inhibitory dysfunction prevents the anticipatory motor planning of adults with ID.
The major finding of this study is that problems of manual dexterity were found to be related with anticipatory motor planning in adults with ID. Moreover, partial correlation analyses suggest that nonverbal ability (RCPM score) mediates this relation. The RCPM score is used as an index of the fluid intelligence, which is the capacity to reason and solve novel problems. Some studies revealed that the performance of the BTT was interrelated with cognitive planning, which is a component of fluid intelligence, in typical developed children. It might be inferred that the same tendency can be found in adults with ID, but the role of the fluid intelligence on the Purdue pegboard task in adults with ID remains unclear. Features of the movement process in the BTT and the Purdue pegboard should be investigated by specifically examining reaction times and kinematic characteristics.

5. The influence of ADHD symptoms on self-esteem and depression in young adolescents

Yosuke Kita[1], Yuki Inoue[1,2,3]

([1]Department of Developmental Disorders, National Institute of Mental Health, National Center of Neurology and Psychiatry (NCNP), Tokyo, Japan; [2]Department of Child Psychiatry, Shimada Ryoiku Center Hachioji, Tokyo, Japan; [3]Department of Child Psychiatry, Yokohama City Southern Area Habilitation Center for Children, Yokohama, Japan)

kitay@ncnp.go.jp

Introduction

The association of attention-deficit hyperactivity disorder (ADHD) symptoms with self-esteem is one of the interesting research and clinical topic in the research field of ADHD. A number of studies found that children with ADHD had lower self-esteem compared with healthy controls. However, relatively few studies have focused on adolescent ADHD. Scholtens et al reported that ADHD symptoms had a negative effect on academic progress and academic self-perception in adolescent. Additionally, Glass et al examined the relationship between self-esteem and conduct problems in adolescents with ADHD, and reported that self-esteem was significantly lower in adolescents with ADHD and conduct problems but not in adolescents with ADHD only. Based on previous findings, we hypothesized that self-esteem in people with ADHD symptoms decreases with age from childhood, and that adolescence is a transitional stage in which ADHD symptoms affect both self-esteem and external and/or internal behavior problems such as conduct problems and depressive symptoms.

The current study had two research aims. The first aim was to examine the influence of ADHD symptoms on self-esteem in early adolescence. The second aim of the current study was to clarify the relationships between self-esteem and other clinical symptoms, such as behavioral and depressive symptoms, which are frequently comorbid with ADHD in adolescents. We investigated the relationships among ADHD symptoms, ODD symptoms, self-esteem, and depressive symptoms in adolescents based on our hypothetical model using structural equation modeling (SEM) analysis.

Methods

Participants comprised 564 children, ranging in age from 12 to 15 years, from local public middle schools (boy = 51.9%; average age (standard deviation (SD) = 13.69 (0.89)). We obtained school approval and informed consent from all schools and parents, respectively, prior to study participation. The research protocol was approved by the local ethics committee.

We used a Japanese version of the Swanson, Nolan, and Pelham Rating Scale-IV (SNAP-IV) Teacher form to assess symptoms of ADHD and ODD. The SNAP-IV is a 26-item questionnaire that comprises three factors: Inattention, Hyperactivity–Impulsivity, and ODD. Self-esteem and self-perception were evaluated using the Japanese version of the Scale of Self-Cognition. The JSSC is a 26-item self-reported questionnaire for children ranging in age from 8 to 15 years, and has two main factors: Global Self-Worth (i.e., self-esteem) and

domain-specific judgments (i.e., self-perception). The latter factor is divided into five specific domains: Scholastic Competence, Athletic Competence, Behavioral Conduct, Social Acceptance, and Physical Appearance. We assessed depression in children via the Japanese version of the Depression Self-Rating Scale for Children (DSRS-C). The DSRS-C has high validity and reliability, and is suitable for children because it consists of just 18 easy items.

We generated descriptive statistics for each measurement and calculated Pearson's correlation coefficients for analytical preparation of SEM. SEM was used to study our hypothesis regarding the relationship between ADHD and ODD symptoms, depression, self-perception, and self-esteem. We examined the suitability of our hypothetical model using maximum likelihood estimation techniques. We used multiple fit indices, such as the ratio between the chi square statistic and the Degrees of Freedom (χ^2/df), the Goodness-of-Fit Index (GFI), the Adjusted Goodness-of-Fit Index (AGFI), the Comparative Fit Index (CFI), and the Root Mean Square Error of Approximation (RMSEA) to evaluate model fit. We also examined each path in the model using Wald tests with significance set at $p = 0.05$.

Results

All children had scores below the cut-off values for Inattention (i.e., 100.0% of the total sample). 0.3% of the total sample shows scores above the cut-off value for Hyperactivity–Impulsivity and 13.9% of the total sample were identified as depressed because they obtained scores above the cut-off value for Depression.

A first SEM was used to evaluate our hypothetical model, which set all paths between the observed variables. This first test step produced several inadequate values of fit indices, such as $\chi^2/df = 41.72$ and GFI = .62. Thus, we modified the first model by removing paths that were insignificant and adding the residual error covariance between the factors. We repeated these modification procedures to reach the final modified model. The SEM produced fit indices that indicated a good fit between the final model and data (χ^2 (18) = 31.37, p = .03; χ^2/df = 1.743; GFI = .984; AGFI = .952; CFI = .989; RMSEA = .048).

All paths in the final model were significant according to the Wald test (ps< .05). Inattention was associated with self-esteem and self-perception. Specifically, severe inattentive symptoms decreased Global Self-worth, Scholastic Competence, and Athletic Competence. High levels of Hyperactivity–Impulsivity also decreased self-perception with respect to Behavioral Conduct but increased Athletic Competence. We did not find any direct effects of ADHD symptoms on depression, although severe ODD symptoms were associated with severe depression. Greater Global Self-Worth was strongly associated with decreased depression. Moreover, greater self-perception regarding Social Acceptance and Physical Appearance, both of which were not influenced by ADHD symptoms, was associated with decreased depression.

Discussion

The present data indicate that ADHD symptoms in early adolescents are associated with self-esteem and several domains of self-perception. This is consistent with a previous survey conducted with a community sample. We found that severe inattentive symptoms were associated with decreased self-perception in terms of scholastic and athletic competence, both of which are related to school activities and classes. Children with severe inattention are more likely to make mistakes on schoolwork and in physical education classes in school, and to be reproached by teachers and parents. These reproaches could decrease self-perception in

some domains, while individuals may maintain healthy self-perception for other domains, such physical appearance, that are not as likely to draw rebukes from others.

Hyperactive–impulsive symptoms were associated with self-perception in terms of Behavioral Conduct. Hyperactive–impulsive children often cannot keep themselves from doing things they should not do. They may regret their behaviors later on, particularly when they get scolded by their teachers and other adults for what they have done. The combination of remorse and reproaches from others may decrease their self-perception regarding behavioral conduct.

Low self-esteem was associated with more severe depressive symptoms. Many previous findings have indicated that children with ADHD have low self-esteem, which can lead to depression. These internalized problems become pronounced during the transition from childhood to adolescence, and some children with ADHD are first diagnosed with depression during adolescence. Additionally, it is interesting to note that depression was associated with low self-perception with respect to Social Acceptance and Physical Appearance, which were not influenced by ADHD symptoms. Nishikawa et al also proposed non-academic self-concept (i.e., social and physical factors) as a predictor of internalizing and externalizing problems in Japanese adolescents. Japanese adolescents assign more importance to friendships and physical appearance compared with school activities such as scholastic and athletic competence. This is likely because Japanese people traditionally emphasize group harmony and compliance with social norms. Thus, such culturally-imbedded attitudes can have a potent influence on the mental health of Japanese adolescents, for instance, making them more susceptible to depressive symptoms if they have low self-perception regarding social and physical appearance.

ODD symptoms were directly associated with depressive symptoms, while ADHD symptoms were indirectly associated with depression via self-esteem. Recently, Leadbeater and Homel reported that ODD symptoms among adolescents were linked with both internalizing (anxiety and depression) and externalizing (conduct problems) problems. Boylan also indicated that ODD is often comorbid with internalizing disorders (anxiety/depressive disorder) in childhood and adolescence. The present results are consistent with these previous findings, and suggest that ODD symptoms might influence depression directly, unlike the relationship between ADHD symptoms and depression mentioned above. Thus, adolescents with ODD symptoms may be at risk for depression, even though their ODD symptoms have a minimal influence on self-esteem and self-perception.

In conclusion, the present findings indicate that ADHD symptoms have a negative influence on self-esteem and depressive symptoms. Additionally, adolescents with severe ODD symptoms may be at greater risk for depressive symptoms.

6. Temporal attention in atypical cognitive development: the case of Down Syndrome

Giovanni Mento[1], Gaia Scerif[2], Silvia Lanfranchi[3]

([1]Department of General Psychology, University of Padova, Padova, Italy; [2]Department of Experimental Psychology, University of Oxford, Oxford, UK; [3]Department of Developmental Psychology and Socialization, University of Padova, Padova, Italy)

giovanni.mento@unipd.it

Introduction

It has been suggested that impairment in domain-general cognitive abilities might be at the core of the observed neuropsychological profile in children with Down Syndrome (DS) (Karmiloff-Smith, 1998). Specifically, many researchers have proposed that the presence of deficits in attention and executive functions could be an early core feature of DS constraining the subsequent acquisition of task- or domain-specific skills. In this regard, impairments in visual selective attention has been suggested as a possible early dysfunctional cognitive hallmark of DS (Cornish, Scerif, & Karmiloff-Smith, 2007; Rowe et al., 2006; Scerif and Steele, 2011; Scerif, Cornish, Wilding, Driver, & Karmiloff-Smith, 2004). So far, most research efforts to understand the relationship between selective attention and the emergence of other cognitive functions have been operationalized in spatial terms (Shimi et al., 2014; Amso and Scerif, 2015). Yet, recent evidence is suggesting that temporal orienting of attention may be a fundamental gating mechanism to select relevant information for further computational processing (Coull and Nobre, 1998; Correa et al., 2006; Mento, 2017). More specifically, it may be argued that, similarly to what has been suggested for spatial attention, a disruption in the typical developmental trajectory of the ability to allocate attention in time may constitute a domain-general hallmark common to several developmental disabilities. More recently, Mento and Tarantino (2015) provided first behavioural evidence that voluntary (top-down) and automatic (bottom-up) mechanisms at the basis of temporal orienting follow a stable developmental trajectory after 6 years of age. This evidence has been further supported by neuroimaging data demonstrating that 8 to 12 year-old children engage adult-like neural networks (Mento and Vallesi, 2016) and oscillatory patterns (Mento et al., 2017). Yet, no experimental evidence is currently available about temporal orienting of attention in atypical development.

Aims

In the present study we aimed to provide first empirical evidence about the interplay between top-down and bottom-up temporal orienting mechanisms in DS. To this purpose we compared the behavioural performance of a group of children and adolescents with DS with that observed in typically developing individuals matched by either chronological or mental age when undergoing a simple cued reaction time purposely designed to assess top-down and bottom-up temporal attention.

Methods

Participants

Thirty-three participants with DS (11.58 ± 3.78 years; range 5-17 years; 14 females) were enrolled and compared with two control groups matched by mental age (TD-MA; 5.19 ± 0.48 years; range 4-6 years; 15 females) and chronological age (TD-CA; 11.45 ± 3.99 years; range 6-18 years; 14 females), respectively. Both DS and TD-MA groups were administered tests aimed at measuring verbal (i.e., Raven's Colored Progressive Matrices; Belacchi et al., 2008) and non-verbal (Peabody Picture Vocabulary Test; Stella et al., 2000) ability, respectively. The raw score obtained at the Raven's PCM test was used to estimate the mental age of both groups. Furthermore, the parents of participants with DS were asked to fill in the SDAG (Cornoldi et al., 1996), an Italian scale purposely addressed to parents in order to assess the presence of inattentive or hyperactive behaviours in their children.

Experimental task

All participants underwent a block-wise, cued reaction time (RT) task, already proven to reliably assess both top-down and bottom-up temporal orienting effects in typically developing children (Mento and Tarantino, 2015; Mento and Vallesi, 2016; Mento et al., 2017). Each trial began with the display of a visual cue consisting of the picture of a black circle, which was followed by the presentation of a target consisting of a picture of an animal inside the circle. In the cued blocks the colour of the external circle provided valid temporal information about the onset of the target, i.e., after a short (600 ms) or a long (1400 ms) interval from cue onset. In the uncued blocks the circle was always black, thus providing no predictive information about target onset. This could appear after a short (i.e., 600 ms) or long (i.e., 1400 ms) interval, as well. All participants were asked to press a button at target onset. This allowed us to calculate the advantage provided by the cue on RTs (top-down temporal orienting). We also explored the presence of both the foreperiod (FP) and sequential effects (SE). FP is the evidence of shorter RTs in long trials as a function of the increased conditional probability of target onset, while SEs consist in the influence exerted by the FP length of a trial *n* on the RT observed in the following one (trial *n-1*). For example, a short FP trial biases participants toward expecting a short FP in the next one, thus affecting their performance. Both FP and SEs are two main bottom-up mechanisms of temporal orienting since they do not require explicit knowledge about the temporal properties of the stimuli.

Results

Mean task accuracy was calculated as the percentage of trials in which participants did not pressed the response box before target onset and was predicted by verbal ($r=.41$; $p<.02$), non-verbal ($r=.69$; $p<.001$) and inattention/hyperactivity scores ($r_s>.40$; $p_s<005$) in DS but not in TD-MA group. To mitigate the effect of variability in task compliance and RT speed on temporal orienting effects, we focused our subsequent analyses on a subsample of children scoring higher than 65% in mean accuracy ("high-performers") with DS (n=19; mean age 13.58 ± 2.69 years; range 9-17 years), TD-MA (n=24; 5.25 ± 0.53 years; range 4-6 years) and TD-CA (n=19; 10.47 ± 4.74 years; range 10-18). Analyses revealed that bottom-up temporal orienting mechanisms are well established and operating in all groups. This was yielded by a main effect of FP ($F(1,59) = 16.98$; $p < 0.001$; ${}_p\eta^2 = 0.22$), with overall faster

RTs for long as compared to short FP trials as well as by a main effect of trial sequence, with RTs in trial *n* being affected by the FP length in the preceding, *n-1* trial ($F(1,59) = 45.13$; $p < 0.001$, $\eta_p^2 = 0.43$).

Conversely, only typically developing children are able to use temporal attention top-down, taking advantage from the temporal information provided by the cue to speed up their performance. This was revealed by a GROUP × CUE × FP interaction [$F(2,59) = 3.16$; $p < 0.05$; ${}_p\eta^2 = 0.1$].

Discussion

To our knowledge this is the first study specifically addressing the presence of temporal orienting effects in atypical development. Our findings suggest a dissociation between top-down and bottom-up mechanisms of temporal orienting in DS. In line with a neurocostructive account, we argue that the ability to implicitly represent and process the temporal information to selectively orient attention is preserved in DS in relatively young children and adolescents with DS, while the ability to represent and use such information explicitly has not yet developed.

7. The interpretation and production of grammatical gender by a Spanish-English bilingual with Prader-Willi Syndrome: an idiosyncratic cognitive divide?

Juana Munoz Liceras[1,2], Estela García-Alcaraz[1]

([1]Faculty of Arts, University of Ottawa,Ontario, Canada; [2]Facultad de Lenguas y Educación- Universidad Nebrija, Madrid, Spain)

Juana.Munoz-Liceras@uottawa.ca

The Minimalist Program (MP) and Distributed Morphology (DM) have provided theoretical frameworks for analyzing spontaneous and experimental code-switched data produced and elicited from both unimodal bilinguals (i.a. Liceras et al. 2008) and bimodal bilinguals (i.a. Chen Pichler et al. 2016). However, to the best of our knowledge, code-switched data from bilinguals with developmental disabilities have not been analyzed, in spite of the fact that they can provide important information as to how language in general and formal features in particular are represented in the mind of these bilinguals. In this study we focus on a 34-year-old adult English (majority language)-Spanish (Heritage language) bilingual with Prader-Willi Syndrome (PWS), a genetic disorder that besides behavioral disturbances presents intellectual and linguistic disabilities. Speech and language development are frequently delayed as these individuals often have poor speech-sound development, reduced oral motor skills and language deficits in terms of grammar, morphology, narrative abilities and pragmatics (Lewis 2006). While extensive research has been conducted on the intellectual disabilities and behavioural disturbances of individuals with PWS (i.a. Ho & Dimitropoulos, 2010), their speech and language development remains almost entirely unexplored, as the little linguistic research that has been carried out to date has mainly focused on monolingual speakers and their narrative abilities.

Code-switched structures provide insight into the representation of gender in the mind of the bilingual because they make it possible to determine whether bilinguals whose dominant language does not classify Nouns according to grammatical gender do, in fact, assign these Nounsthe gender of their 'translation equivalents' in the gender-marked language. Previous research (Liceras et al. 2008) has shown that Spanish-dominant English-Spanish bilinguals significantly prefer gender-matching switched concord structures (as in 1) over non-matching (as in 2), namely they abide by the so-called 'analogical criterion' (Otheguy& Lapidus 2003).

—Concord: Determiner Phrase (DP)

(1a) La $_{[theF]}$ house $_{[casaF]}$[FF matching] / (1b) El $_{[theM]}$ book $_{[libroM]}$ [MM matching]

(2a) El [$_{theM]}$ house $_{[casaF]}$ [MF non-matching] / (2b) La $_{[theF]}$book $_{[libroM]}$ [FM non-matching]

The 'analogical criterion' has also been shown to occur (Valenzuela et al. 2012; Liceras 2013; Liceras et al. 2016; Liceras et al. 2017) in switched agreement structures (3 versus 4).

—Agreement: Adjectival Phrase (AP)

(3a) The house$_{[la\ casaF]}$ es roja$_{[is\ redF]}$ [FF matching] / (3b) The book$_{[el\ libroM]}$ es rojo$_{[is\ rojoM]}$ [MM matching]

(4a) The house$_{[la\ casaF]}$ es rojo$_{[is\ redM]}$ [FM non-matching] / (4b) The book$_{[el\ libroM]}$ es rojo$_{[is\ rojoF]}$[MF non-matching]

However, while Spanish-dominant bilinguals abide by the 'analogical criterion' regardless of the experimental task and structure, English-dominant bilinguals (specifically Heritage Spanish speakers) and sequential L2 Spanish learners are significantly closer to Spanish-dominant bilinguals in the case of the agreement structures (Valenzuela et al. 2012; Liceras 2013) than in the case of concord structures when performing an acceptability judgement task. Interestingly enough, the reverse pattern is found when performing a production task, since in this case they are closer to the Spanish-dominant bilinguals in the case of concord structures (Liceras et al. 2016; Liceras et al. 2017).

In relation to this divide, we propose that the different status of the 'analogical criterion' in the production and interpretation of code-switched DPs and code-switched APs in (1)-(2) and (3)-(4) can be accounted for by two constraints. One constraint is determined by the feature valuation mechanism that leads to matching the Spanish D and the English N in (5) or the English DP and the Spanish Adjective in (6).

(5)

D		N
La$_{the-}$		house (as Spanish casa)
[uGen: fem.+ (Φ)]		[Gen-fem. + u(Φ)]

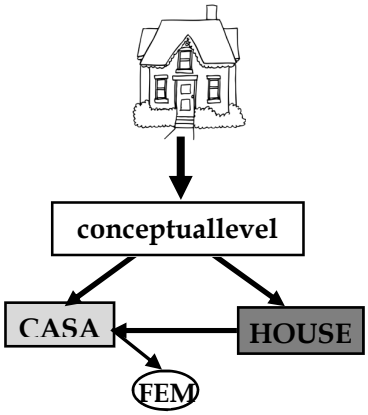
(6)

DP		Adj.
The house	es	roja
[Gen: fem.+ (Φ)]		[uGen-fem. + u(Φ)]

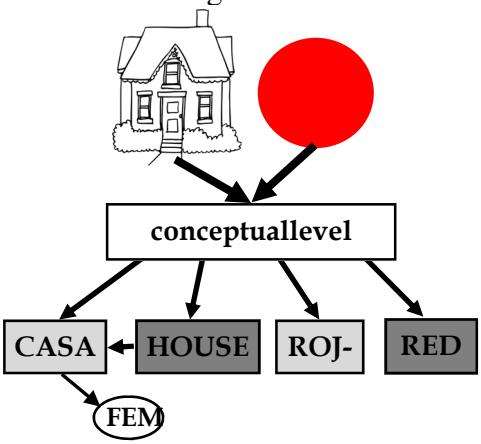
This implies that, in the acceptability judgement task, the opposing directionality of the double feature valuation mechanism (left-to-right and right-to-left) in concord versus the equal directionality (right-to-left) in agreement accounts for the different performance of the TD English dominant English-Spanish bilinguals with respect to the analogical criterion: the opposing directionality makes it more problematic to assign the Spanish Gender features to the English Noun in concord structures than in agreement structures with equal directionality.

The other constraint which pertains to production is determined by the number of lexical categories that are to be accessed in a code-switched construction, as in (7) versus (8).

(7) production model of concord



(8) production model of agreement



What the models in (7) and (8) show is that when producing a code-switched DP in a concord structure, only one lexical category, the Noun, has to be accessed. In the case of the code-switched AdjP in the agreement structure, two lexical categories, the Noun and the Adjective, have to be accessed. This makes the agreement structure more problematic for both the Heritage speakers and the L2 Spanish speakers in the TD population.

In order to determine whether the representation of gender in the mind of our English dominant English-Spanish bilingual with PWS is shaped by the 'analogical criterion' along the same lines as in TD Heritage Spanish speakers, our participant performed an acceptability judgment task in which he rated switched concord and agreement structures as in (9a) and (10a) on a scale of 1 to 4, and a written production task where he completed switched concord and agreement structures as in (9b) and (10b). Both tasks included pictures to provide and to allow for the use of colour Adjectives in the production task.

(9a) Where is the milk? - La leche estáen el glass. *[MM matching]*

the milk is in the (*vaso*-masc.)

(9b) Hay nubes en _____ sky. *Response:* <u>*el*</u>*[masc.][MM matching] /* <u>*la*</u>*[fem.] [FM non-matching]*

There are clouds in(cielo-masc.)

(10a) Why do you like the castle? – The castle es preciosa. *[MF non-matching*]

(castillo-masc.)beautiful[fem.]

(10b) The table es _____. *Response:* <u>*negra*</u>*[FF matching] /* <u>*negro*</u> *[FM non-matching]*

La mesa[fem.] is black[fem.] black[masc.]

The results show that, when performing acceptability judgments, our English-Spanish bilingual with PWS has a stronger preference for the concord and the agreement structures that abide by the 'analogical criterion'. Namely, this participant gives a higher rating to (1) versus (2) and (3) versus (4). However, in the production task, our participant systematically abided by the 'analogical criterion' when producing the two types of structures, thus performing at ceiling, as TD Spanish-dominant bilinguals do. Furthermore, this divide between the two tasks evidences that, rather than sensitivity to the directionality of the valuation mechanisms in (5) versus (6) or issues with the number of lexical categories to be

accessed in a given construction, it is the actual task, the acceptability judgement task, that is problematic for the PWS individual. These results constitute a first step towards investigating which cognitive capacities may be compromised in the case of the PWS population and provide clear-cut evidence that bilingualism does not have a negative effect on the activation of formal features in their grammar.

8. Simultaneous and sequential visuospatial working memory and attentional control in individuals with intellectual disabilities

Yuhei Oi[1,2], Hideyuki Okuzumi[2], Mitsuru Kokubun[2]

([1]Faculty of Education, Tokoha University, Japan; [2]Faculty of Education, Tokyo Gakugei University, Japan)

y.oi@sz.tokoha-u.ac.jp

Introduction

Working memory is a set of cognitive processes that maintain information temporarily for use in ongoing mental operations. Individuals with intellectual disabilities (ID) are known to have impaired verbal working memory. That impairment becomes more prominent as the degree of attentional control involved in the task increases (Carretti, Belacchi, & Cornoldi, 2010).

Reports of the literature suggest that visuospatial working memory is preserved in individuals with ID. Further recent investigations have elucidated visuospatial working memory in individuals with ID, particularly addressing the distinction between simultaneous and sequential processes, which are involved respectively when information is presented simultaneously and sequentially. A study by Lanfranchi, Carretti, Spanò, and Cornoldi (2009), for instance, found that individuals with Down syndrome were impaired in simultaneous process but not in sequential process.

Aside from ID of genetic origin, visuospatial working memory in individuals with non-specific ID has also been investigated based on that framework. Consequently, individuals with non-specific ID performed better on a simultaneous visuospatial working task compared to mental age peers (Oi, Okuzumi, & Kokubun, 2018).

Earlier studies have elucidated characteristics of visuospatial working memory in individuals with ID, but it remains unclear how individuals with ID perform on tasks that demand high attentional control. Sequential visuospatial working memory in individuals with non-specific ID might be subject to influences by attentional demands considering their relatively poor performance on a sequential task (Oi et al., 2018) and the relation between sequential tasks and attentional control (Rudkin, Pearson, & Logie, 2007).

Therefore, this study investigated visuospatial working memory in individuals with non-specific ID in terms of the distinction between simultaneous and sequential processes and attentional control. Two types of attentional control were specifically examined: attentional control during encoding (perceptual shifting and selection of attention) and during retrieval (mnemonic shifting and selection of attention; Nobre, Coull, Maquet, Frith, Vandenberghe, & Mesulam, 2004).

Method

This study examined 23 individuals with non-specific ID: 11 female, 12 male; chronological age 29.4 ± 14.0 years; IQ 46.1 ± 14.8. A control group comprised 23 typically developing children: 9 female, 14 male; chronological age 6.0 ± 0.4 years. The two groups were matched for gender ($\chi^2_1 = 0.09$, $p = .766$) and nonverbal intelligence as assessed using Raven's Colored Progressive Matrices (ID group score, 20.3 ± 8.2; control group score, 20.5 ± 4.9; $t_{44} = 0.13$, $p = .897$).

All participants were individually administered visuospatial working memory tasks of three types under simultaneous and sequential presentation. The tasks were the following. (1) In the *baseline* task (requiring simple maintenance of information), participants were presented with a matrix with some cells filled in red and were asked to remember the locations. (2) In the *precue* task (requiring attentional control during encoding), participants were presented with a matrix with some cells filled in red and green, and were asked to remember only the red cell locations (precue). (3) In the *retrocue* task (requiring attentional control during retrieval), participants were presented with a matrix with some cells filled in red and green. They were asked to remember the locations of red and green cells. At recall, participants were required to recall the locations of either the red or green cells according to the retrocues presented.

Each filled cell appeared all at once under simultaneous presentation, but each appeared one-by-one under sequential presentation. The numbers of filled cells to be remembered were two, four, and six. The matrix sizes were, respectively, 3 × 4, 4 × 4, and 4 × 5. Two trials were given for each level of difficulty. For all tasks under both presentation formats, task performance was measured as the proportion of the filled cells correctly recalled out of all those presented.

Results, Discussion, and Conclusion

A 2 (group: ID vs. control) × 3 (task: baseline vs. precue vs. retrocue) × 2 (presentation format: simultaneous vs. sequential) repeated measures analysis of variance revealed a significant three-way interaction ($F_{1.67,\ 73.36} = 3.39$, $p = .048$, $\eta^2 = .01$). Significant group and task interaction was also found for sequential presentation ($F_{1.83,\ 80.67} = 5.16$, $p = .010$, $\eta^2 = .03$). Post hoc analyses of this interaction showed that the ID group underperformed the control group in the precue task ($F_{1,\ 44} = 4.83$, $p = .033$, $\eta^2 = .10$) and the retrocue task ($F_{1,\ 44} = 5.29$, $p = .026$, $\eta^2 = .11$), although they were comparable in the baseline task ($F_{1,\ 44} = 0.01$, $p = .928$, $\eta^2 = .00$). Under simultaneous presentation, performance in no task differed between the groups, as indicated by findings of no significant main effect of the group ($F_{1,\ 44} = 0.14$, $p = .706$, $\eta^2 = .00$) and no significant interaction of the group and task ($F_{1.8,\ 79.19} = 0.42$, $p = .638$, $\eta^2 = .00$).

Those results demonstrate that individuals with non-specific ID performed equivalently to typically developing children matched for nonverbal intelligence on the tasks requiring simple maintenance of visuospatial information presented simultaneously and sequentially. However, when additional operations were required during encoding and retrieval, performance of individuals with non-specific ID became impaired. This was found only in cases where items to be remembered were presented sequentially. Given the finding that sequential visuospatial working memory tasks involve executive resources to a greater degree than simultaneous ones (Rudkin et al., 2007), the impairments might be related to difficulties with executive processes in individuals with ID (Willner, Bailey, Parry, & Dymond, 2010).

In conclusion, results of this study suggest that visuospatial working memory in individuals with ID is preserved overall, but it is impaired when sequential process and attentional control are recruited. Results of this study augment our understanding of the characteristics of visuospatial working memory in individuals with ID, and also demonstrate possible differences between non-specific ID and ID of genetic origin.

9. Cognitive profiles in children with Down syndrome

Sara Onnivello, Francesca Pulina, Silvia Lanfranchi, Renzo Vianello

(Department of Developmental Psychology and Socialization, University of Padova, Padova, Italy)

sara.onnivello@gmail.com

Introduction

Down syndrome (DS) is caused by an extra copy of chromosome 21 and it is the most common cause of intellectual disability (Kittler, Krinsky-McHale & Devenny, 2008). The IQ of individuals with DS generally ranges between 25 and 70, and only a few of them reach a mental age beyond 7 years, with particular problems in abstract reasoning (e.g., Dykens, Hodapp & Finucane, 2000). These individuals' cognitive functioning is characterized by speech and language impairments (Chapman & Hesketh, 2000), and their difficulties are greater in expressive language than in auditory language comprehension. On the other hand, their non-verbal skills are usually less severely impaired, although recent studies have shown a variable picture depending on which aspect of visuospatial cognition is considered (Yang, Conners & Merrill, 2014). Research has also shown that individuals with DS are extremely limited in terms of memory span, especially in auditory verbal memory (Jarrold, Baddeley, & Hewes, 1999; Vicari, Carlesimo, & Caltagirone, 2004), and in executive functions, particularly working memory. (In the present study we investigated the cognitive profile of children with Down Syndrome using the Wechsler Preschool and Primary Scale of Intelligence-III (WPPSI-III), commonly used in Italy to measure cognitive functioning.

Methods

Participants

The participants of this study were 18 children and adolescents with Down Syndrome, from 7 years old to 21 years old (M= 148,72 months; DS=38,16 months)

Materials

We used the Wechsler Preschool and Primary Scale of Intelligence-III (WPPSI-III; Wechsler, 1967.), which is an intelligence test designed for children ages 2 years 6 months to 7 years 3 months. It provides subtests and composite scores that represent intellectual functioning in verbal and non-verbal domains, as well as providing a composite score that represents a child's general intellectual ability (i.e. Full Scale IQ). In this study we considered only the 5 subtests designed for children from 2 years 6 month to 3 years 11 months because they were those that everybody was able to do and that did not show a floor effect. Moreover, as in the study of Tsao and Kindelberg (2009) we did not based our analyses on standardized scores because of different reasons: the chronological age of some of the participants exceeded the ages provided for the standardization; transforming row scores in standard scores would have shown a floor effect; finally, the focus is not comparing scores of DS with typically developing children but to study the trajectory of scores within DS children. The verbal subtests are: Information (questions of general knowledge are asked); Receptive Vocabulary (the child looks at a group of four pictures and points to the

one the examiner names aloud); Picture naming. The performance subtests are: Block Design (the child is required to re-create with blocks a model is shown by the examiner); Object Assembly (the task is to assembly pieces of puzzles).

Procedure

All the participants were evaluated at the University of Padua in one session, which was about 90 minutes, variable considering the fatigue of the person. All the children did at least the 5 subtests for younger children and, when it was possible, we continued with the others.

Analysis and Results

Analyses were conducted using SPSS 23. We first divided the participants in two age group: from 7 to 13 years old (N=9, M=121.33, DS=18.21) and from 13 years 1 month and older (N=9, M=176.11, DS=32.79). Then we run a repeated measures ANOVA using the age equivalent scores of the 5 subtests. We found a significant effect of the subtest $F(4, 64)=4.23$, $p=.004$,$\eta^2=.209$. Looking at the post-hoc analysis, significant differences between subtests did not emerged because of the high variability, except for the one between Receptive Vocabulary and Object Assembly that tended to significance ($p=.08$) Moreover the interaction between subtest and age group was significant, $F(4, 64)= 2.79$, $p=.034$,$\eta^2 =.148$. Subsequent post hoc analysis showed that in the youngest group there was a significant difference between Information (M=62.78±7.53) and Object Assembly (M=45.11±6.18) with $p=.013$, while in the oldest one the significant differences are found between Information (M=54.44±7.53) and Receptive Vocabulary (M=68.89±7.05), $p=.043$, and between Picture Naming (M=52.22±6.75) and Receptive Vocabulary with $p=.031$.

Afterwards, we run another repeated measure ANOVA to explore if there was any difference between the mean of equivalent age scores of the verbal and performance subtests. Differences between the two indices were significant, $F(1,16)=9.33$, $p=.008$,$\eta^2=.368$, with higher verbal score (M=58.76±19.01) than performance one (M=48.61±16.06). No significant interaction between subtests and age group was found. Cluster analysis will be performed to explore the possibility of different sub-profiles.

Conclusion

Looking at the preliminary analyses, a particular WPPSI-III profile emerged in children with DS. This profile can vary across age.

10. Do typically and atypically developing children learn and generalize novel relational names similarly: the role of conceptual distance during learning and at test

Arnaud Witt[1], Annick Comblain[2], Jean-Pierre Thibaut[1]

([1]LEAD-CNRS, UMR 5022, Université de Bourgogne Franche-Comté, Pôle AAFE, Dijon, France; [2]Département de Logopédie, Université de Liège, Liège, Belgium)

arnaud.witt@u-bourgogne.fr

Introduction

Concept learning requires understanding what is essential about novel situations andneglect superficial, often idiosyncratic properties. For relational concepts, the difficulty is that relational nouns apply to very different objects (e.g., neighbor). Relational categories are thus acquired later. Understanding which situations will the discovery of nonobvious properties over salient irrelevant properties is a crucial issue. The opportunity to compare exemplars from a category often contribute to highlight nonobvious common properties (Augier & Thibaut, 2013; Gentner & Namy, 1999; Namy & Gentner, 2002). However, all comparison conditions are not created equal. It has been shown that semantic distance between the learning items and between the learning items and the generalization targets matter for both relational and object nouns (Gentner et al., 2011; Thibaut & Witt, 2015; Thibaut &Witt, 2017). To the best of our knowledge, there is no study available regarding the role of comparison in the case of persons with mental deficiencies. A large number of former studies were descriptive and do not relate lexical development to cognitive factors (see Barrett & Diniz, 1989, for a review). In terms of levels of categorization, it has been shown that ID children have more difficulties with the superordinate (e.g., food) and the subordinate (e.g., golden apple) levels than the basic level of categorization (apple) (Harrison, Budoff, & Greenberg, 1975). In terms of generalization, Hupp and Mervis (1982) showed that persons with ID underextended novel words, excluding peripheral members of categories and including typical members of the categories. This evidence is mostly available for object categories. Much less is known for relational categories.

Aims of the study

We contrasted ID and TD MA-matched children, divided into high- and low-functioning groups on the basis of their Raven scores, in various comparison situations during a novel relational word learning task. These factors were crossed with Learning type (Close vs. Far comparison) and Test distance (Near vs. Distant) as within-subject factors. Overall, ID children, especially those with low Raven scores, should have lower results because they process stimuli slower than MA matched TD children. As argued by Augier and Thibaut (2013), or Thibaut and Witt (2015) comparison situations involve cognitive costs which might negatively impact ID children. More specifically, one could argue that the comparison conditions involving far learning items or distant generalization items might be more difficult to unify and, thus impede ID children's performance. The general opposite hypothesis might also be true. Given that the learned categories are familiar to all the

children and that ID children have more experience with the world, they might more easily capture the underlying unifying concepts of these situations.

Methods

Participants. Forty-six TD preschoolers (mean age = 5 years 6 months) and forty-six children (mean age 10 years 6 months) with mild and moderate ID of various etiologies participated in the experiment. Common measure for matching children with and without ID on mental age was obtained by administrating the Raven's Coloured Progressive Matrices (RCPM; Raven, 1965). Because of very heterogeneous performance, we separated the ID and TD children into a High and a Low Raven score group: ID, Low Mean RPCM = 15 (N = 23) and High Mean RPCM = 26 (N = 23); TD: Low RPCM = 17 (N = 13); High RPCM = 26 (N= 23).

Material. Different sets of pictures were built. Each set corresponded to one relational category (*cutter for*, *home for*, *food of*, *baby of*, etc.). For each relational category (e.g., cutter for), the *close* learning pairs were composed of conceptually similar items (knife1-watermelon, knife2–orange), while the *far* learning pairs were composed of less conceptually similar pairs (knife1-watermelon, cleaver-piece of meat). The test pictures consisted of two sets of 4 pictures for the *near* and the *distant* conditions: the entity (respectively, sheet of paper ; bearded face1), a taxonomic choice (pile of sheets of paper ; bearded face2), a thematic choice (pencil ; toothbrush), and a relational choice (e.g., respectively, scissors ; razor). Independent conceptual similarity ratings from 54 students confirmed that *close* learning pairs were more similar one to the others than *far* learning pairs, $p < .01$, and that *near* generalization materials were more similar to the learning materials than the *distant* generalization materials, $p < .01$.

Procedure

The experimenter introduced the learning phase with the following instructions "*In this game we are going to teach Sammy, the puppet, the word buxy. We are going to show him what buxy means." "Look! This knife is the buxy for the watermelon, and this knife is the buxy for the orange.*" The test started with these instructions: "*Now let's look all of them (gesturing across all the learningpairs). You see how these are the buxies for these objects? Now it's your turn. Which one of these (pointing to the test materials) is the buxy for the paper in the same way?*" Children chose among the three test pictures by pointing which is the buxy for the paper.

Results

A 2 (Learning Type: *close* or *far*) x 2 (Test Distance: *near* or *distant*) x 2 (Group: *ID* or *TD* children) x Raven score (*Low* or *High*) analysis of variance (ANOVA) was carried out on the relational choices. Analysis revealed that the TD children (.78) did not differ significantly from the ID children (.73), $F(1, 88) = 1.71$ $p = .19$, while children with high Raven scores (.80) outperformed those with low Raven scores (.71), $F(1, 88) = 5.65$, $p < .05$. Learning (close = .75 ; far = .76) was not significant, $F < 1$. There was a main effect of Test distance showing that participants performed better for near generalization trials (.78) than for distant test trials (.73), $F(1, 88) = 4.42$, $p < .05$. The Group*Raven interaction effect was marginally significant, $F(1, 88) = 2.88$, $p = .09$. The a posteriori comparisons suggested that TD children performed irrespectively of their Raven scores (low = .77 ; high = .79), $F < 1$, while ID

children with high Raven scores (.81) outperformed ID children with low Raven scores (.66), $F(1, 88) = 8.30$, $p < .01$, np =.36 In addition, the marginally significant Group*Test interaction effect, $F(1, 88) = 2.78$, $p = .09$, suggested that TD children showed good generalization performance as well as in the near condition (.79) than in the distant test condition (.77), $F < 1$, while ID children generalized novel names better in the near test condition (.78) than in the distant test condition (.68), $F(1, 88) = 7.11$, $p < .01$.

Discussion

Similar performance in TD and ID children suggest that ID's lexical learning mechanisms are functional for relational concepts. However, despite ID children are significantly older than TD children, the former did not outperformed the latter. This suggests that their more developed world knowledge allows them to compensate lexical deficits. In addition, the fact that only ID children were affected by Distance at test suggests that their more developed world knowledge did not allow them to compensate all conceptual difficulties. Interestingly, there was an interaction between Group and Raven score : Low Raven individuals underperformed High Raven participants in the ID children whereas Low Raven and High Raven in the TD children had similar performance. This suggests that a high level of cognitive functioning is crucial to compensate conceptual deficits and to allow learning and generalizing relational concepts in ID children as efficiently as in TD children. However, despite the influence of cognitive functioning on performance, the performance of children with ID remained above chance level whatever Raven score, learning condition and test distance. Because the performances were high, compared with chance, we hypothesize that factors like Learning Type (close or far) did not interact with Group or Raven score and did not affect performance in consequence above a given level of performance. Another hypothesis is that part of the variance of the performance is captured by individual properties we did not investigate here, like world knowledge and lexical development. Further investigations should integrate a control group matched with the Peabody Picture Vocabulary Test (PPVT; Dunn, Thériault-Whalen, & Dunn, 1993).

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Silvia Lanfranchi

Francesca Pulina

Giulia Gerotto

airipa

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