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reasoning ( $p=0.016$ ) and visual memory ( $p=0.014$ ). Within the NS/FS group there was a lower neurodevelopmental level in children with history of infantile spasms ( $p=0.026$ ).  
**Conclusions:** Patients with nonsense or frameshift variants show a lower neurodevelopmental level; however, a history of infantile spasms modulates this genotype-phenotype relationship.  
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#### Neocerebellar abnormalities in a neonate with the FOXP2 mutation

Georgios P.D. Argyropoulos, Rachael Elward, Maneet Saini, Mortimer Mishkin, Faraneh Vargha-Khadem  
**Objective:** A dominantly inherited verbal and orofacial dyspraxia in half the members of the multi-generational 'KE family' is linked to a mutation in FOXP2, the first gene implicated in the developmental processes culminating in articulate speech and language. Neural and genetic substrates of this disorder may inform the ontogeny and developmental trajectory of human speech. *Foxp2* expression is known to occur strikingly early during embryonic development and is prominent in the human, rodent and avian olivo- and ponto-cerebellar circuits. Indeed, imaging studies from our laboratory on affected KE family members aged 9-77 years have previously reported structural and functional abnormalities in the cerebellum as well as other cortical and subcortical structures. However, up to now, it had not been possible to document the emergence of FOXP2-dependent abnormalities in the brain of affected neonates from this large pedigree.

**Methods:** We analysed structural T<sub>1</sub>- and T<sub>2</sub>-weighted magnetic resonance images acquired from a neonate with the FOXP2 mutation, his unaffected twin, and 12 healthy control neonates (6-16 weeks-old). We used voxel-based morphometry and volumetry to investigate grey- and white-matter abnormalities in the affected neonate.

**Results:** We report a marked reduction of neocerebellar lobule VIIa Crus I in the affected member as compared to his unaffected sibling and unrelated controls.

**Conclusions:** FOXP2 mutation is associated with cerebellar Crus I volume reduction from the early stages of neonatal life, consistent with the gene's expression in the human embryonic cerebellum. These findings highlight the significance of cerebellar abnormalities in developmental orofacial dyspraxia in the pre-linguistic infant.

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#### Genetic subtyping and its implications for clinical management: The case of 22q11.2 syndrome

Jos Egger, Willem Verhoeven, Joep Tuerlings, Nicole De Leeuw  
**Objectives:** The 22q11.2 deletion syndrome (22qDS), mostly caused by the *common* deletion (LCR-A-D) including *TBX* and *COMT* genes, is highly associated with congenital anomalies and endocrine dysfunctions accompanied by schizophrenia-like psychoses and autism spectrum disorders. The *distal* deletion (LCR-D-H) comprises the *MAPK1* gene and is associated with specific heart defects and the presence of anxiety disorders. The relatively rare *central* deletion (LCR-B-D) encompasses the *CRKL* gene and predominantly shows renal/urogenital anomalies in combination with autistic-like behaviours.

**Participants and Methods:** Thirty patients with genetically proven and subtyped 22q11DS were referred to the Dutch national outpatient facility specialized in psychopathology and genetics for detailed cognitive neuropsychiatric assessment in order to ascertain the most appropriate neuropsychological and psychopharmacological strategy.

**Results:** Apart from one distal and one central deletion, common deletion was found in 28 patients. They presented with a variable level of intellectual disability. Patients with common deletion had a history of relapsing schizophrenia-like psychoses, partial or non-responsive to conventional antipsychotics, and often accompanied by anxieties and mood instability. The patient with distal deletion displayed anxiety symptoms, whereas in the one with central deletion, autistic-like behaviour was present. Most patients with common deletion could effectively be treated with targeted contextual measures and clozapine or quetiapine, often combined with valproic acid. The patient with distal deletion showed full remission upon treatment with citalopram whereas in the patient with central deletion,

behaviour strongly improved upon contextual-neuropsychological and behavioural measures only.

**Discussion:** Clinical management of patients with 22q11DS should be guided primarily by its genetic subtype.

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#### Intellectual development in Noonan syndrome: A longitudinal study

Renée Roelofs, Nikki Janssen, Ellen Wingbermühle, Roy Kessels, Jos Egger

**Objective:** While cognitive impairments in adults with Noonan syndrome (NS) seem to be limited to a low-average intelligence and slower processing speed, studies in children with NS have demonstrated more extensive cognitive problems (e.g. deficits in language, memory, attention, and executive functioning). This longitudinal study is the first to investigate intellectual development in patients with NS. Although childhood IQ is expected to be lower than adult IQ, it is assumed to be a significant predictor of adult intelligence.

**Participants and Methods:** Sixteen patients with NS underwent intelligence assessment in childhood and in adulthood, using Wechsler's intelligence scales. IQ scores and Wechsler standard scores achieved in childhood and adulthood were compared. Childhood verbal and performance IQ (VIQ/PIQ) were included as predictors in multiple regression analyses for adult IQ and index scores.

**Results:** Compared with childhood scores, adult full-scale IQ (FSIQ) and PIQ significantly increased (FSIQ:  $t(15)=2.88$ ,  $p=.01$ ,  $\eta^2=.36$ ; PIQ:  $t(15)=5.49$ ,  $p<.001$ ,  $\eta^2=.67$ ). Adult PIQ was higher than VIQ ( $t(15)=-2.23$ ,  $p=.04$ ,  $\eta^2=.25$ ). Childhood PIQ and VIQ together predicted all adult IQ and index scores (*adjusted R*<sup>2</sup>  $>.62$ ,  $F>13.32$ ,  $p<.001$ ), except for processing speed.

**Conclusions:** In accordance with the hypothesis, childhood IQ significantly predicted adult intelligence in patients with NS. PIQ advanced to a normal level in adulthood, while VIQ did not develop proportionately, resulting in a discrepancy between adult PIQ and VIQ. This may suggest a delay in the development of executive functioning in patients with NS, which seems to be outgrown in adulthood.

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#### Quality of life in adults with Noonan syndrome

Ellen Wingbermühle, Floor Nobbe, Renée Roelofs, Ineke Van der Burgt, Roy Kessels, Jos Egger

**Objective:** Noonan syndrome (NS) is a genetic disorder related to mutations in the RAS-MAPK pathway. Cardinal features include short stature, facial dysmorphism, congenital heart defects, subtle cognitive decrements and a slightly lowered mean IQ ( $\approx 90$ ). These characteristics may bring about lowered levels of quality of life (QoL). In this study, QoL was evaluated in adults with NS.

**Participants and Methods:** Forty-five adult patients with NS and 26 IQ-matched, healthy controls completed the Dutch version of the Lancashire Quality of Life Profile (LQoLP), a comprehensive structured interview covering nine domains of QoL, as well as global measures on wellbeing. Groups were compared using ANOVA and chi-square tests.

**Results:** Patients with NS demonstrated significantly lower levels of QoL on two out of four general outcome measures (Happiness with life and Cantril's ladder,  $p<0.05$ ). Contrary to the controls, the majority of patients did not have a relationship ( $p<0.05$ ). A history of being bullied in youth was more prevalent in the NS group ( $p<0.01$ ) and patients presented with significantly lower levels of self-esteem ( $p<0.05$ ). No difference was found in satisfaction with health, in spite of the medical burden in the NS group.

**Conclusions:** The QoL profile of adult NS patients differs from that of controls with respect to both subjective measures, such as happiness with life and self-esteem, and objective measures like relationship status. Lowered QoL in NS may be moderated by neurocognitive deficit, such as slower speed of information processing and alexithymic traits, which have been demonstrated in this group before.

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