European Society for the Study of Tourette Syndrome

14th European Conference on Tourette Syndrome and Tic Disorders

LAUSANNE, SWITZERLAND 9-11 JUNE 2022

book of abstracts
programme
polls

ESSTS

Hannover 2019

2020

2021

Lausanne 2022

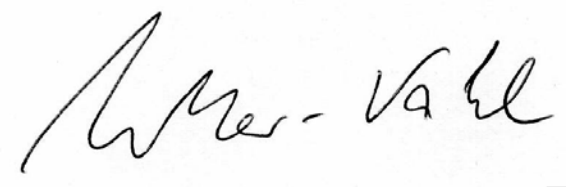
a special welcome

What an anticipated moment this has been, to welcome you all again, *physically,* after 3 long years since our last meeting in Hannover in 2019.

We are grateful that after consecutive cancellations we remained connected through virtual meetings and our Society made it to beautiful Lausanne today, with invited speakers from 11 countries and delegates from 18, from both sides of the Atlantic.

We hope you enjoy this 14th European Conference and we are very much looking forward to welcoming you in person!

Kirsten R. Müller-Vahl



a special welcome

On behalf of our local organising committee of the 14th ESSTS Congress, I wish you all a very warm welcome to the beautiful city of Lausanne.
Here at the lakeside, we will have the pleasure of getting together and sharing science, personal knowledge and hopefully a wonderful experience during the coming days!

On a historical note, it might be of interest to you that the fate of **Georges Albert Édouard Brutus Gilles de la Tourette** is tied to this place; after a life full of interesting discoveries and difficult experiences, he died tragically in 1904 at the Hospital of Psychiatry at Cery, which is still the Center of Mental Health in Lausanne and part of the University hospital.

We look forward to exploring with you this dark side of the great scholar who still means a lot to ESSTS, as well as the brighter sides of the city, such as the Olympic Museum, where the conference dinner will take place.

Wishing us all a rich three days full of joy, diversity and exchange.

Kerstin von Plessen

the organising committee

Our local hosts

Kerstin von Plessen
Chair of scientific committee

Céline Rodriguez

Sophie Grandchamp
Operations genies

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Kirsten R. Müller-Vahl
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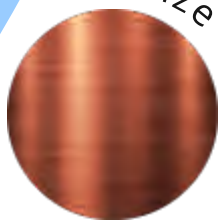

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Tics and Tourette's Across the Globe (TTAG) are thankful and delighted by the continued support of European Society for the Study of Tourette Syndrome (ESSTS).

We greatly appreciate the support of ESSTS in our mission to promote equality, participation, and opportunity for those people with tics and Tourette Syndrome (TS) through collaboration between advocates, clinicians, educators and scientists around the world, to benefit those affected by Tourette Syndrome and other disorders.

Thank you to the ESSTS board for continuing to provide space for the patient association representatives to meet at the annual ESSTS conference.

We look forward to working and collaborating with researchers and clinicians around the world to better support patients and their families affected by TS. Please support us and reach out to us with your ideas for collaboration.

For LIVE updates during the conference:

TICS AND TOURETTE ACROSS THE GLOBE

Tics and Tourette across the Globe (TTAG) is an umbrella organisation representing a community of Tic and Tourette Syndrome (TS) associations collaborating at an international level to improve conditions for people touched by Tics and TS.

OUR VISION

Our vision is a world in which people with Tourette Syndrome and tic disorders are understood, accepted, respected, empowered and included in all contexts of life.

OUR MISSION

Our mission is to promote equality, participation and opportunities for people with TS through collaboration between advocates, clinicians, educators and scientists around the world, to benefit those affected by Tourette Syndrome or tic disorders.

www.ticsandtourette.org

info@ticsandtourette.org

Visit our social media channels:
twitter.com/TTAGpatients
www.facebook.com/groups/ttagpatientassociation
TTAG GoFundMe: https://www.gofundme.com/f/please-supporttourettes-across-the-globe

CONFERENCE PROGRAMME

Thursday 9 June 2022

Workshops

10.00-13.00 (parallel sessions)	
I. Workshop in **French:** Thérapies comportementales des tics et du syndrome Gilles de la Tourette **Trainers:** Virginie Czernecki Velina Negovanska	II. Workshop in **English** for **beginner** participants: Behavioural therapy for tic disorders: "Tic treatment – Learn how to become a tic therapist or enhance your skills." **Trainers:** Tara Murphy Zsanett Tarnok Jolande van der Griendt Cara Verdellen
Mieux connaître les bases des techniques TCC "evidence based" pour le traitement des tics / SGT et apprendre à les appliquer avec les patients. Dans un premier temps, nous aborderons ensemble les aspects théoriques de ces thérapies ainsi que les recommandations internationales et les études faisant preuve de leur efficacité. Dans un second temps, nous présenterons les deux techniques validées dans le traitement des tics, à savoir l'Habituation avec Renversement d'Habitude et l'Exposition avec Prévention de la Réponse. Nous illustrerons leurs aspects pratiques à travers différents exemples cliniques au moyen de vidéos et répondrons à toutes les questions pouvant se poser sur ces deux thérapies. Cette formation couvrira à la fois les prises en charge destinées aux enfants et aux adultes. 10.00 – 10.30: **Introduction aux principes et rationnel des TCC dans les tics / SGT**	*Tic treatment – Learn how to become a tic therapist or enhance your skills* Whether you are learning for the first time or recapping on well-honed skills this beginners' workshop will likely be useful. We will update you on the recent European Guidelines for psychological intervention and review core topics in diagnostics and assessment. We will then cover the two most evidence-based models of behavioural therapy for tics with some brief practice aspects. Following on, we focus on functional interventions and relapse management. There will be plenty of time for questions and discussion. 10.00 – 11.00: **Introduction, Diagnostics, Research/guidelines** Break-10' 11.10 – 12.10: **HRT/CBIT, ERP** Break-10' 12.20 – 13.00; **Function based interventions, Relapse management - Q&A**

10.30 – 11.15: Technique “Habituation par renversement d’habitude (HRT)” 11.15 – 11.30: Pause 11.30 – 12.15: Technique “Exposition par prévention de la réponse (ERP)” 12.15 – 13.00: Vidéos / Études de cas / Q&A	

Workshop

14.00-17.00 (parallel session; TTAG session at **13.00,** see below)

III Workshop in **English** for **advanced** participants:
Behavioural therapy for tic disorders:
"Tic treatment – Learn how to become a tic therapist or enhance your skills."

Trainers:
Tara Murphy
Zsanett Tarnok
Jolande van der Griendt
Cara Verdellen

Exciting advances in Group treatment for Tics and Tourette syndrome

In this advanced behaviour therapy workshop, we will have a smorgasbord of topics relating to treatment delivered in group format, a now well supported modality of treatment. We have invited experts from several specialist clinics in Europe to give presentations followed by a panel discussion with the speakers and organisers of the session

14.00 – 15.10
-Judith Nissen, Denmark: Group training in youth with tics
-Eve Mc Allister & Nimmi Parikh, England: Delivery of group interventions for children and young people with tics online – tips, tricks and pitfalls
-Annet Heijerman-Holtgrefe & Cara Verdellen, The Netherlands: TYT & adult group
Break-20’
15.30 – 16.30
-Zsanett Tarnok, Hungary: Clinical application
-Sharon Zimmerman Brenner, Israel: HRT & Psychoed in groups
-Noa Benaroya-Milshtein & Dana Feldman Sadeh, Israel: Parenting groups
16.30 – 17.00
Expert panel with room for discussion

13.00-17.00 (parallel session; **BT Workshop** at **14.00** see above)

Patient associations meeting organised by Tics and Tourette Across the Globe (TTAG)

13:00-13:20

Introduction to Tics and Tourette Across The Globe (TTAG)

A. TTAG Mission-Vision-Values
B. Meet Our TTAG Board of Directors
C. Overview of TTAG's Organization Structure
D. Meet Our TTAG Global Patient Organization Collaborators
E. TTAG Global Participation: *Greetings from Partnership-building Activity from Budapest* (Paula-Riitta Huttunen (Finland)
F. Section Presenter: Michele Dunlap, Germany

13:20 -14:40

Meet Global Patient Association Representatives

A. Introduction To Global Patient Organizations
    i. Their Patient Organization's Mission Vision Values
    ii. Their Patient Organization's Future Strategic Objectives
    iii. Their Patient Organization's enthusiasm for collaboration with TTAG
B. Section Presenter: Marla Shea (USA/UK)

14:40-15:00

Coffee Break w/Treats From Around The World

15:00-15:20

Moments from ESSTS Past and Current Chairs - researchers & clinicians join

A. Words from our Past ESSTS Chair
B. Words from our Current ESSTS Chair
C. Section Presenter: Michele Dunlap, Germany

15:20-16:50 - 2 sessions

Workshop Brainstorm & Networking w/Researchers (Part I)

A. How Tics and Tourette Across The Globe (TTAG) can best collaborate with you
B. Future direction and feedback of our collaboration
C. Section Presenter: Seonaid Anderson (Belgium)

Researchers Collaborating Talk (Part II)

A. Patients' discussion regarding their collaboration and working together
B. Section Presenter: Paula-Riitta Huttunen (Finland)

16:50-17:00
Tics and Tourette Across The Globe (TTAG) Closing Summary and Gratitudes

A. *Section Presenter: Michele Dunlap, Germany*

17:00-18:00
TTAG Official Registration Signing Celebration
(Closed meeting for TTAG board/members & signing of statutes)

18:00
I. Opening ceremony and lecture:
"Functional, Tourette-like behaviours; an evolving landscape"
Speaker:
Davide Martino

II. Apéritif time, getting together again!

III. Projection of film-documentary "Tics", by Thomas Oswald with the collaboration of Prof. Dr. Münchau and the neurologist & psychiatrist Dr. Daniel Alvarez-Fischer

Friday 10 June 2022

Brain stimulation sessions

09:00-09:45 Non-invasive brain stimulation in TS
Stephen Jackson

09:45-10:30 Invasive brain stimulation in TS
Michael S. Okun

10:30-11:15 Podium discussion including discussion with the audience
moderated by Kirsten R. Müller-Vahl
Participants: Stephen Jackson, Michael S. Okun, Juan Carlos Baldermann

11:15-11:45 Coffee break

11:45-12:15 Ecopipam in Children and Adolescents with Tourette Syndrome: Results from a Randomized, Double-Blind, Placebo-Controlled Phase 2b Study
Kirsten R. Müller-Vahl

12:15-13:00 Poster rounds, session I (page 51)
moderated by Nanette Mol Debes
Vote for best poster presentation. Voting platform opens on Saturday 11 June at 16:15

13:00-14:00 Lunch break

13:00-14:00 **ENIGMA-TS Working group meeting** (at "Pavillon Ouest", adjacent to main building)
Coordinated by Perry Paschou

Society and TS session

14:00-14:45 Ticking the wrong box; a global look at why we don't know what works in tic education and how we can find out
Tara Murphy

History of TS session

14:45-15:30 Georges Gilles de la Tourette, the man behind the name
Olivier Walusinski
moderated by Andreas Hartmann

15:30-16:15
Neural mechanisms of cognitive behavioral treatment in the framework of perception-action integration
Alexander Münchau
moderated by Andreas Hartmann

16:15-16:45 Coffee break

16:45-18:30
Oral presentations of submitted abstracts, session I (page 28)
moderated by Natalia Szejko and Andreas Hartmann
O1. Feasibility of a Novel Virtual Tic Tool Kit Therapy Group
O2. Automatic assessment of tic expression

O3. Prognosis of Rapid Onset Functional Tic-Like Behaviours: Prospective Follow-Up Over Six Months
O4. A Formulation Driven Approach to Management of Functional Tics
O5. Family history of neurodevelopmental and mental health problems in children with functional tics
O6. Evaluation of a Psychoeducation Group for Children presenting with Functional Tics
O7. Prevalence of mass social media-induced illness presented with Tourette-like behavior in Germany
Vote for best oral presentation. Voting platform opens on Saturday 11 June at 16:15

18:30-19:00
General assembly meeting

From 20:00
Social event; dinner the Olympic Museum of Lausanne

LE MUSÉE OLYMPIQUE

How to reach the Olympic Museum on foot:

Saturday 11 June 2022

Comorbidities

09:00-09:45 **Update of guidelines for the treatment of OCD and OCD with GTS including PANDAS**
Susanne Walitza

09:45-10:30 **Podium discussion including discussion with the audience**
moderated by Kerstin von Plessen

Participants: Susanne Walitza, Danielle Cath, Renata Rizzo

10:30-11:15 Poster rounds, session II (page 72)
moderated by Nanette Mol Debes

Vote for best poster presentation. Voting platform opens at 16:15

11:15-11:45 Coffee break

11:45-12:30 Are functional tics easy to diagnose?
Controversy discussion, followed by a poll
Arguing *yes*:
Tamara Pringsheim
Arguing *no*:
Davide Martino

Platform opens at 12:20. You answer here:

12:30-13:30 Lunch break

13:30-14:30 Best papers of 2021 on tics and TS

Kevin J. Black
moderated by Andreas Hartmann

14:30-16:15
Oral presentations of submitted abstracts, session II (page 40)
moderated by Natalia Szejko and Andreas Hartmann
O8. Online Exposure and Response Prevention for Children and Adolescents with Tourette Syndrome: A Randomized Controlled Trial
O9. A randomized controlled trial comparing videoconference versus face-to-face delivery of behaviour therapy for youths with Tourette Syndrome in the time of Covid-19

O10. Functional connectivity during tic suppression predicts reductions in vocal tics following behavior therapy in children with Tourette syndrome
O11. Increased alpha-band connectivity during tic suppression in children with Tourette syndrome revealed by source electroencephalography analyses
O12. The Tourette OCD Alberta Network: Development of a Continuing Professional Development Program for Community Based Mental Health Therapists
O13. Speech and language disorders and complex vocal tics affecting speech fluency in people with Tourette syndrome
O14. A voxel-based morphometry study of Provisional Tic Disorder with follow-up at diagnosis of Tourette syndrome

Vote for best oral presentation. Voting platform opens at 16:15

16:15-16:30 **Coffee break**

16:30-17:30 **Clinical rounds**
Co-chairs:
Liselotte Skov
Tammy Hedderly

17:30 **Closing ceremony, best poster & best oral presentation prizes, Professor Mary Robertson award**

...and see you next year in....? 😉
Brussels!

Table of content

Oral presentations of selected abstracts

O1. Feasibility of a Novel Virtual Tic Tool Kit Therapy Group

Juliana Silva[1,2], Tamsin Owen[2], Sara Sopena[2], Alice Bailey[2], Claire Grose[2], Kayleigh Maclellan[2], Osman Malik[2], Mary Doyle[2] and Tammy Hedderly[2]

[1] University of East Anglia, [2] TANDeM, Evelina Hospital London, Guys and St Thomas' NHS Foundation Trust

Background:
Behavioural therapy is the main form of symptomology management for tics, such as Exposure Response Prevention (ERP) and Habit Reversal Therapy (HRT), and is typically administered in person. Due to challenges presented by COVID-19, this was no longer possible, raising questions surrounding the effectiveness of alternative delivery methods. The current study assesses the efficacy of virtually delivered tic therapy in a group setting. Delivered by the Tics and Neurodevelopmental Movements Service (TANDeM) at the Evelina London Children's Hospital, combined ERP and HRT delivered virtually with externalised attention strategies is a pioneering combination and has not yet been explored.

Methods:
16 TANDeM patients attended a 6-session virtual tic therapy group, each lasting one hour. The Yale Global Tic Severity Scale (YGTSS) was completed for all patients prior to and following the group, and qualitative feedback was also gathered post-hoc regarding satisfaction and acceptability of the management techniques.

Results and Conclusions:
Patients' post group YGTSS scores showed a statistically significant improvement compared to pre group scores, and all patients reported better management of tics after having attended the virtual group. 91.6% of attendees returned positive feedback for the virtual aspect, such as it being "more accessible", and availability of 1:1 practice with clinicians. Twelve of 16 attendees reported learning combined ERP and HRT to manage their tics was the main attraction of the group. The cost-effective virtual group produced a significant improvement in patient outcome, suggesting it is an effective way of delivering tic therapy. The significant difference between pre and post group YGTSS scores provides a preliminary basis for delivering combined ERP and HRT alongside externalised attention strategies.

O2. Automatic assessment of tic expression

Yocheved Loewenstern[1], Noa Benaroya-Milshtein[2,3] Izhar Bar-Gad[1]

[1] Gonda Multidisciplinary Brain Research Center, Bar-Ilan University, Ramat Gan, Israel, [2] The Matta and Harry Freund Neuropsychiatric Tourette Clinic, Schneider Children's Medical Center of Israel, Petach Tikva, Israel, [3] Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel

Background:
Tourette syndrome (TS) and other tic disorders are characterized by the expression of motor and vocal tics. Tics follow a complex waxing and waning pattern of severity, intensity, and frequency over multiple timeframes. Likewise, the large tic modulation by behavioral states and environmental factors complicates symptom assessment. The most prevalent measures used for assessing tic expression are subjective qualitative measures based on self-reports taken periodically during clinical visits, thus lacking objective quantitative assessments of tics over prolonged periods of time. The goal of the current study is to create an automatic measure for quantifying tic expression and modulation in natural behavioral settings.

Methods:
We used a custom-developed smartphone application to record data from children and adolescents with TS or other chronic tic disorders attending Schneider Children's Hospital. Each recording session included active (playing games, filling questionnaires) and passive (watching videos) tasks on the smartphone, while the patient's facial tics were simultaneously recorded by the frontal camera. Trained experts annotated the videos offline, marking the precise times of tic onset and tic completion, while specifying the subtypes of movement displayed. The recordings were stored on a secure server and 98-point facial landmarks were extracted from each frame. The landmarks representing the whole video were segmented to short clips, each labeled "tic"/"non-tic" based on the annotations. Finally, a tandem of custom deep neural networks for extracting the spatial (*grouped local feature network*) and temporal (*long short-term memory network*) were used for classifying the segments.

Results and Conclusions:
We recorded 45 sessions from 13 TS patients (7-18 years old, 1-4 sessions per patient). The session duration was 35.1±13.6 minutes including both active and passive tasks. All the patients expressed facial motor tics (177.2±116.7 tics per session, rate of 4.9±2.1 tics per minute). The tics were highly variable with different subtypes involving a combination of eyes, nose, head, mouth and lip movements (5.3±3.0 repeating tic subtypes per session). Automatic tic detection was initially tested using binary classifications, i.e., determining whether a short video segment contains a tic or not. Preliminary results show that our model achieves over 97% precision recall within patients and 88% precision across patients. Applying the trained model on the whole video, by using a sliding window and then classifying each segment along the video, resulted in detecting roughly 90% of all the tics in the video. Finally, observing the different tic subtypes revealed large variability in the detection rates which were dependent on the representation of the tic subtypes in the training set. This novel objective measure of tic expression provides key insights to the modulation factors influencing motor tic expression in TS patients during everyday activities. This work has the potential to provide clinicians a powerful tool for diagnosis and follow-up of

their patients, and for evaluating the efficacy of different behavioral and pharmaceutical treatments. Finally, such a tool has the potential of revolutionizing the large-scale clinical studies and trials enabling faster development and testing of new measures.

O3. Prognosis of Rapid Onset Functional Tic-Like Behaviours: Prospective Follow-Up Over Six Months

Tamara Pringsheim[1], MD Megan Howlett, MD[2], Christelle Nilles, MD[3], and Davide Martino, MD, PhD[3]

[1]Department of Clinical Neurosciences, Psychiatry, Pediatrics and Community Health Sciences, University of Calgary, Calgary, Alberta, Canada, [2]Department of Psychiatry, University of Calgary, Calgary AB, Canada, [3]Department of Clinical Neurosciences, Cumming School of Medicine, University of Calgary, Calgary AB, Canada

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Background:
The prognosis of rapid onset functional tic-like behaviours (FTLBs) is currently unknown. In 2021, we published two case series of 20 adolescents and 9 adults with rapid onset FTLBs seen in Calgary before the end of June 2021. The purpose of this prospective cohort study is to report the trajectory and course of illness after six months of follow-up of these originally reported cases, as well as their response to medical and behavioural interventions. It was hypothesized that patients with FTLBs would improve at 6-month follow-up with behavioural interventions and treatment of comorbid mental health concerns.

Methods:
All 29 patients reported in our two published case series were diagnosed by one of two movement disorders neurologists (TP or DM) and were offered continuing care at our center. Our overall treatment approach for FTLBs included medical and behavioural treatment for co-occurring anxiety and depression, in addition to the Comprehensive Behavioural Intervention for Tics (CBIT). At the initial consultation, the Yale Global Tic Severity Scale (YGTSS) was completed, and this was repeated in all patients returning at six months. At the six-month assessment, all treatments used for FTLBs and any psychiatric comorbidities were recorded. A paired t-test was used to compare YGTSS scores at initial presentation and follow up. This project received ethical approval from the University of Calgary Conjoint Health Research Ethics Board. Subjects gave informed consent for participation.

Results and Conclusions:
In adolescent patients, there was a significant improvement from initial consultation to six month follow up in motor tics, vocal tics, total tics, impairment and global score on the YGTSS, with a mean decrease of 31.9 points on the YGTSS global score (95% CI 15.4, 48.4, p=0.0005). Seven adolescents had YGTSS impairment scores of zero at follow-up. Two adolescents had YGTSS global scores of zero; four had YGTSS global scores less than 10. The most used treatments in adolescents were SSRIs and cognitive behavioural therapy (CBT) for anxiety or depression. One adolescent was taking an antipsychotic medication (aripiprazole) for treatment augmentation for depression. Both adolescents with YGTSS global scores of zero were receiving an SSRI (sertraline, fluoxetine) and CBT for anxiety or depression. Two adolescents developed psychogenic non-epileptic seizures (PNES) during the follow-up period.

In adult patients, while there was a decrease in motor tics, vocal tics and total tics on the YGTSS from initial consultation to six-month follow-up, the change was not statistically significant. Impairment and global scores on the YGTSS were significantly lower at six months, with a mean decrease on the global score of 19.6 points (95% CI -

3.2, 42.3, p=0.04). Three adults had YGTSS impairment scores of zero at follow-up; one had a YGTSS global score of zero. The most used treatments in adults over the six-month period of follow up were antipsychotics, SSRIs and CBT for anxiety or depression. Of the three adults taking antipsychotics, two were taking quetiapine and one was taking aripiprazole, all for augmentation for depression. The one adult with a YGTSS global score of zero at follow-up was receiving sertraline and quetiapine, and CBT for anxiety. Two adults developed PNES during the follow-up period.

This prospective study suggests that adolescents have a better prognosis than adults with FTLBs. Management of comorbidities with SSRIs and CBT seems effective.

O4. A Formulation Driven Approach to Management of Functional Tics

Juliana Silva[1], Tamsin Owen[2], Sara Sopena[2], Alice Bailey[2], Claire Grose[2], Kayleigh Maclellan[2], Osman Malik[2], Mary Doyle[2] and Tammy Hedderly[2]

[1] University of East Anglia, [2] TANDeM, Evelina Hospital London, Guys and St Thomas' NHS Foundation Trust

Background:
The Tics and Neurodevelopmental Movements Service (TANDeM) at the Evelina London Children's Hospital has seen a large increase in referrals since the COVID-19 pandemic, largely attributable to sudden, late-onset, functional tics. Functional tics can have a similar presentation to tics, but are vastly different in terms of aetiology, therefore, thorough assessment and formulation are essential in order to inform appropriate intervention. TANDeM uses evidence-based Cognitive Behavioural Therapy 5P's formulation to support accurate diagnosis and inform treatment. Our aim was to increase awareness in primary and secondary care services of how to assess, diagnose and formulate functional tics via psychoeducational training delivered to general practitioners, pediatricians, nurses, and neurologists in order to reduce referrals to specialist services such as TANDeM, reduce patient wait times, and guide more efficient local support.

Methods:
85 professionals, including pediatricians, neurologists, general practitioners, psychologists, and psychiatrists attended the virtual TANDeM Educational Zoom Event (TEZE) delivered by our multidisciplinary team, lasting approximately 8 hours. Quantitative and qualitative feedback was gathered post-hoc regarding satisfaction surrounding the content and delivery of the training component which focused on functional tics, their assessment, diagnosis, and management.

Results and Conclusions:
Quantitative analysis of attendee feedback on the efficacy of content and delivery of the training surrounding functional movements and tic-like attacks showed an overall efficacy rating of 4.9 out of 5, with 85% strongly agreeing that it was effective. Qualitative analysis indicated that clinicians and other professionals had a better understanding of functional tics and how to approach management after attending TEZE. It is vital that individuals with tics and functional tics both receive the best available care, and this process is greater supported if primary level practitioners are equipped with the training to implement the 5P's formulation as part of the diagnostic process for tics, allowing a more coherent understanding of the individual's condition, and informing treatment. The 5P's formulation allows for a comprehensive understanding of individual cases, aiding in the development of holistic management strategies based on an informed diagnosis. A lack of knowledge surrounding functional tics has previously led to misdiagnosis and delivery of incorrect treatment, resulting in avoidable increases in referrals to specialist services, extending NHS waiting lists. Virtual psychoeducation workshops for professionals and patients are cost effective and are an accessible way of delivering treatment and training, equally as effective as when delivered in person. Longer term analysis on such workshops in relation to their impact on referrals and patient care is needed.

O5. Family history of neurodevelopmental and mental health problems in children with functional tics

Katie Harrold[1], Sophie Allen[1], Sacha Evans[1], Ho-lan Liang[1], Eve McAllister[1], Tara Murphy[1], Shauna O'Dwyer[1], Nimmi Parikh[1], Zoe Pearman[1], Sara Shavel-Jessop[1], Amy Warren[1], and Morvwen Duncan[1]

[1]Tic Disorder Service, Psychological and Mental Health Services, Great Ormond Street Hospital, United Kingdom

Background:
Poor parental mental health is a risk factor for childhood mental health problems (Essex et al., *2006*). Parental influence on child mental health problems can be passive via the passing on of vulnerability genes to mental health disorders or active via parenting (Bolhuis et al., *2021*). Vulnerability factors for the development of functional symptoms include case history of anxiety disorders and/ or neurodevelopmental disorders (Han et al., *2022*). One would therefore expect increased levels of anxiety and neurodevelopmental disorders in families where children develop functional symptoms. Parental anxiety is also thought to be linked with maintenance of functional symptoms (Newton et al., *2019*). We seek to explore the prevalence of parental mental health problems in children with functional tics. We hypothesize higher levels of anxiety and neurodevelopmental disorders in family members compared to other mental health problems and that this will be elevated compared to population norms. We hope to explore patterns of familial influence.

Methods:
A detailed case series of children (N=62) aged 8 to 17 years old presenting to the specialist tic/Tourette service and subsequently diagnosed with functional tics are described. A chart review of their referral letter and assessment was undertaken to determine the family history of mental health disorders.

Results and Preliminary Conclusions:
The mean age of the sample was 14.28 years, 87.1% were cisgender female, 12.9% were cisgender male, and 11.3% identified as non-binary or transgender. 66.1% were white British. 80.6% of children had a diagnosed psychiatric condition in addition to functional tics: 72.6% of those had anxiety, 17.7% had depression, 14.5% had PTSD, 3.2% had specific phobia, and 3.2% had eating disorders. 75.8% had a diagnosis or suspected diagnosis of neurodevelopmental diagnosis (67.7% ASD, 41.9% ADHD), 24.2% had Tourette syndrome, 9.7% had OCD, and 6.5% had a specific learning disorder (SpLD).

38.7% had a first degree relative with a neurodevelopmental diagnosis: ADHD (17.7%), ASD (16.1%), tics (16.1%), a SpLD (11.3%), and OCD (3.2%). 37.1% had a second degree relative with a neurodevelopmental diagnosis. 19.4% had both a first and second degree relative with a neurodevelopmental diagnosis. 56.5% had a first degree relative with a psychiatric diagnosis; anxiety (30.6%), depression (29%), PTSD (12.9%), personality disorder (6.5%), addiction (3.2%), and bipolar disorder (1.6%). 33.9% had a second degree relative with a psychiatric diagnosis. 19.4% had both a first and second degree relative with a psychiatric diagnosis.

Adult UK population base rates for anxiety are 5.9%, depression 3.3%, OCD 1.3%, PTSD 3.7-5.1%, bipolar disorder 2-3%, psychosis 0.7%, alcohol addiction 1%. As expected from Han et al. (*2022*), adults who were related to children with functional tics reported increased levels of anxiety and neurodevelopmental disorders compared to other mental health disorders and compared to population base rates. Patterns of familial influence will be further explored by June 2022.

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O6. Evaluation of a Psychoeducation Group for Children presenting with Functional Tics

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Background:
The COVID-19 pandemic has led to an increase in rapid-onset functional tic-like behaviours (FTLBs) in children and adolescents, which are thought to be related to underlying depression, stress, and anxiety (1, 2). The current evidence base for interventions to treat FTLBs is limited. Clinical interventions are pragmatic with a focus on targeted psychoeducation. Goal-based outcomes (GBOs) have been used in children with functional movement disorder including tics and allows them to set their own targets and to measure change post-intervention (3). We implemented a pilot psychoeducation group, collected service-user feedback, and used GBOs to monitor effectiveness. The aim was to evaluate a two-and a half-hour psychoeducational group intervention on functional tics, measuring change in patient centred goals.

Methods:
Following a multidisciplinary assessment and diagnosis of functional tics within a specialist hospital, young people and their families were invited to a remote psychoeducation group. 37 young people attended one of four remote psychoeducation groups between 7th May 2021 and 15th February 2022. To date we have received 19 GBOs and 9 service-user evaluation forms. Achievement of each goal was rated on a scale of 0 (not at all) to 10 (fully met) before and immediately after the group. The service-user evaluation form developed by the team gathered qualitative and quantitative data about service users' experiences of the group and was distributed to parents and young people. Parents and young people were asked their thoughts using statements on the helpfulness of the group, how much they learnt, their understanding of functional tics, whether questions were sufficiently answered, and if they would recommend the group to others. Parents were asked to rate an additional statement; 'I feel confident in supporting my child with their functional tics'. The method of data collection included telephone follow-up and the hospital's patient record messaging system.

Results and Preliminary Conclusions:
Typical goals were 'to learn more about functional tics,' 'to meet other young people with functional tics,' and 'to learn coping strategies.' Young people and their parents reported significant improvement in their goals following the group ($t(18) = -5.85$, $p = < .001$, Cohen's $d = 1.88$, a large effect size). Goal achievement ranged from a 1 to 7-point increase following the group. Of this group, 85.7% of parents and 60% of children agreed or strongly agreed that the functional tics group was helpful, 92.9% and 100% respectively felt that they understood what functional tics were and how they could be managed following the group. 92% of parents and 80% of children would recommend

the group to other young people with functional tics and their parents and 100% of parents felt confident in supporting their child with their functional tics following the group.

The remote format is acceptable to parents and children; reasons for this are feeling comfortable in their own setting and the economic benefit. They found meeting other young people and their families experiencing similar difficulties one of the most helpful aspects of the group. This should be considered moving forward, as face-to-face provision may be less acceptable and as a result fewer families may access the intervention. This shows that remote psychoeducation sessions successfully support young people with functional tics and appear to be an acceptable first step in managing their care.

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O7. Prevalence of mass social media-induced illness presented with Tourette-like behavior in Germany

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Background:
Since about 3 years, worldwide there has been an increase in patients with functional Tourette-like behavior (FTB), which in our opinion is best explained as an outbreak of mass sociogenic illness (MSI) induced by social media (mass social media-induced illness; MSMI). In Germany, we identified the protagonist of the YouTube channel "Gewitter im Kopf" (English: "Thunderstorm in the brain") as a *virtual* index person of this outbreak, since patients presenting in our specialized outpatient clinic show similar or identical symptoms. It has been suggested that lockdown, social isolation, and other consequences of the COVID-19 pandemic fueled the outbreak.
This study aimed to provide first data on the prevalence rate of MSMI-FTB in Germany.

Methods:
We conducted a large-scale representative population survey in Germany in cooperation with the USUMA market and social research institute. Between August and December 2021, 2.509 people (mean age: 49.5 years, range: 16-95 years, *n*=1276 females) were randomly selected, visited in their households, interviewed, and asked to answer for themselves, but also for close family members (*n*=6.744). Thus, in total, we received answers for *n*=9.253 individuals. In addition to a survey on demographic data, subjects filled out a newly developed questionnaire asking specifically about rapid onset complex movements and vocalizations similar to those seen in the host of the YouTube channel "Gewitter im Kopf" that occurred after channel launch in 2019.

Results and Conclusions:
Based on data on *n*=9253 individuals provided by *n*=2509 people interviewed, for *n*=71 subjects newly developed "rapid onset complex movements and vocalizations" since 2019 were reported either in themselves (*n*=23) or in one of their family members (*n*=48). After careful evaluation of all answers given (including age at onset, symptom description, provided diagnosis, and awareness of the YouTube channel "Gewitter im Kopf"), in 15 individuals (mean/median age: 24.4/20 years, range: 11-46 years, *n*=2 females; reported in *n*=2 in themselves and in *n*=13 in one of their family members), the diagnosis of MSMI-FTB was considered highly probable. For none of these individuals was reported that he or she had been diagnosed with FTB or TS, although some of them suspected suffering from TS.
Based on our data, MSMI-FTB is a rare manifestation of a functional movement disorder (FMD) with a (current) prevalence rate of 0.16% in Germany. Although the prevalence is much less common compared to TS (0.16% vs. 0.4-0.8%), it is similar to other rare neurological and psychiatric diseases such as narcolepsy and delusional disorder. However, based on our data, MSMI-FTB does not fulfill criteria for a *rare disease* as defined in Europe (<0.05%) and in the US (<0.07). This first data on the prevalence rate of MSMI-FTB underlines the health economic relevance of this new

type of FMD and illustrates the importance of education of healthcare professionals and the general public to avoid misdiagnosis and incorrect treatment.

O8. Online Exposure and Response Prevention for Children and Adolescents with Tourette Syndrome: A Randomized Controlled Trial

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Background:
The availability of behavior therapy (BT) for individuals with Tourette syndrome (TS) and chronic tic disorder (CTD) is limited. One potential way to make BT more available is to deliver it remotely via the internet. This study aimed to determine the efficacy and cost-effectiveness of internet-delivered exposure and response prevention (ERP) for children and adolescents with TS or CTD.

Methods:
This was a single-blind, parallel group, superiority randomized clinical trial with national recruitment conducted at a research clinic in Stockholm, Sweden. Out of 615 individuals assessed for eligibility, 221 participants (aged 9-17 years) with TS/CTD were included in the study. Enrollment began in April 2019 and ended in April 2021. Participants were randomized to 10 weeks of therapist-guided internet-delivered ERP for tics (*n*=111) or to therapist-guided internet-delivered education for tics (comparator; *n*=110). The primary outcome was tic severity at 3-month follow-up as measured by the Total Tic Severity Score of the Yale Global Tic Severity Scale (YGTSS-TTSS). YGTSS-TTSS assessors were blind to treatment allocation. Treatment response was operationalized as a score of 1 ("Very much improved") or 2 ("Much improved") on the Clinical Global Impression - Improvement scale.

Results and Conclusions:
All participants have now completed treatment and reached the primary end point (3-month follow-up). The preliminary efficacy and cost-effectiveness results will be presented.

O9. A randomized controlled trial comparing videoconference versus face-to-face delivery of behaviour therapy for youths with Tourette Syndrome in the time of Covid-19

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Background:
Tourette syndrome (TS) is a neurodevelopmental condition characterized by the presence of concomitant multiple motor tics and, at least one, vocal tic, that occurs for more than 1 year. Recently, the European Society for the study of Tourette Syndrome (ESSTS) wrote guidelines for the management of TS recommending psychoeducation as the initial intervention, and behaviour therapy (BT) as a first-line intervention when psychoeducation alone is insufficient. A promising development in increasing accessibility to behavioural treatments is the use of digital health interventions (DHIs). We aimed to evaluate the clinical effectiveness of online remote behaviour therapy, compared with face-to-face therapy in reducing tics and co-occurring disorders associated with the tics in a sample of youths with Tourette Syndrome.

Methods:
A total of 40 patients aged between 9 and 16 years affected by Tourette Syndrome were randomly assigned to receive face-to-face or online remote behaviour therapy. Participants underwent the first assessment at baseline (T0), the second after two months (T1). At baseline point (T0), patients were assessed according to Yale Global Tic Severity Rating Scale (YGTSS), Children's Yale-Brown Obsessive-Compulsive Scale for Children (CY-BOCS), Premonitory Urge for Tic Scale (PUTS), Multidimensional Anxiety Scale for Children (MASC), Child Depression Inventory (CDI) and the Conners' Parent Rating Scale (CPRS). Furthermore, after two months (T1), changes in symptoms severity were evaluated by the difference in the rating scales.

Results:
Online remote and face-to-face behaviour therapy are equally effective in the treatment of tics and co-occurring disorders in children and adolescents affected by Tourette Syndrome. Both groups showed an improvement in the severity of tics, obsessive-compulsive symptoms, and anxiety symptoms, as assessed by neuropsychological findings. Online remote behaviour therapy was more effective for reducing depressive symptoms than face-to-face behaviour therapy.

Conclusions:
Online remote behaviour therapy is a promising tool for behavioural therapies for patients with Tourette Syndrome. The use of digital health interventions may represent an alternative approach to improve access to behaviour therapy for tics in the time of Covid-19, likely beyond the end of pandemic.

O10. Functional connectivity during tic suppression predicts reductions in vocal tics following behavior therapy in children with Tourette syndrome

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Background:
Comprehensive Behavioral Intervention for Tics (CBIT) is recommended as a first-line treatment for Tourette syndrome in children and adults. While there is strong evidence proving its efficacy, the mechanisms of reduction in tic severity during CBIT are still poorly understood. In a recent study, our group identified a functional brain network involved in tic suppression in children with TS. This brain network encompassed multiple and distributed cortical areas, including core nodes of the default mode network. We reasoned that voluntary tic suppression and CBIT may share some mechanisms and thus we wanted to assess whether functional connectivity during tic suppression was associated with CBIT outcome. We hypothesized that increased brain connectivity during tic suppression at baseline would predict greater decreases in tic severity at endpoint.

Methods:
Thirty-two children with TS, aged 8 to 13 years old, participated in a randomized controlled trial of CBIT vs a treatment-as-usual (TAU) control condition. EEG was recorded during tic suppression in all participants at baseline, but data from one participant in the TAU condition was unusable. Thus, in the current study, 16 children were part of the CBIT group and 15 were part of the TAU group. We used a source-reconstructed EEG connectivity pipeline to assess functional connectivity during tic suppression. In our analyses, we included the YGTSS motor and vocal tic subscales as a factor to assess if functional connectivity interacted differently with reductions in motor and vocal tics. Therefore, we performed an ANOVA with the between-subjects factor Treatment (CBIT vs. TAU), the within-subjects factor Tics (motor vs. vocal), and the continuous predictor Connectivity.

Results:
We found a Treatment by Tics by Connectivity interaction [$F(1,27) = 4.89$, $p = .036$]. Decomposition of this interaction revealed a Tics by Connectivity interaction in the CBIT group only [$F(1,14) = 5.82$, $p = .030$]. In this group, functional brain connectivity during tic suppression at baseline predicted the decrease in vocal tic severity at endpoint [$R^2 = .35$, $\beta = -0.59$, $t(14) = -2.57$, $p = .015$]. However, it did not predict the decrease in motor tic severity [$R^2 = .03$, $\beta = -0.16$, $t(14) = 0.62$, $p = .55$].

Conclusions:
This study revealed that functional connectivity during tic suppression at baseline predicted reduction in vocal tic severity. These results suggest probable overlap between the mechanisms of voluntary tic suppression and those of behavior therapy for tics, which may both involve the default mode network. In CBIT, competing responses for vocal tics generally consist of “controlled breathing”. Such technique may involve mechanisms that are more similar to those of voluntary tic suppression than those of

competing responses for motor tics, which generally involves a movement or a response that is opposed or incompatible with the tic.

O11. Increased alpha-band connectivity during tic suppression in children with Tourette syndrome revealed by source electroencephalography analyses

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Background:
Tourette syndrome (TS) is a neurodevelopmental disorder involving chronic motor and phonic tics. Most individuals with Tourette syndrome can suppress their tics for at least a short period of time. Yet, the brain correlates of tic suppression are still poorly understood.

Methods:
In the current study, high-density electroencephalography (EEG) was recorded during a resting-state and a tic suppression session in 72 children with TS. Functional connectivity between cortical regions was assessed in the alpha band (8-13 Hz) using an EEG source connectivity method. Graph theory and network-based statistics were used to assess the global network topology and to identify brain regions showing increased connectivity during tic suppression.

Results:
Graph theoretical analyses revealed distinctive global network topology during tic suppression, relative to rest. Using network-based statistics, we found a subnetwork of increased connectivity during tic suppression ($p < .001$). That subnetwork encompassed many cortical areas, including the right superior frontal gyrus and the left precuneus, which are involved in the default mode network. We also found a condition by age interaction, suggesting age-mediated increases in connectivity during tic suppression.

Conclusions:
These results suggest that children with TS suppress their tics through a brain circuit involving distributed cortical regions, many of which are part of the default mode network. Brain connectivity during tic suppression also increases as youths with TS mature. These results highlight a mechanism by which children with TS may control their tics, which could be relevant for future treatment studies.

O12. The Tourette OCD Alberta Network: Development of a Continuing Professional Development Program for Community Based Mental Health Therapists

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Background:
Tourette syndrome and obsessive-compulsive disorder are neurodevelopmental disorders with onset in early childhood. The Tourette OCD Alberta Network (TOCDABN) is an organization whose main aim is to provide care navigation, education, and support to people with TS and OCD in the province of Alberta, Canada. The purpose of this presentation is to outline how the TOCDABN created a continuing professional development program for healthcare workers (HCWs) treating TS and OCD in the province. Clinical treatment for TS and OCD in Alberta varies markedly across the province, and access to specialty clinics is limited to one center. There are relatively few HCWs specialized in cognitive behavioral therapy (CBT) for TS and OCD, such as the comprehensive behavioral intervention for tics (CBIT) and exposure and response prevention (ERP). Despite a high percentage of HCWs regularly treating patients with TS and OCD, many lack formal training in the treatment of these conditions.

Methods:
To evaluate the HCWs' professional development needs, in November 2019, a stakeholder survey was sent out to, and completed by, HCWs across Alberta. The survey asked a range of open-ended and multiple-choice questions, pertaining to current skill sets, clinical challenges, and formal knowledge of TS and OCD. The analysis of the HCWs' responses enabled TOCDABN to create a series of live webinars, addressing the specific needs of HCWs, in terms of clinical knowledge and practice. In this presentation, we describe the results of the stakeholder survey, the educational curriculum we developed for the 2020-2021 year, participation at curriculum events, and the results of pre and post webinar tests of participant knowledge.

Results:
107 HCWs completed the stakeholder survey. 81% of the respondents treated children with TS and OCD, but rates of HCWs having no formal training in either condition were high. HCWs confidence in their ability to treat patients with TS and OCD varied, with 43% expressing a favorable response to TOCDABN developing an educational program to support their learning needs. A curriculum consisting of a series of 12 live webinars was developed and delivered between September 2020 and June 2021, covering a wide range of clinical TS and OCD topics. The webinars were attended on average by 63 attendees. The percentage improvement of the correct answer from the pre to the post evaluation showed a positive knowledge gain for all webinars. 96% of attendees were either extremely or very satisfied with the webinar events.

Conclusions:
The stakeholder survey demonstrated an urgent need for HCWs to have access to a continuing educational development program. HCWs required support in knowledge

about TS and OCD and in the varied contexts these conditions occur. The series of live webinars that TOCDABN developed achieved high satisfaction ratings. However, the continuing educational program will need to reflect the ongoing developing clinical understanding of TS and OCD.

O13. Speech and language disorders and complex vocal tics affecting speech fluency in people with Tourette syndrome

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Background:
Tourette syndrome (TS) and speech and language disorders are neurodevelopmental disorders with onset in early childhood. Data on the prevalence of speech and language disorders in people with TS are sparse, with inconsistent reports across studies. Patients with tic disorders may display vocal tics in the form of speech blocking or stutter-like dysfluencies. The purpose of this study is to explore the prevalence and characteristics of speech and language disorders and complex vocal tics affecting speech fluency in children and adults with primary tic disorders.

Methods:
We analyzed the prevalence of speech and language disorders and complex vocal tics affecting speech fluency collected in three of our clinical registries of people with tic disorders in Calgary, Canada. We searched for associations between speech and language disorders and complex vocal tics affecting speech fluency with sex, age of tic onset, tic severity and psychiatric comorbidities.

Results and Conclusions:
Our first Child Tic Disorder Registry (from 2010 to 2012) systematically captured information on speech and language delay and speech therapy in 114 children (79% males, mean age 10.3 years, range 5-17) with primary tic disorders. A total of 28/114 (25%) were diagnosed with a speech or language delay according to their parents, of whom 25/114 (22%) required speech therapy. On linear regression, Yale Global Tic Severity Scale (YGTSS) total tic score was not associated with the diagnosis of speech or language delay or the need for speech therapy.
In our second Child Tic Disorder Registry (from 2017 to 2022), the YGTSS tic inventory was systematically captured at the first clinical visit in all participants. A total of 180 children (76% males, mean age 10.7 years, range 5-17) with primary tic disorders were included; 14/180 (8%) reported blocking speech tics, 17/180 (9%) had speech atypicalities and 18/180 (10%) had palilalia. On linear regression, blocking speech tics were associated with YGTSS vocal tic score (coefficient 7.9), total tic score (coefficient 13.1), tic-related impairment (coefficient 15.4) and age at registration (coefficient 3.14) ($p<0.0001$), but not with age of tic onset.
Two children with stuttering-like tics reported a variety of sounds and speech blocking events, associated with concurrent breathing tics.
In our Adult Tic Disorder Registry, 58 individuals with primary tic disorders have been included since January 2021. Mean age at registration was 33.6 years (range 18-73) and 63.8% were male. We identified 2 patients with blocking speech tics (3.5%), 1 (1.7%) with speech atypicalities and 5 (8.6%) with palilalia. Of the patients reporting blocking speech tics, one described that her throat feels constricted when she tries to speak, and

one described blocking tics while praying or reading aloud, in conjunction with palilalia. The blocking episodes had a clear waxing and waning pattern.

These findings allow us to acknowledge the high prevalence of speech and language disorders in patients with tics, and the frequency of different types of vocal tics affecting speech fluency that can resemble stuttering. The age of onset, phenomenology and waxing and waning pattern are helpful to distinguish developmental speech and language disorders from complex vocal tics that impair speech fluency.

O14. A voxel-based morphometry study of Provisional Tic Disorder with follow-up at diagnosis of Tourette syndrome

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Background:
Several studies have examined brain structure in Tourette syndrome (TS). One of the two largest used voxel-based morphometry (VBM). Previously we reported the first structural imaging results in Provisional Tic Disorder (PTD). That report examined prespecified subcortical structures in PTD at an average of 4 months after tic onset. No 3D, data-driven analysis of brain structure in PTD has appeared.

Methods:
The New Tics study examines children an average of 4 months after their first tic and again at the one-year anniversary of the first tic, when they can first be diagnosed with TS. Here we report on 65 children from that study with PTD and 60 control subjects matched for age, sex, and handedness, all with high-quality structural MRI at baseline. In the 65 PTD subjects, age at scan was 7.4 ± 1.7 years (range 5-12), 15 were girls, 10 were non-right-handed, and mean YGTSS total tic score (TTS) was 17.4 ± 5.6. MR acquisition used 3T scanners and an MP-RAGE sequence with 0.8-1.0 mm isotropic voxels; see DOI 10.3390/jcm9061715 for details. Standard VBM was performed using SPM12 as described in DOI 10.1038/s41380-019-0382-8 using a 6mm Gaussian filter prior to statistical analysis. Correlation of selected VOIs from baseline MRI with clinical outcome at 12 months was performed using the R statistical software package, with baseline TTS included as a covariate.

Results:
The following VOIs differed significantly in PTD compared to tic-free controls (TFC) after FDR correction for multiple comparisons. Increased gray matter (GM) volume in midbrain (p_{FDR}=.049), decreased GM volume in caudate (p_{FDR}=.004) and in L orbitofrontal cortex, BA 11 (p_{FDR}<.0005). For the correlation of baseline MRI with 12-month clinical outcome, based on the TS literature we also chose VOIs that did not survive FDR correction from left ventrolateral thalamus (decreased GM) and bilateral superior and inferior clusters from the anterior thalamic radiation (decreased WM). The 7 variables chosen from MR images acquired at baseline all significantly correlated with TTS at follow-up.

Discussion:
These data represent the first 3D, data-driven analysis of brain structure in Provisional Tic Disorder. Decreased caudate volume was reported in TS (Peterson et al 2003, 2005), and the left inferior anterior thalamic WM peak was lateral to midline BA 10 and 9.7mm superior to the BA 11 decreased WM volume peak in the Greene, Williams et al, 2017, study. Since brain structure already differs from controls after only a few months of ticcing, long-term consequences of or adaptation to tics are unlikely to cause the similar structural brain differences in TS. Individual differences in GM and WM volume at these VOIs can predict the degree of clinical improvement an average of 8 months later when TS is diagnosed. We conclude that structural MRI may be useful in

predicting which children with PTD are most likely to go on to have clinically problematic tic severity when TS can first be diagnosed.

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Poster presentations of selected abstracts

P1. Why does CBIT work?

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Background:
The clinical effectiveness of CBIT in Tourette syndrome has been very widely demonstrated. However, from a cognitive-theoretical perspective, a precise mechanistic explanation of why CBIT is so successful in reducing symptoms is still missing. From a basic science perspective, recent findings suggest that Tourette syndrome is associated with a significantly increased perception-action binding. This results in a stronger association between sensory inputs and motor outputs than in typically developing individuals. As a result, changing the nature of automatised motor outputs proves to be very difficult for the affected individuals. As CBIT trains individuals with tics to perform competing responses instead of the tic-movements (without changing the sensory input), this might be interpreted as a modulation of perception-action binding. Indeed, a first pilot study demonstrated that this increased binding was reduced after completion of CBIT training. However, this study did not yet include an untreated control group or any neurophysiological measures.

Methods:
It is now our goal to examine the working mechanisms of CBIT in more detail. Especially, we will compare how it affects perception-action binding in the response selection vs. response inhibition context in children and adults with Tourette syndrome using corresponding experimental paradigms and neurophysiological measures.

Results and Conclusions:
Presented results will contain first data on the effects of CBIT on perception-action binding in patients with Tourette syndrome. The extent to which this perception-action binding perspective on Tourette syndrome constitutes a suitable explanatory framework to explain why CBIT works will be discussed.

P2. The Impact of Virtual Parent Psychoeducation Workshops on Quality of Life

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Background:
Psychoeducation is the recommended first line of management for Tourette's Syndrome and other tic disorders to inform and equip patients and families with management techniques. The current study explores the ability of a parent psychoeducation group in providing families with practical strategies for managing tics and other common issues occurring in this population via a virtual platform. It also aims to look at the effect of the group on patient tic symptomology and quality of life.

Methods:
28 parents of children within the TANDeM clinic attended four virtual psychoeducation workshops, each lasting 2 hours. The workshops covered an introduction to tics, discussion surrounding anxiety, methods to cope better at school, and managing emotional outbursts and self-esteem. Both prior to and following the group, feedback was gathered regarding perceived parental understanding and competence in managing specific issues mentioned in the workshop, as well as Gilles de la Tourette Syndrome Quality of Life (GTS-QoL) data.

Results and Conclusions:
There was a statistically significant improvement in parent scores regarding their perceived understanding of and confidence in managing tic disorders and associated co-occurring conditions. A statistically significant decrease in the mean of parent-scored GTS-QoL data implies an improvement in tic-related quality of life. Parent ratings regarding the ease of understanding and quality of the sessions were high, and the average score for their satisfaction regarding the content of the presentations was 79.7%. The cost-effective virtual platform is reported as more accessible and suits most of our service users more than in-person groups, increasing uptake. TANDeM are offering additional therapy groups virtually due to the success of this pilot, and will continue delivering virtual psychoeducational groups for parents of children with tics as this intervention helps reduce the demand for follow up appointments.

P3. A double-blind, randomized, placebo-controlled crossover trial of medical cannabis in adults with Tourette syndrome

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Background:
The number of effective pharmacological options for the treatment of tics is limited. A substantial proportion of patients do not respond adequately to currently available medications or experience significant adverse effects. Emerging evidence shows cannabinoids as promising for the treatment of tics. We set out to compare the efficacy and tolerability of single doses of three vaporized medical cannabis products and placebo in reducing tics in adults with Tourette syndrome (TS).

Methods:
In a randomized, double-blind, crossover design, each participant received a vaporized single 0.25 g dose of THC 10%, THC/CBD 9%/9%, CBD 13% and placebo at two-week intervals. Our primary outcome was the Modified Rush Video-Based Tic Rating Scale (MRVTRS), taken at baseline and at 0.5, 1, 2, 3, and 5 hours after dose administration. Secondary measures included the Premonitory Urge for Tics Scale (PUTS), Subjective Units of Distress Scale (SUDS), and CGI-I. Correlations between outcomes and cannabinoid plasma levels were calculated. Tolerability measures included open-ended and specific questions about adverse events (AEs).

Results and Conclusions:
Twelve adult patients with TS were randomized (11 males, mean age 28.7 years, range 15-44), with 9 completing the study. There was no statistically significant effect of product on the MRVTRS. However, there was a significant effect of THC 10%, and to a lesser extent THC/CBD 9%9%, versus placebo on the PUTS, SUDS, and CGI-I. As well, there were significant correlations between plasma levels of THC and its metabolites, but not CBD, with MRVTRS, PUTS and SUDS measures. There were more AEs from all cannabis products relative to placebo, and more from AEs from THC 10% versus other cannabis products, particularly cognitive and psychomotor effects. Most participants correctly identified whether they had received cannabis or placebo. In this randomized controlled trial of cannabis for tics in TS, there was no statistically significant difference on the MRVTRS for any of the cannabis products, though the THC 10% product was significantly better than placebo on the secondary outcome measures. As well, THC and metabolite plasma levels correlated with improvement on all measures. The THC 10% product resulted in the most AEs. This pilot data will inform the design of a larger chronic treatment clinical trial to characterize the efficacy and safety of medical cannabis in TS.

P4. Moderating Role of Depression on the Association of Tic Severity with Functional Impairment in Children

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Background:
Chronic tic disorders (CTD) commonly co-occur with other psychiatric disorders. CTD have been linked to functional impairment and reduction in quality of life. Insufficient research is available on depressive symptoms in patients with CTD, especially children and adolescents, yielding conflicting findings.

Methods:
The sample consisted of 85 children and adolescents (6-18 years) with a CTD who were treated in a large referral center. Participants were evaluated using gold standard self- and clinician-reporting instruments to measure tic symptom severity and tic-related functional impairment (Yale Global Tic Severity Scale: YGTSS); depression (Child Depression Inventory: CDI); and obsessive–compulsive symptoms (Children Yale Brown Obsessive Compulsive Scale: CY-BOCS).

Results:
Depressive symptoms (mild to severe) were exhibited by 21% of our sample. Study participants with CTD and comorbid obsessive–compulsive disorder (OCD) and/or Attention Deficit Hyperactivity Disorder (ADHD) had higher rates of depressive symptoms compared to those without comorbidities. Significant correlations were found within and among all tic related and OCD related measures, yet depressive symptoms only correlated to tic-related functional impairment. Depression significantly and positively moderated the correlation between tic severity and tic related functional impairment.

Conclusions:
Findings suggest that depression plays an important part as a moderator in the link between tic severity and functional impairment in children and adolescents. Our study highlights the importance of screening for and treating depression in patients with CTD.

P5. Early development difficulties as predictors for tic and comorbid severity, an EMTICS study

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Background:
Chronic Tic disorders (CTD), including Tourette Syndrome (TS), are neurodevelopmental disorders that appear in childhood and are frequently associated with psychiatric comorbidities. It is clinically known that children with CTD are more often diagnosed with developmental disorders, but the link between developmental delay and the severity of tics and comorbidities later in life has not yet been fully described. Therefore, the current study aimed to investigate the severity of tics and common comorbidities (obsessive compulsive disorder: OCD; Attention deficit and hyperactivity disorder: ADHD; autistic spectrum disorder: ASD) in the context of delays in the acquisition of common, early childhood, developmental milestones. It was hypothesized that children with CTD will show higher prevalence of developmental delays and that there will be a significant correlation between the severity of developmental delays and the severity of CTD and associated comorbidities.

Methods:
The current study is a part of the longitudinal European Multicenter Study of the Etiology of Tic Disorder. Children and adolescents diagnosed with CTD, aged 3-16 years (n=383, *M*=10.67± 2.69 years) were recruited from sixteen child and adolescent psychiatry or pediatric neurology outpatient clinics throughout Europe and Israel. Participants were asked to complete parent-report questionnaire and to participate in a clinical interview. Measures included: Developmental Milestones Questionnaire; Yale Global Tic Severity Scale (YGTSS); The Children's Yale–Brown Obsessive Compulsive Scale (CY-BOCS); Swanson, Nolan, and Pelham, version IV (SNAP-IV) rating scale; The Autism Spectrum Screening Questionnaire (ASSQ); Strengths & Difficulties Questionnaire (SDQ).

Results:
Participants were mostly boys (76.8%, n=294) with TS (87.5%, n=335), with moderate severity of tics (n=180, 47%). Additional diagnoses included ADHD and OCD, present in 96 (25.1%) and 116 (30.3%) participants, respectively while 37 participants (9.7%) had both ADHD and OCD. Suspected developmental disorders were prevalent in 20.6% of the participants (n=79). Most correlations between developmental milestones, tics and comorbidities were found insignificant while the significant ones were weak ($r < .20$). Delayed motor developmental milestone was correlated with OCD severity, while motor, language and toilet training delays

were all positively correlated with severity of ADHD symptoms. Prediction of suspected developmental disorders by developmental milestones was statistically significant ($\chi 2(8) = 28.85$, $p < .001$).

Conclusions:
TS as a neurodevelopmental disorder, has always been considered a prototype of developmental psychopathology, still, the link between delay in developmental milestones and CTD remined unclear in past studies as in the current study. While most correlations were found insignificant, OCD and ADHD were significantly and positively correlated with delay in some developmental milestones. Developmental milestones also significantly predicted suspected developmental disorders. Future research is warranted in order to elaborate our knowledge on the neurodevelopmental precedents of TS.

P6. Urge-tic associations in children and adolescents with Tourette syndrome

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Background:
Besides motor and vocal tics, premonitory urges are a cardinal feature of Gilles de la Tourette syndrome (GTS), a developmental disorder usually starting in the first decade of life. However, the fine-grained temporal relationship between urges and tics has so far only been investigated in adults.

Methods:
We analyze the temporal association between urges and tics in 25 children and adolescents (8-18 years), including inter-individual differences in urge-tic associations, their relation to clinical measures as well as in comparison to previously published data from adults with GTS. For the assessment of urge-tic-association we use the urge monitor, an established tool combining continuous urge ratings and synchronized video recordings of tics. Tic occurrence and intensity were manually rated from video recordings by two independent raters. Urge-tic associations were quantified by applying logistic and linear regression to individual time series (300s), relating urge intensity to tic occurrence and intensity, respectively.

Results:
At the group level, our results confirm positive associations between subjective urges and tics also in children and adolescents with GTS, with increased tic frequency and tic intensity during periods of elevated urge. Inter-individual differences in the associations between urges and tics were, however, substantial. Less than half (48%) of participants showed positive associations, a similar proportion did not (44%), and two (8%) even had significant negative associations with reduced tic occurrence and intensity at times of increased urges. Tic expression and subjective urge levels correlated with corresponding clinical scores. Measures of the strength of urge-tic associations did not correlate with clinical measures but showed a significant positive correlation with tic intensity: participants with more severe tics during the urge monitor had stronger urge-tic associations. Comparison to a previously reported sample of adults with GTS showed some evidence for weaker urge-tic associations in children and adolescents relative to adults with GTS.

Conclusions:
Our results do not support the commonly held view of tics being directly caused by urges and emphasize the complex and heterogeneous nature of urge-tic associations. More severe tics may facilitate anticipation of tics and thereby lead to more pronounced

urge-tic associations, consistent with a hypothesis of urges as an adaptive phenomenon to tics.

P7. The Calgary and Paris Adult Tic Disorders Registry

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Background:
In children, tics affect more boys than girls by a ratio of 4:1. In adults, the limited existing data suggest that the sex distribution is more equal between men and women. There is a need to accumulate information regarding the clinical dimorphism of tic disorders between sexes. The aim of this study is to assess the phenomenology of tics in adults and investigate how sex influences tic phenomenology, tic-related impairment and comorbidities.

Methods:
Adults with tics were recruited from our two specialty clinics in Canada and France and followed prospectively for 12 months. We examined the most common body areas affected and types of sounds. We compared age of onset, Yale Global Tic Severity Scale (YGTSS) scores, including detailed tic inventory and tic-related impairment, psychiatric comorbidities and treatments used in women compared to men. We distinguished primary tic disorders, including Tourette syndrome (TS), persistent motor and vocal tic disorder, from functional tic-like behaviours (FTLBs).

Results and Conclusions:
Since January 2021, 124 participants have been included in Calgary and Paris: 86 with TS (69.4%), 11 with persistent motor tic disorder (8.9%), 1 with other specified tic disorder (adult-onset) (0.8%), 1 with secondary tics (0.8%) and 25 with FTLBs (20.2%).
In patients with primary tic disorders (n=98): 30 (30.6%) were females, mean age at registration was 33.4 years (range 18-73), mean age at tic onset was 8.9 years (range 3-27) and it did not differ by sex. The most common simple tics were eye blinking (54.1%), head jerks/ movements (50.0%) and throat clearing (32.7%). The most common complex tics were complex hand movements (12.2%), tic-related compulsive behaviours (13.3%) and coprolalia (8.2%). Females presented more often with eye blinking (OR=2.6, p=0.039), simple eye movements (OR=4,3, p=0.006) and simple arm movements (OR=3.6, p=0.009) than males. There was no difference in tic-related impairment or in YGTSS total tic score by sex. The most common comorbidities in patients with primary tic disorders were anxiety (50.0%), mood disorders (32.7%) and attention-deficit/hyperactivity disorder (32.7%); only 17.4% had no psychiatric comorbidities. Females were significantly more often affected by anxiety (OR=3.54, p=0.007). The most frequently introduced treatments were aripiprazole (34.7%), cognitive behavioural therapy for tics (26.6%) and botulinum toxin (23.5%); 23.5% were not treated for their tics. French patients were more often treated by aripiprazole (70%) than Canadian patients (10.3%).
In patients with FTLBs (n=25): 23/25 (92.0%) were females; mean age at registration was 19.9 (range 18-24). Tic number, intensity, complexity, interference, and YGTSS

total tic score were higher than in patients with primary tic disorders, as was tic-related impairment (31.3 vs 19.0/50, $p < 0.00001$).
A total of 23/56 (41.1%) of patients with primary tic disorders had at least one family member with an autoimmune disease. A total of 35/56 (62.5%) patients with primary tic disorders and 11/13 (84.6%) patients with FTLBs had at least one family member with a neuropsychiatric disorder (mostly depression and anxiety, respectively); female sex was associated with a neuropsychiatric family history (OR 5.6, $p=0.003$).

Our ongoing prospective international registry of adults with tics allows us to identify the typical presentation and distribution of tics in this population, with, as it seems from these first analyses, few sex differences.

P8. Artificial intelligence as an avenue for research and clinical work related to tic disorders

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Background:
In recent years there has been a growing number of methodologies aimed to apply new technologies for determination of clinical phenotypes and development of new treatment strategies for patients with tics. These include strategies such as machine learning and deep learning and other modalities of artificial intelligence (AI) used to analyze clinical variability of tics, neuroimaging phenotypes or treatment options.

Methods:
One reviewer (NS) searched the electronic database of PubMed on April, 2022 for relevant studies using the search terms: ('Tourette syndrome' [MeSH Terms] OR 'Gilles de la Tourette syndrome' [MeSH Terms] OR 'tic disorders' [MeSH Terms] OR 'tics' [MeSH Terms] OR 'tic disorders'[Title/Abstract]) AND ('artificial intelligence' [Title/Abstract] OR 'machine learning' [Title/Abstract] OR 'deep learning' [Title/Abstract], limit: 'humans'. These studies were further reviewed for additional relevant citations. The titles and abstracts of the studies obtained through this search were examined by the reviewer (NS) in order to determine article inclusion. Discrepancies were addressed by the reviewers through discussion and eventually conversation with the senior reviewers (TZ, PN, JP).

Results and Conclusions:
Our search strategy yield 10 studies which used AI methodology in studies dedicated to tics. All in all, these included the topics of clinical phenotypes, neuroimaging and response to treatment. In particular, in the area dedicated to clinical phenotypes, Paulus et al. developed a machine learning model helpful to differentiate between voluntary movements and tics. They used methodology of support vector machine (SVM) to evaluate the impact of each category of Modified Rush Videotape Rating Scale (MRVRS), the motor tic count per minute, age and gender on the classification of individuals into the groups "Tourette syndrome" and "no Tourette syndrome". As a result, they demonstrated that severity of motor, but not vocal tics, is the best predictor to separate and classify patients with Tourette syndrome (TS) and healthy controls. Similar study was released by Wu et al. who attempted to find an automatic method for detecting tic movement to assist in diagnosis and evaluation based on real clinical data and deep learning architecture that combines both unsupervised and supervised learning methods.
Further evaluation suggested its potential clinical application for auxiliary diagnoses and evaluations of treatment effects. As for neuroimaging studies, previous attempts were mainly focused on application of machine learning to analyze neuroimaging phenotypes that can distinguish healthy controls and TS individuals or using these techniques to develop more advanced neurostimulation via deep brain stimulation (DBS). It can therefore be concluded that all these avenues will serve to plan better, individualized treatment for patients with tics. These technologies enable better and

personalized planning of treatment, which in the nearest future will be based on the combination of genetic information, neuroimaging findings and biological biomarkers.

P9. Predictors of response to behavioral therapy in children with Tourette syndrome – results of the machine learning study

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Background:
While behavioral therapy is considered to be the first line treatment of Tourette syndrome (TS) both according to the guidelines of the European Society for the Study of Tourette Syndrome and the American Academy of Neurology, it is still not clear what could be the predictors of best treatment response. Preliminary studies have demonstrated that the presence of tic medication, greater tic severity and positive participant expectancy predicted greater tic improvement. On the contrary, the presence of some co-existing psychiatric disorders, in particular, anxiety disorder or attention deficit hyperactivity disorder, as well as the presence of premonitory urge predicted lower tic reduction. However, this topic has been explored in only two studies and have applied standardized analytical methodology. The purpose of this study is to determine possible predictors of symptom response to behavioral therapy in children with TS using selected machine learning approaches.

Methods:
Data were aggregated from 126 children (aged 9-17 years) with impairing TS or chronic tic disorder who were enrolled in randomized controlled trial (NCT00218777) testing the efficacy of comprehensive behavioral intervention for tics (CBIT) for tic reduction in children. The participants were randomly assigned to 8 sessions during 10 weeks of behavior therapy (n=61) or a control treatment consisting of supportive therapy and education (n=65). We compared standardized logistic regression model with two multivariable approaches in order to elucidate possible predictors of treatment response: recursive partitioning and random forests. Post-treatment Yale Global Tic Severity Scale (YGTSS) reduction of ≤ 30% indicated response.

Results and Conclusions:
Logistic regression did not consistently identify significant multivariate predictors. Recursive partitioning and machine learning found ADHD to predict response, with model accuracy ranging between 67% and 76%, and adequate sensitivity (67%-78%) and specificity (70% to 85%). Post-hoc analyses indicated that treatment responders had significantly lower rates of ADHD (p=0.04) than non-responders. It can therefore be concluded that multivariable approaches may be superior to regression for identifying predictors of treatment response for pediatric TS. These results may be helpful to identify evidence-based, low cost measurement approaches for identifying TS-affected youth who are likely to benefit from CBIT, which may inform clinical decision making.

P10. Automated tic detection: Machine learning approach for the detection of Tics in videos

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Background:
The modified RUSH Video Protocol is a useful tool for the objective and blinded evaluation of tic severity and frequency in patients with Gilles de la Tourette syndrome (GTS). In trained raters, inter-rater reliability is good. However, video rating is time-consuming and can be cumbersome, particularly when large numbers of videos need to be assessed by two independent raters. Automated detection and counting of tics using machine learning (ML) could simplify this process, requiring a fraction of the time. Moreover, ML algorithms detecting tics may potentially be used to distinguish between classical tics and functional tic-like behavior. Against this background, as a first step, we trained artificial neural networks to detect tics per seconds using video recordings taken during urge-tic measurements. Thereby, other than severity and frequency of tics, the precise timing of tics, was determined in advance to create an optimal data set.

Methods:
In total, 64 videos of n=42 subjects were used, whereof n=36 (86%) were included in the training and n=6 (14%) were reserved for testing. Clinically, tic intensity was rated as follows: **0 =** None; **1**= very mild, could be a normal movement, (e..g. short sniff); **2** = mild, clearly tic; undoubtedly noticeable to tic experts but may not be noticed by others (e.g. nasal flare; opening eyes); **3** = mild; clearly tic, noticeable to any observer attending to it, no exaggerated muscle activity (e.g. mouth pouting, kiss); **4** = moderate, easily noticeable, short lasting exaggerated muscle activity (e.g. raising the nose); **5** = moderate to severe, exaggerated muscle activity leading to long lasting distortions (e.g. screwing up the eyes, raising the nose, head to side for longer period); **6** = severe, unusual movement clearly raising attention (e.g. staring); **7** = severe, unusual movement that is off-putting or frightening (e.g. mouth wide open); **8** = very severe, i.e. apparently painful or potentially dangerous, e.g. due to self-injury (hitting in the face). For the classification task, two different supervised learning approaches were proposed based on the prior extraction of landmarks or bounding boxes containing the subject's face, respectively. Both were performed using the Google mediapipe toolbox. In the first approach, manual features were extracted on the basis of the landmarks, which served as an input for a random forest classifier, while the second one represents a fully automated approach in which the regions of interest in the video snippets act as inputs to a ResNet 3D 18, a special type of neural network designed for video processing.

Results and Conclusions:
Focusing on tics rated with a tic intensity larger than 2, the established machine learning models showed a tic detection accuracy of 85.4 % in the landmark-based aproach as well as 88.5 % in the fully automated neural network approach.
These results illustrate that tics in patients with GTS could be detected successfully. This provides a new approach to tic detection that will need further refinement to be used on RUSH videos.

P11. Impact of Tourette syndrome on education

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Background:
Tourette syndrome (TS) is characterized by motor and vocal tics. Previous studies have shown that TS has an impact on academic achievements. The aim of this study was to investigate the association between TS and education, including the influence of severity of tics and comorbidities.

Methods:
During 2005-2007, 395 participants were included in a large cohort (314 with TS and 81 controls) and mean age was 12.60±2.64 years. The cohort was re-examined after 6-8 years where N=276 participants (223 with TS and 53 controls) were included with a mean age of 18.52±2.73 years. At both timepoints, severity of tics and the presence and severity of comorbidity were assessed. Educational achievements were assessed through structured interviews.

Results and Conclusions:
Vocal tics were found to be inversely associated with having passed lower secondary school at a prospective level. At a cross-sectional level, severity of motor tics was found to be inversely associated with having passed high school. The severity of comorbidity was found to be associated with educational level at a longitudinal view, but not cross-sectional. Overall, children with TS had a lower passing rate at lower secondary school and high school compared to healthy controls. We found that this difference was more likely driven by severity of comorbidities than tic severity. Tic severity only influenced children with TS without comorbidity. It is important to be aware of academic achievement in children with TS in order to give them the right support and thereby optimize educational opportunities.

P12. Tourette Syndrome and rage attacks in children and adolescents: A longitudinal study.

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Background:
Many patients with Tourette syndrome (TS) are experiencing rage attacks (RA) and patients report these to affect their quality of life even more than their tics. The physiology of RA has still not been found, but due to TS's relationship with attention deficit hyperactivity disorder (ADHD) and obsessive compulsive disorder (OCD) a genetic reason could be hypothesized. Another explanation could be that the strain of suffering from severe tics or comorbidities could also lead to an increased level of irritability resulting in RA later on in life. This study is aiming to examine whether tic severity or comorbid symptoms at baseline will result in more RA 6 years later in time, in order to further uncover the relationship between TS with OCD and ADHD.

Methods:
314 patients between the age of 5 and 19 years with TS were examined at baseline and 227 returned for follow-up 6 years later. A matched control group of 81 at baseline and 53 for follow-up also examined. The examinations consisted of The Yale Global Tic Severity Scale (YGTSS), ADHD rating scale (ADHD-RS), the Children's Yale-Brown obsessive compulsive scale (CY-BOCS) or Yale-Brown Obsessive Compulsive Scale for adults (Y-BOCS) and a structured questionnaire regarding the presence of RA. The same tests were repeated at follow up.

Results:
The patients with TS experienced significantly more RA than the control subjects at both baseline and follow up ($p<0.001$). TS patients with RA at baseline had significantly more compulsions and higher scores of hyperactivity, impulsivity and concentration problems than the patients without RA. Furthermore, patients with RA at follow up had significantly higher scores of hyperactivity and impulsivity at baseline. There was no significant difference in tic severity between TS patients with or without RA at baseline and follow up.

Conclusions:
Our study showed that RA was significantly more present in patients with TS than in healthy controls. Furthermore, the severity of OCD and ADHD correlated with the presence of RA and hyperactivity and impulsivity early in life can predict the presence of RA later in childhood and adolescence. It is important to screen for the presence of RA in patients with TS and especially in patients who also have comorbid ADHD and/or OCD.

P13. Therapist-guided exposure and response prevention treatment for adults with TS/CTD delivered via internet: a pilot trial.

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Background:
Tourette syndrome (TS) and Chronic Motor or Vocal Tic Disorder (CTD) are childhood-onset disorders, but many continue to experience impairing tics into adulthood. TS/CTD are associated with reduced quality of life, lower educational attainment, and an increased risk for cardiovascular and metabolic disorders. Effective interventions are crucial to prevent undesirable health outcomes in these patients. Behavior therapy (BT) has shown effects in reducing tic severity both short- and long-term and is recommended as a first-line treatment by expert guidelines in Europe and North America. However, access to BT in regular care is extremely scarce and many patients seeking help only receive pharmacological treatment, known for its side effects. Meanwhile, therapist-guided internet-delivered treatments have shown comparable effects to traditional face-to-face treatments for several disorders. The aim of the study was to determine if internet-delivered guided BT (I-BT) based on exposure and response prevention (ERP) is a feasible, acceptable, safe, and preliminary efficacious treatment for adults with TS/CTD in an uncontrolled pilot trial.

Methods:
A total of 30 participants have been recruited from the general public between April 2021 and Mars 2022. The participants needed to be 18 years of age or older, fulfil diagnostic criteria for TS/CTD according to DSM-5 and have Total Tic Severity Score (TTSS) of >15 (>10 for individuals with motor or vocal tics only) measured with Yale Global Tic Severity Scale (YGTSS), that also served as primary outcome measure. Upon inclusion in the study, participants received 10 weeks of therapist-guided I-BT delivered by clinical psychologists at a psychiatric clinic specializing on OCD and related disorders. The treatment is based on ERP - the patients are encouraged to expose themselves to tic-triggering situations and practice resisting tics – also including functional analyses, habit reversal training and relapse prevention. The therapists give support in applying the treatment techniques, help the patients to problem-solve and as a rule reply to the patients' messages within 24 hours. Apart from tic severity, other psychiatric symptoms and quality of life are measured. The measurements are collected at pre- and post-treatment, as well as 3, 6, and 12 months after the treatment's end.

Results and Conclusions:
Twenty-eight participants will have completed their treatment by June 2022. The results on the treatment's reach, feasibility, acceptability, safety and preliminary efficacy will be presented.

P14. A clinical observation for treatment of patients with Tourette syndrome using a new (oromucosally delivered) nanoparticle-based cannabinoid spray

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Background:
Cannabis based drugs are seen as a promising and safe treatment strategy in Tourette Syndrome (TS). Currently, several galenic applications with cannabinoids are available, such as inhalation, smoking or oral applications. These applications often have lack in bioavailability, where a possible way to enhance bioavailability is the use of oromucosal administration. This allows for rapid absorption of cannabinoids into the systemic circulation. The use of nanoparticle-based drug delivery systems provide a new approach to improve the bioavailability of oramucosal drugs. This study treated a small number of TS patients with the nanoparticle-based drug formulation CannaXan® and assessed how tics and other psychiatric symptoms changed over time of treatment.

Methods:
18 TS patients (15 male) received the CannaXan® medication for 6 months. Changes in tics, as well as in psychiatric comorbidities and quality of life were assessed at baseline, after one month (Visit 1), three month (Visit 2) and after six months (Visit 3) at the end of the treatment.

Results and Conclusions:
An 8% reduction in tics compared to baseline, according to the Total Tic Score of the Yale Global Tic Severity Scale (YGTSS-TTS), were observed after six months (visit 3; n = 13). In addition, a reduction of symptoms in psychiatric comorbidities were observed over time (e.g., 17 % decrease in severity of obsessive-compulsive disorder according to the Yale-Brown Obsessive Compulsive Scale (YBOCS); n = 13), as well as an increase in quality of life (39.1%; n=12) based on the total score measured with the Gilles de la Tourette Syndrome–Quality of Life Scale (GTS-QOL).

In this study, the nanoparticle-based oromucosal administration has shown positive trends leading to tic reduction in TS. In addition, a positive trend was found in improvements of psychiatric comorbidities and quality of life.

P15. ENIGMA-TS: A worldwide platform for collaboration on the study of Tourette Syndrome genetics and neuroimaging

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Background:
To date, studies on Tourette Syndome (TS) brain structure and function have been limited in size with efforts mostly fragmented across multiple sites. Efforts to integrate genetics and neuroimaging are only now beginning. At the same time, multiple international collaborative studies on the genetics and neuroimaging of TS are providing an opportunity for worldwide collaboration and large-scale studies that can lead to robust and reproducible results, providing insights into the neurobiology of TS.

Methods:
ENIGMA-TS brings together all major worldwide collaborative efforts on neuroimaging and genetics for TS and aims to integrate with equivalently large and already existing studies of highly comorbid OCD, ADHD, ASD, as well MDD, and Anxiety Disorders. We take advantage of access to data, resources and standardized pipelines from the ENIGMA (Enhancing Neuroimaging Genetics through Meta-Analysis) consortium and the Psychiatric Genomics Consortium (PGC). Already multiple sites have begun to work on merging together neuroimaging datasets and our first goal for joint analysis will include a study of cortical and subcortical neuroanatomical signatures for more than 1,000 patients with TS and equal number of controls.

Results and Conclusions:
Our work will help close major gaps in understanding brain structure and function in TS and elucidate the etiological correlations between TS and its frequently comorbid disorders. Our efforts will lead closer to novel and improved management approaches and help identify biomarkers to tailor individualized therapies.

P16. Prevalence of misophonia in the general population in Germany

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Background:
Misophonia refers to a phenomenon in which affected individuals have a selective intolerance to sounds of oral or nasal origin. This typically manifests itself in strong emotional reactions such as anger, irritation, and disgust. Although misophonia has not yet been included in the ICD or DSM as a specific disorder, preliminary diagnostic criteria have been proposed by experienced researchers and clinicians because there is growing evidence that misophonia constitutes an independent diagnostic category. Previous prevalence estimates are based on surveys from student or hospital populations and one prevalence study of misophonia in the general population. The aim of this study was to conduct the first epidemiological survey of the prevalence of misophonia in Germany.

Methods:
We conducted a large-scale representative population survey in Germany in cooperation with the USUMA market and social research institute. For this purpose, 2,519 people were visited in their households and interviewed in a randomized procedure. In addition to a survey of demographic data, the self-report questionnaires Misophonia Questionnaire (MQ) and Amsterdam Misophonia Questionnaire (AMISOS-R) were used to record misophonic symptoms.

Results and Conclusions:
Based on the severity subscale of the MQ, we found a prevalence of misophonia of 5.0% in our representative population sample. At the same time, the AMISOS-R showed that 5.8% of respondents were similar in symptom severity to a sample of misophonic patients. Based on our results, it can be assumed that misophonia is a common phenomenon with a prevalence of about 5%. In addition, a significant proportion of affected individuals reported actually suffering from the symptoms. Our results support the assumption of an independent disease entity and the inclusion of misophonia in ICD and DSM.

P17. Functional tic-like behaviours during the COVID-19 pandemic

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Background:
Functional movement disorders (FMDs) are conditions in which affected patients develop abnormal movements that are incongruous with known "organic" diseases, often associated with psychological stressors or social influences. Functional tics are part of the wide spectrum of functional movement disorders. Their distinction from organic tics is challenging, because phenomenologically both functional and organic tics share common features. During the COVID-19 pandemic, the use of social media and websites such as Tik-Tok quickly expanded. There has also been a dramatic increase in functional tic-like behaviours (FTLBs) in vulnerable children and adolescents after social media exposure.

Methods:
We analysed clinical data (n = 240) from June 2021 to December 2021 collected at the outpatient Tourette Clinic, Child and Adolescent Neurology and Psychiatry Unit, Catania University. We compared demographic and clinical variables of patients with Tourette to patients with functional tic-like behaviours.

Results:
Among the cohort of 240 TS patients referred for evaluation at our centre, 7 were diagnosed with functional tic –like behaviours. Participants with functional tic –like behaviours were more likely female and presented a mean age of 15 years old. Patients with functional tic –like behaviours had also several characteristics including an explosive onset of complex tic-like behaviours and family-related emotional distress linked to tensions between parents and increased stress levels related to virtual schooling.

Conclusions:
Our data suggest that several features in clinical course and their phenomenology are important to differentiate functional tic –like behaviours from organic tics. Functional tic –like behaviours has increased during the COVID-19 pandemic in vulnerable children and adolescents. A prompt diagnosis and expert review when necessary is recommended as these patients generally do not respond to conventional pharmacotherapies for tics.

P18. Brain networks associated with disruptive behavior in children with Tourette syndrome

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Background:
Irritability and low frustration tolerance are common features in children with Tourette syndrome. Often, these symptoms result in disruptive behaviors such as anger outbursts, aggression, and noncompliance. For many children with TS and their family, disruptive behaviors are also among the most debilitating symptoms associated with TS. However, very few studies have investigated the neural correlates of disruptive behaviors in TS. In this study, we wished to assess the brain networks associated with the severity and the interference caused by disruptive behaviors in children with TS.

Methods:
Sixty-eight children with TS were included in this study. Disruptive behaviors were assessed with the severity and interference scales of the Disruptive Behavior Rating Scale (DBRS). The severity scale has 8 items assessing the presence of symptoms of oppositional defiant disorder and 8 items assessing the degree of interference of disruptive behavior with children's functioning in various settings. EEG was recorded during a 7-minute eyes-open resting-state session. Source activity was reconstructed from the continuous EEG data and was projected onto the Desikan-Kiliany atlas. Connectivity between brain sources was computed in the alpha frequency band using the phase-locking value. Network-based statistics were used to assess the correlation between disruptive behaviors and functional connectivity.

Results:
Network-based statistics did not reveal a subnetwork that was significantly associated with the severity scale of the DBRS. However, there was a subnetwork which was negatively associated with the interference scale of the DBRS ($p = .028$). That subnetwork comprised 4 connections between 5 brain regions. Of note, the bilateral ventromedial prefrontal cortex and dorsal anterior cingulate were part of that subnetwork.

Conclusions:
Our results suggest that disruptive behaviors in TS are associated with reduced functional connectivity between the ventromedial prefrontal cortex and the dorsal anterior cingulate. Such connectivity pattern is similar to previous studies in children with disruptive behavior without tics. The ventromedial prefrontal cortex and the dorsal anterior cingulate cortex are involved in emotion processing and regulation, and reduced connectivity between these regions may lead to disruptive behaviors in children with TS.

P19. Clinical characteristics in mass social media-induced illness with functional Tourette-like behavior compared to Tourette syndrome

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Background:
Tourette syndrome (TS) is defined by the DSM-5 as a chronic tic disorder with the presence of at least two motor and one vocal tics over a period >12 months in someone under the age of 18 after excluding secondary causes. Even in combination with the definition for tics as rapid, repetitive, non-rhythmic movements or vocalizations for those, who are unfamiliar with the diagnosis, differentiation from functional Tourette-like behavior (FTB) induced by social media (=mass social media-induced illness, MSMI) is challenging.
Since about 3 years, MSMI-FTB became a global phenomenon presumably spread via numerous influencers on several social media channels including YouTube and TikTok. In Germany, we identified the host of the YouTube channel "Gewitter im Kopf" (English: "Thunderstorm in the brain") as the virtual index person of this outbreak, since patients presenting in our specialized outpatient clinic showed similar or even identical symptoms. We present clinical characteristics of a relatively large single-center sample of patients with MSMI-FTB compared to data from a large sample of patients with TS and other chronic tic disorders that may be helpful to differentiate both diseases from each other.

Methods:
We collected a large number of clinical data from 32 patients (mean/median age: 20.1/18 years, range: 11-53 years, *n*=16 females) with MSMI-FTB. Sex differences were examined with respect to age and kind of onset and course of FTB, premonitory sensations, suppressibility, rostro-caudal distribution, distractibility, factors resulting in complete symptom reduction, and absolute numbers of different motor and vocal FTB. Results were compared to a large sample of patients with primary tic disorders (*n*=1032 including 529 children, *n*=235 females) from our center.

Results and Conclusions:
We identified several clinical characteristics in patients with MSMI-FTB that allow a clear differentiation including abrupt onset (in 84%), mean age at onset at age 19, and constant symptom deterioration (in 59%). No sex differences were found concerning the above-mentioned criteria. Above all, vocalizations and movements were mainly complex and in large numbers. More specifically, the absolute numbers of *complex* movements and vocalizations were nine times greater than that of *simple* movements and vocalizations; similarly, that of (simple and complex) *vocalizations* were one and a half times greater than that of (simple and complex) *movements*. Although the presence of premonitory sensations and suppressibility by itself did not allow a differentiation, kind and duration of these phenomena were very different compared to description in patients with TS. Furthermore we found a significantly higher age at onset (p_c<0.001) a significantly higher rate of obscene and socially inappropriate

symptoms/coprophenomena (p_c<0.001), a significantly lower rate of comorbid ADHD (p_c=0.003), a significantly higher rate of OCB (p_c<0.001) and a significantly higher rate of females (p=0.01) in comparison to a sample of patients with TS only.
In conclusion, based on a thorough clinical characterization, the diagnosis of MSMI-FTB can be made easily and clearly differentiated from tics in TS.

P20. Psychiatric comorbidities in patients with mass social media-induced illness presenting with Tourette-like behavior

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Background:
For the past 3 years we are faced with an outbreak of a new type of mass sociogenic illness (MSI) presenting with functional Tourette-like behaviors (FTB). Remarkably, symptoms spread solely via social media, while so far it was believed that for an outbreak of MSI *personal* contact among affected individuals is needed. We identified the protagonist of the German YouTube channel "Gewitter im Kopf" (English: "Thunderstorm in the brain") who acts as the *virtual* index person of this outbreak in Germany, since patients presenting in our specialized outpatient clinic showed similar or even identical symptoms. Meanwhile, FTB became a global phenomenon presumably spread via numerous influencers on several social media channels including YouTube and TikTok. Here, we present a detailed clinical characterization of psychiatric comorbidities in patients with mass social media-induced illness (MSMI) presenting with FTB.

Methods:
Based on a thorough neuropsychiatric examination, standardized assessments, and a newly developed semi-structured interview, we collected data of 32 patients with regard to FTB, psychopathology, and diagnostic criteria for Tourette syndrome (TS) as well as use of social media.

Results and Conclusions:
Of 32 patients (mean/median age: 20.1/18 years, range: 11-53 years, n=16 females) with MSMI-FTB, 94% suffered from further psychiatric symptoms most common abnormalities in social behavior (81%) followed by obsessive-compulsive behavior (OCB) (47%), anxiety (41%), and depression (31%). Furthermore, 47% of patients had experienced bullying, and 75% suffered from coexisting somatic diseases. Remarkably, more than half of patients (53%) also suffered from TS. Even when disregarding MSMI-FTB, 41% of patients were considered as severely mentally ill, 13% as severely physically ill, and 25% as both. Exceptional high numbers of complex motor symptoms but even more vocal symptoms were observed with a remarkably high overlap with symptoms shown by the host of the YouTube channel "Gewitter im Kopf".
After having patients diagnosed with MSMI-FTB – with or without "cormorbid" TS – based on our data it is important to explore all individuals not only with respect to further psychiatric symptoms, but also for somatic diseases and experience of bullying, since these factors seem to be predisposing factors for MSMI-FTB and thus should also be addressed in psychotherapy.

P21. Mass social media-induced illness presenting with Tourette-like behavior: impact of unconscious intrapsychic conflicts, structural deficits, and maintaining factors

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Background:
So far, little is known about predisposing factors for the occurrence of mass social media-induced illness (MSMI) presenting with functional Tourette-like behaviors (FTB). This becomes of importance since we are currently faced with an outbreak of this new type of mass sociogenic illness (MSI) which symptoms spread solely via social media. Patients presenting in our specialized outpatient clinic showed similar or even identical symptoms as seen on the German YouTube channel "Gewitter im Kopf" (English: "Thunderstorm in the brain"). Functional tic-like behaviors are usually a rare presentation of functional movement disorders (FMD). However, meanwhile, FTB became a global phenomenon presumably spread by numerous influencers on different social media channels including YouTube and TikTok.
Here we present first data on underlying psychic processes including intrapsychic conflicts and structural deficits as well as timely-related psychological factors and maintaining factors in patients with MSMI-FTB.

Methods:
Based on a thorough neuropsychiatric examination, standardized assessments, and a newly developed semi-structured interview, we collected data of 32 patients (mean/median age: 20.1/18 years, range: 11-53 years, *n*=16 females) with regard to FTB, underlying psychodynamics and further influencing factors. Using the Operationalized Psychodynamic Diagnostic System (OPD), we evaluated rater's perception of the patient to further explore underlying psychic processes including intrapsychic conflicts. Furthermore, we assessed patients' overall maturity of mental functions to determine pre-existing structural deficits, since ability to manage psychological stressors strongly depends on patients' level of structural integration.

Results and Conclusions:
In all patients, unconscious intrapsychic conflicts (*n*=11, 34.4%), structural deficits (*n*=12, 65.6%) or both (*n*=9, 28.1%) were found. Of these, 14 patients (43.8%) exhibited relevant autonomy-dependency-conflicts. In almost 70% of patients timely-related psychological factors were found. Remarkably, in 99% of patients maintaining factors were identified.
Based on our data, it is suggested that co-occurrence of several different factors including timely-related psychological factors, unconscious intrapsychic conflicts, and structural deficits predispose for contagion with MSMI-FTB. This is in line with the theory of a multimodal etiology in FMD. Treatment of patients with MSMI-FTB should take these predisposing, but also maintaining factors into consideration.

P22. Neural, physiological and behavioral correlates of empathy for pain in Tourette syndrome

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Background:
In addition to the defining features of motor and vocal tics, patients with Tourette syndrome (TS) show diverse symptoms of altered social behaviors, such as echophenomena, coprophenomena, emotional dysregulation and difficulties in social cognition tasks. Furthermore, they report increased personal distress in emotional situations. It has been suggested that these symptoms reflect increased mirroring or sharing of others' experience, possibly together with decreased mentalizing about others. We tested this using an empathy for pain paradigm together with EEG recordings, focusing on mu suppression over the sensorimotor cortex as putative neural marker for the mirror neuron system (MNS).

Methods:
Fifty participants (25 persons diagnosed with TS, 25 age-, gender and education matched controls) underwent an empathy for pain paradigm, while we measured EEG and EDA. Pictures of hands and feet in painful or neutral situations were presented in two conditions: normal pain sensitivity of the actor in the picture versus enhanced pain sensitivity. Participants were asked to rate the painfulness for the actor as well as for themselves in a subset of the trials. Furthermore, we tested the frequency of echophenomena with a video protocol and collected extensive clinical data. Changes in mu suppression during the observation of the pictures, as well as pain ratings and skin conductance response were compared between groups and were correlated with the occurrence of echophenomena, self-reported empathy and clinical measures.

Results:
Our patient sample showed more echophenomena than controls. In the empathy paradigm, the two groups did not differ on the behavioral level. Controls showed the predicted increase of mu suppression when watching painful compared to neutral actions, but TS patients did not show this effect. Mu suppression correlated positively with self-reported perspective taking and negatively with personal distress, while pain ratings correlated positively with measures of tic severity. Both patients and controls showed slightly enhanced skin conductance responses to painful stimuli.

Conclusions:
Our results do not support the hypothesis of higher empathy for pain in TS. On the contrary, TS patients showed less pain-related mu suppression compared to controls, did not differ from controls in their pain-related skin conductance responses and showed no behavioral differences. Our results question the hypothesis of an overactive MNS in TS and highlight the need for more research on social cognition and behavior in TS.

P23. Inhibitory control in children with Tourette syndrome: Parent-report and behavioural assessments with typically developing and ADHD comparison groups

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Background:
Research is conflicting regarding the presence of inhibitory control difficulties in children with Tourette syndrome (TS). Discrepancies between parent-report and behavioural measures of inhibitory control are an important consideration when evaluating existing evidence. The high prevalence of attention-deficit hyperactivity disorder (ADHD) in TS populations – at approximately 55% – further complicates the matter, as inhibitory control difficulties are a core feature of ADHD. Here, we explore the potential impact of ADHD on parent-report and behavioural measures of inhibitory control difficulties in TS through findings from (i) a large questionnaire study ($N = 166$) and (ii) a pilot study ($N = 25$) assessing behavioural performance on a Flanker task, controlling for ADHD.

Methods:
In the online questionnaire, parents of children aged 7 to 12 years ($M = 9.54 \pm 1.60$) with TS ($n = 67$), TS+ADHD ($n = 25$), and neurotypical children ($n = 74$) completed the childhood executive functioning inventory (CHEXI) to measure everyday behavioural manifestations of inhibitory control difficulties. In the follow-up pilot study, 25 children aged between 8 and 11 years ($M = 9.84 \pm 1.34$) with TS ($n = 8$), ADHD ($n = 7$), and neurotypical children ($n = 10$) took part. Parents completed the CHEXI and children completed a modified computer-based Flanker task to assess inhibitory control. The task was child-friendly, with a horizontal row of cartoon fish presented on-screen as stimuli. Children were asked to indicate, as quickly and as accurately as possible, the direction in which the middle fish was facing across both congruent and incongruent trials. The task comprised of one block of 12 practice trials and four blocks of 24 test trials, with self-paced breaks between blocks. Performance was assessed based on speed (reaction times) and accuracy (correct responses).

Results and Conclusions:
Parent-report inhibition scores in the online questionnaire ($N = 166$) differed significantly between children with TS ($M = 39.02 \pm 9.60$), TS+ADHD ($M = 45.28 \pm 7.74$), and neurotypical children ($M = 27.00 \pm 7.65$), $F(2, 163) = 58.30$, $\eta^2 = .42$, $p < .001$, indicating a very large effect based on group. These findings suggest that inhibitory control issues are present in TS based on parent-report measures independent of co-occurring ADHD. Pilot data from the follow-up study ($N = 25$) exploring whether these parent reports of disinhibition manifest behaviourally in children indicate some links between reaction times on the Flanker task and CHEXI inhibition scores ($p < .05$), but these findings require further validation with a larger sample of children. Differences in task performance between groups based on speed and accuracy of responses in the Flanker task will be presented. As inhibitory control is a predictor of academic achievement and TS has been associated with poorer educational outcomes, children with TS who also display inhibitory control difficulties are important to

identify. The utility of brief parent-report measures and online behavioural tasks to screen for inhibitory control difficulties in children with TS will be discussed.

P24. Functional tic-like behaviors in patients with Tourette syndrome

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Background:
Until recently, it was believed that functional tics are a rare presentation of functional movement disorders (FMD). Hence, co-occurrence of tics and functional tic-like behaviors (FTB) in patients with Tourette syndrome (TS) is a largely neglected clinical presentation and up to now, only very few patients have been described. The main objective of this work is to raise awareness of comorbid FTB in patients with TS.

Methods:
We analyzed clinical data of 71 patients (mean age=21.5 years, range, 11-55, n=27 females (38.0%)) who had been diagnosed in our specialized TS outpatient clinic with TS and comorbid FTB between 2016 and 2021. Data were compared with a large sample of patients with primary chronic tic disorders (n=1032) from the same center.

Results:
In any case, onset of FBT (mean age=20.8 years, range, 10-47 years) was after tic onset (mean age=6.3 years, range, 0-21 years), on average after 14.5 years (+/-9.5 (SD)). Sixty-one patients (86%) described FTB onset as a sudden symptom worsening and 38 patients (53.5%) were able to precisely indicate the date due to abrupt onset of FTB. Different from tics, FTB mainly presented with complex movements (n=57, 80%) located at the upper extremities (most frequently presenting with throwing and breaking of objects, self-hitting, hitting others, and obscene gestures), involvement of several body parts or whole body (e.g., lying on the floor) and thus did not follow the typical rostro-caudal distribution of tics. Most frequent presentation of vocal FTB were complex vocalizations (e.g., obscene words and phrases, screaming, animal sounds, repetitive shouting of phrases) including functional coprolalia in 27 patients (38%). Thirty-three patients (46%) reported that FTB typically occurs in clusters persisting for hours and were often described as “tic attacks”. More than half of patients (n=38, 53.5%) reported concrete timely-related factors that preceded FTB onset. While most patients reported stress being the most relevant triggering factor for tics, FTB were mainly influenced by very different factors such as the presence of a particular person and occurrence only in particular positions, specific locations, or situations. Forty-four patients (62%) reported a complete remission of FTB in particular situations. Remarkably, 47% of patients with TS+FTB were transferred to our clinic as being “treatment-resistant”.
Compared to our large sample of patients with primary chronic tic disorders (n=1032), we found no differences with respect to mean age and mean age at tic onset, but the TS+FTB group comprised significantly more females (38% vs. 23%, p=0.003) and had significantly more coprophenomena (43% vs 28%, p=0.005), significantly less ability of symptom suppressibility (72% vs. 85%, p=0.002), and significantly higher rates of comorbid obsessive-compulsive disorder (23% vs. 10%, p<0.001) and self-injurious behavior (56% vs. 30%, p=0.009).

Conclusions:
FTB is a common comorbidity in patients with TS. Particularly in patients with abrupt onset of so far unknown complex movements and vocalizations, co-occurrence of FTB should be taken into consideration.

P25. Induced Spoonerism and Tourette Syndrome

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Background:
The Gilles de la Tourette syndrome (GTS) is characterized by motor and phonic tics. Although it affects only 20-30% of all GTS patients, coprolalia is probably the best-known phonic tic of GTS. To get a better understanding of this phenomenon, the present study investigated the difference in neural correlates of controlling speech plans between GTS patients and healthy controls, in a situation where we attempted to provoke taboo words by presenting competing speech plans. It has been argued, that speech errors occur when two competing speech plans are activated and the speaker is unable to inhibit the erroneous plan. The involuntary utterances of taboo words belong to speech plans, that are usually suppressed in daily social interaction.

Methods:
25 GTS patients and 25 matched typically developing controls (TDC) participated in the study. Each participant had to undergo a structured interview with a series of questionnaires to assess psychiatric and neurological disorders and to determine the severity of tics in GTS patients. We adapted a previously established EEG version of the SLIP task (Spoonerism of laboratory induced predisposition). A spoonerism is an error in speech, in which corresponding consonants, vowels, or morphemes are switched between two words in a phrase. Here, the presented word pairs were constructed so that when the participants were asked to read words aloud, it could result in either a taboo or a non-taboo word spoonerism. In this way we elicited two competing speech plans, one being correct and one embodying either a taboo or a non-taboo spoonerism. 64-channel EEG was recorded and participants vocalized answers were recorded.

Results and Conclusions:
Behavioral data from the audio recordings showed that spoonerism was rare overall, especially taboo word spoonerism. We found slightly more spoonerisms in the GTS group, with the same number of neutral spoonerisms compared to the TDC group, but with more taboo word spoonerisms. Furthermore, we found a higher number of errors in the GTS group.
The first explorative analysis of the EEG data showed that implicit speech plans for taboo words in the SLIP task are differentially activated in GTS patients compared to TDC participants.

P26. Specific Features of Tics and Stereotypies Interview –

Exploratory Study on a Semi-Structured Interview to estabilish the differential diagnosis between tics and stereotypies

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Background:
The comorbidity between stereoypies and tics is common in children and teenagers. The differential diagnosis between tics and stereotypies can be difficult in patients with autism spectrum disorders although it is very important in terms of the treatment course. In order to assess the difference between tics and stereotypies in this population it was designed a semi-structured interview to clarify the specific features of tics and stereotypies and support the differential diagnosis.

Methods:
The design of the interview was supported by the most recent literature concerning the specific features of tics and stereotypies in order to establish the difference between both movements. The interview was applied to 5 patients with autism spectrum disorder, level 1, and Tourette Syndrome. All patients were diagnosed with Autism Diagnostic Interview – Revised and Autism Diagnostic Observation Scale and Yale Global Tic Severity Scale.

Results and Conclusions:
The results show that the interview can identify the presence of tics and stereotypies in patients with autism spectrum disorders and Tourette Syndrome. This suggests that the interview is sensitive to the presence of tics and stereotypies and can distinguish between both. It will be necessary to extend the number of patients on this sample and also apply the interview to patients with the only diagnosis of autism spectrum disorders, tic disorders and to a control group.

P27. Tourette syndrome poster – What is Tourette syndrome?

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Background:
European clinical guidelines for Tourette syndrome and other tic disorders – version 2.0 Part II: psychological interventions recommend psychoeducation as an initial intervention for all individuals diagnosed with Tourette syndrome (TS). Based on previous created and designed materials at Regional Resource Center for Autism, ADHD and Tourette Syndrome (RRC) to be used in communication when the diagnosis Autism spectrum disorder (ASD) or Attention Deficit Hyperactivity Disorder (ADHD) is concluded, we wanted to design similar material for individuals diagnosed with TS. The purpose of the former materials regarding ASD and ADHD were to provide visual and written support for a review of relevant areas when the diagnose has been confirmed. The aim with the materials in this project is to simplify and standardise communication of the findings and conclusions of an Tourettes diagnosis assessment. The materials contain a « package » including a written introduction to the materials, posters with illustrations and text divided into main areas affected in people with the diagnoses and co-occuring challenges, and further communication/discussion cards belonging to the different areas correponding with the poster. The illustrations in the materials are irrespective of language and cultural background, and the entire material is also produced in several language versions. The former material is free for everyone to use, and has been printed and distributed to all relevant clinics belonging to the South Eastern Regional Health Authority in Norway.

Methods:
The materials concerning ASD and ADHD have been used as a precursor in this project, with the aim to create similar materials adapted to Tourette syndrome.
The work has been led by RRC, and a working group was established consisted of representatives from Child and Adolescent Psychiatric Services at Oslo University Hospital, Vestre Viken Hospital Trust and Akershus University Hospital, Norwegian Tourette Association and Melkeveien Design office. A group of adolescence with Tourette syndrome from the Norwegian Tourette Association has also been involved in the work, and gave valuable suggestions.
The work was based on the diagnostic criteria described by the ICD-10. Experiences from participating clinicians and representative from the Norwegian Tourette association were important to prioritize and elaborate the best illustrations and describing text. The graphic designer involved, was the same person who had designed the previous ASD and ADHD materials. This became very helpful since she knew the background of earlier work.

Results and Conclusions:
The result of the project is qualitative materials developed to be a support and supplement in psychoeducation and communication with patients and family members, presenting the core challenges in Tourette syndrome following a diagnostic assessment.

It is evaluated to make it easier to convey and understand findings – irrespective of language and cultural background.
The material is however not intended to replace a structured psycho-educative approach, but rather be a visual support and supplemental tool in psychoeducation.
The materials contain two posters. One poster shows illustrations and short text about motor and vocal tics. The other poster presenting common co-occurring conditions and challenges prevalent for those with Tourette syndrome. Each illustration and belonging text is also to be found in the cards, called conversation/discussion cards. The cards give the clinicians an opportunity to tailor the communication to each patient, and help the patient to recognize his/her individual symptoms and challenges. The cards are intended to provide a starting point for discussion about the content depicted in each card. The material will be printed in a limited number of copies and distributed to relevant clinics in the region. The materials will also be translated to several languages. The material is free for everyone to use, and can be downloaded from the RCC webpage and www.touretteplakaten.no.

P28. Functional Motor Disorders in childhood and adolescence: an emerging diagnostic and clinical challenge

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Background:
Functional Neurological Disorders (FNDs) represent an emerging challenge also in childhood and adolescence neuropsychiatry. Clinical presentations of these cases are still vaguely characterized and often misdiagnosed in pediatric population. Even if, it represents a very common disorder in the clinical practice, till up the 5% of patients referred in neurological services, there are not yet common and defied diagnostic work up as well as therapeutic strategies mostly for pediatric neurology, causing important delay in early diagnosis and treatments with possible negative outcome and illness chronicization, causing severe disability on patient quality of life.
This retrospective study was aimed to better-characterized Funtional Motor Disorders (FMDs) in a pediatric population:
1) describing FMDs clinical manifestations
2) analyzing clinical and demographic variables (i.e. cognitive and psychiatric profiles; life events)
3) analyzing short-term outcome in a subset of patients during the two pandemic years of follow up.

Methods:
35 FMDs children and adolescents were selected (30F: 5M; age range: 9-18 years old), referred as neurological inpatients of the urban academic neuropsychiatric department of Rome Umberto I Hospital, during a timeframe of 5 years. For each patient, FMDs diagnosis was obtained (DSM-5 criteria) by a neurological diagnostic workout.
As well, an extensive neurocognitive and neuropsychological evaluation was performed (Weschler Intelligence Scale for Children- WISC IV; Adolescent Dissociative experience Scale A-DES); Somatoform Dissociation Questionnaire SDQ-20); Children's Depression Inventory CDI-2; Multidimensional Anxiety Scale for Children MASC 2).
15 out 35 of the described patients were enrolled during the last 2 years of pandemic (2019-2021) and were followed up with a multidisciplinary approach in psychotherapy and physiotherapy.

Results:
1) epidemiological results highlighted FMDs mean age onset of 11,8 years with a prevalence in females (F:M=5:1). Clinical motor symptoms were characterized by hyperkinetic manifestations (60%) with a prevalence of combined pattern with other FNDs, as: PNES (40%), sensitive disorders (45%); weakness (30%) and generalized pain (65%).
Among the motor manifestations the most expressed was a Gait Disorder (50%), Tremor (28%); Dystonia (22%) and Myoclonus/jerks (11%); Tic (5,5%) and Parkinson manifestations (2,8%)
2) Neurocognitive evaluation highlighted a heterogeneous profile between verbal ability (Verbal Comprehension Index- ICV) higher than the perceptual reasoning (Perceptual reasoning Index- IRP) in the 44% of cases. The Psychopathological evaluation

underlined a higher prevalence of Anxiety (MASC2) and Mood Disorders (CDI2) than Dissociative/ Somatoform symptoms (A-DES; DSQ20). Traumatic Life Events and history of family illness were reported in the 65% and 85% of cases, respectively.
3) The early diagnosis and treatment with a multidisciplinary approach was related with a positive outcome in the 80% of patients.

Conclusions:
Hyperkinetic movements, presenting in combined pattern with further comorbid FNDs, were mainly reported in the pediatric population, showing higher prevalence of heterogeneous neurocognitive profiles associated with anxious/depressive symptoms. Traumatic Life events and a family history of illness seem to represent risk factors in the FMDs onset. An early diagnosis represents a clinical challenge to avoid a negative outcome.

P29. Tourette Syndrome and Obsessive-Compulsive Disorder: different neural correlates from a multimodal neuroimaging study in drug-naïve children

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Background:
Tourette syndrome (TS) and early-onset obsessive-compulsive disorder (OCD) are frequently associated and considered to etiologically overlap. However, the nature of this close relationship is largely unknown. Clinical and neuropsychological investigations have offered limited insight as to whether TS and OCD may represent distinct disorders or different phenotypes of a single disease spectrum. To gain further understanding on TS and OCD pathophysiology, we investigated brain and cerebellar structural and functional connectivity in drug-naïve children with TS without comorbidities (TS-pure), OCD and with the comorbid condition of TS+OCD.

Methods:
Drug-naïve children with TS-pure (n=16), TS+OCD (N=14), OCD (N=10), and 11 age-matched controls underwent 3 Tesla magnetic resonance imaging (MRI). We used diffusion tensor imaging to investigate white matter connectivity and resting state MRI to measure the activity of neural networks at 'rest'. White matter structural integrity as indexed through fractional anisotropy (FA) was analyzed in the cerebellar peduncles and in five supratentorial tracts of interest, i.e., cortico-spinal tract, anterior thalamic radiations, inferior longitudinal fasciculus, corpus callosum, and cingulum. Functional connectivity was examined in the following networks: basal ganglia, sensorimotor, cerebellum, frontoparietal, default-mode, orbitofrontal, and salience, while dentate nucleus functional connectivity was assessed as measure of cortico-cerebellar connectivity. All findings were correlated to symptom severity assessed through the Yale Global Tic Severity Scale and Children's Yale-Brown Obsessive-Compulsive Scale.

Results and Conclusions:
Children with TS-pure and TS+OCD showed the same pattern of functional and structural changes, in contrast to both OCD and controls. Conversely, different and peculiar correlates were identified in OCD.
On a structural level, TS-pure/TS+OCD children showed increased FA in all supratentorial tracts and in cerebellar peduncles compared to controls, while OCD exhibited decreased FA. For both TS and OCD, FA in supratentorial tracts was negatively correlated to symptom severity, highlighting the role of white matter organization in symptom expression. On a functional level, the clinical groups significantly differed in the frontoparietal network, which showed reduced activity in TS-pure/TS+OCD and increased activity in OCD, compared to controls. For both clinical groups, the degree of involvement of the frontoparietal network directly correlated to disease severity. Lastly, dentate nucleus functional connectivity revealed differential connectivity patterns between the cerebellum and the prefrontal cortex in respect to controls (reduced in TS-pure/TS+OCD, increased in OCD), while

connectivity in the cerebello-thalamo-cortical circuit was similarly reduced, supporting a functional disconnection between the cortico-striato-thalamic circuitry and the cerebellum in both disorders.
Overall, our findings show different involvement of fronto-parietal and fronto-cerebellar networks in TS and in OCD and reveal differential white matter organization in the two disorders. We point to the conceptualization of TS+OCD as a particular subtype of TS while suggesting that OCD is characterized by independent pathophysiological mechanisms.

P30. Compulsive Body Spaces: Confusions and rationalisations

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Background:
Compulsions are an important but still only superficially understood symptom group of the Tourette syndrome symptomatology. Especially compulsions that are bound to certain objects (e.g. tooth brushes) and spaces (e.g. one's living room) tend to be more confusing for people with Tourette's than simpler tics. This paper attempts to answer why current (and historical) medical and clinical research in Tourette's cannot clear many of these confusions.

Methods:
The methodology of this paper is based on a (1) study and in-depth review of the methodology and invocation of causality and correlation of a broad range of papers on Tourette symptomatology, phenotype studies, and situatedness in the neurological, neuropsychiatric, and psychological research in Tourette's, and (2) on in-depth, qualitative interviews of 15 people with Tourette's focussing on their sense-making narratives of being medicalised and receiving clinical treatment and therapy.

Results and Conclusions:
The analysis suggests that people with Tourette's understanding and knowledge of their compulsions goes through four transformations. These transformations highlight that the neurological, neuropsychiatric, and psychological research in Tourette's can only partially take away the confusions of people with Tourette's around compulsions. The analysis also shows how the onto-epistemological structures that govern these studies play an important part in impasse in the study of compulsions as such. This study then suggests how the medicalisation of compulsions steers people away from asking certain questions that would help them understand their compulsive movements and body. It also implies the necessity of integrating the bodily surroundings as fundamental component to future Tourette's research.

P31. A masked, controlled trial of median nerve stimulation for Tourette syndrome

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Background:
In mid-2020, the Stephen Jackson lab published intriguing results showing that rhythmic—but not arrhythmic—stimulation of the median nerve (MNS) entrained EEG power at the same frequency. Rhythmic MNS reduced tic severity in Tourette syndrome (TS). However, no control condition was tested and stimulation blocks lasted only 1 minute.

Objective:
This study tests the hypotheses that tic improvement is specific to rhythmic stimulation, which alone entrained cortical activity, and that it lasts after MNS ends.

Methods:
Detailed methods were pre-registered at DOI 10.17605/OSF.IO/8JTEP. People age 15-64 with TS have 2 study visits, one for rhythmic and one for arrhythmic MNS, in random order. Subjects and staff are blind to order, and video raters are additionally blind to block order and to stimulation on versus off.

Results:
30 of a planned 32 participants have completed both visits, and blinded tic counts are available for 15 of these. Enrollment and blinded ratings continue. On 53 of 60 visits, discomfort was rated as none or minimal. 23 participants had at least one visit rated "much" or "very much improved," by self ratings. Investigator ratings had 24 participants with at least one visit rated "much" or "very much improved." Ten of 30 participants rated at least one visit as "complete or nearly complete remission of symptoms" and 17 more rated at least one visit as "decided improvement, partial remission." Urge severity decreased during stimulation blocks, but similarly with rhythmic and arrhythmic stimulation. 7 participants rated R>A, 14 rated A>R. The investigator rated 12 participants as R>A, and 10 as A>R. Masking was effective. In blind-rated participants, tics improved in 10 of 15 with rhythmic and in 11-13 of 15 with arrhythmic stimulation.

Conclusion:
MNS was well tolerated, and some participants had remarkable symptom improvement, but in this preliminary analysis, rhythmic stimulation did not outperform arrhythmic stimulation.

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P32. Network localization of tics: Evidence from coordinate and lesion network mapping

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Background:
Neuroimaging studies implicate widespread cortical and subcortical abnormalities in Tourette Syndrome (TS), however, due to the neuroanatomical heterogeneity of these findings, it remains unclear which brain regions are key to TS symptomatology. The aim of this study was to localize a network of brain regions associated with tics, utilising published coordinates of neuroimaging abnormalities in patients with TS and cases of tics caused by focal brain lesions.

Methods:
We used two network localization techniques termed 'coordinate network mapping' and 'lesion network mapping', which leverage a large dataset of normative resting-state scans (n = 1000), to assess whether structural abnormalities in idiopathic TS and tic-inducing lesions, respectively, map to a shared network. This allowed us to identify a neural network associated with idiopathic and secondary tic symptoms, as well as commonalities between these networks.

Results and Conclusions:
Our analyses showed that seemingly heterogeneous structural neuroimaging findings in patients with TS map to a common network, involving structures within the cortico-basal-ganglia-thalamo-cortical circuit. We further demonstrated that this network identified in TS and a network for tic-inducing lesions converge in the thalamus, caudate, putamen, external segment of the globus pallidus (GPe) and occipital lobe, revealing a sub-network which may mediate tics as shared symptoms between idiopathic and acquired tics.

P33. Further characterisation of the rat model of Tourette-related striatal disinhibition: in vivo electrophysiological and behavioural studies

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Background:
Tourette's syndrome, characterised by tics, has been linked to reduced GABAergic inhibition, so-called neural disinhibition, in the striatum (Jackson et al.,2015,*Trends CognSci*). Dorsal striatal microinfusion of GABA-A antagonists like picrotoxin produces tic-like movements in rodents and primates (Bronfeld et al.,2013,*FrontSystNeurosci*; Klaus&Plenz,2016,*PLoSBiol*.)

Methods:
Here, we infused young adult male Lister hooded rats unilaterally with picrotoxin (300ng/0.5ul) or saline (0.5ul) into the anterior dorsal striatum and recorded electrophysiological and behavioural measurements to characterise further the neuro-behavioural impact of striatal disinhibition.

Results:
Electrophysiological recordings under isoflurane in the striatum showed that picrotoxin disinhibition, apart from evoking large LFP spike-wave discharges, with sharp multi-unit bursts during the negative spike, markedly enhanced burst firing, similar to findings in prefrontal cortex and hippocampus (Bast et al.,2017,*BrJPharamcol*). In freely moving rats, striatal picrotoxin reliably induced tic-like contralateral forelimb movements. Automated photobeam measurements revealed that striatal disinhibition increased locomotor activity and fine motor counts. Fine motor counts showed a similar time course to tic-like movements, suggesting an automated method to quantify these movements. Prepulse inhibition (PPI) of acoustic startle depends on the striatum and is disrupted in Tourette's (Swerdlow,2013,*NeurosciBiobehavRev*). Striatal disinhibition in rats did not affect PPI, but tended to reduce startle during the first test block, before habituation led to similarly low startle responses in both infusion conditions (infusion-X-block: $F(2,26)=3.2$, $p=0.058$).

Conclusions:
Our findings confirm that striatal disinhibition causes marked spike-wave discharges in striatum and tic-like movements. In addition, such disinhibition markedly enhances striatal burst firing and increases locomotor activity, but does not reproduce PPI deficits seen in Tourette's.

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