Received: 4 December 2025 | Accepted: 15 May 2026

DOI: 10.1002/imhj.70102

RESEARCH ARTICLE

WILEY

Parental behaviors supporting child development in mothers of children with sex chromosome trisomies

Laura Cordolcini[1,2] | **Beatrice Riva**[1] | **Paola Zanchi**[3] | **Domenica Mastromattei**[4] | **Paola Francesca Ajmone**[4] | **Maria Antonella Costantino**[4] | **Laura Zampini**[1]

[1]Department of Psychology, University of Milano-Bicocca, Milan, Italy

[2]Department of Statistics, Computer Science, Applications (DiSIA), University of Florence, Florence, Italy

[3]Department of Psychology, Catholic University of the Sacred Heart, Milan, Italy

[4]Child and Adolescent Neuropsychiatric Unit, Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, Milan, Italy

Correspondence
Laura Zampini, Department of Psychology, University of Milano-Bicocca, Piazza dell'Ateneo Nuovo, 1 - 20126, Milan, Italy.
Email: laura.zampini1@unimib.it

Abstract

Sex chromosome trisomies (SCTs) are genetic conditions caused by the presence of an additional sex chromosome. While recent studies have focused on analyzing the early competencies of children with SCTs, relatively few have investigated aspects of parent-child interaction. No studies have yet examined how parents support the development of children with SCTs. This study aims to (1) identify differences in supportive parenting behaviors between mothers of children with SCTs and mothers of typically developing (TD) children, and (2) observe these behaviors longitudinally at 8 months (T1) and 24 months (T2). Participants included 36 Italian mother-child dyads (19 with SCTs and 17 TD). At both T1 and T2, ten-minute semi-structured play interactions were video-recorded and coded using PICCOLO. At 8 months, mothers in the SCT group demonstrated fewer responsive and teaching behaviors than mothers in the TD group, and exhibited fewer encouraging behaviors at 24 months. However, longitudinally, the same mothers exhibited significantly more responsive and teaching behaviors at T2 than at T1. In conclusion, while awareness of their children's condition, or differences in children's behavior, may affect how mothers interact with their children with SCTs, these mothers also exhibit parenting skills that could benefit from targeted interventions to support their children, who are more likely to exhibit developmental delays.

KEYWORDS

child-parent interaction, chromosomal aneuploidy, longitudinal, PICCOLO

1 | INTRODUCTION

Sex chromosome trisomies (SCTs) are genetic conditions characterized by an extra sex chromosome, which defines a karyotype of 47 chromosomes. Three conditions have been identified: triple X (XXX, in females), Klinefelter syndrome (XXY, in males) and XYY syndrome (XYY, in males) (Skuse et al., 2018). These conditions differ from other genetic trisomies (e.g., Down syndrome), as the effects of SCTs are mild, at both phenotypic and cognitive levels, although some developmental differences may become more pronounced as children get older (van Rijn et al., 2023). For

this reason, SCTs are frequently undetected without prenatal genetic testing, making it difficult to determine their exact prevalence (Abramsky & Chapple, 1997). Recent estimates indicate that triple X occurs in approximately 1 in 1000 female births, XYY syndrome in approximately 1 in 1000 male births (Messer et al., 2013; Ross et al., 2009), and Klinefelter syndrome in approximately 1 in 750 births (Blackburn et al., 2025; Skuse et al., 2018).

From a phenotypical point of view, these conditions lead to a developmental trajectory that is largely consistent with the typical one. The neuropsychological profile of children with SCTs is characterized by intellectual abilities within the normal range and uncommon intellectual impairments, even if their developmental quotient yields a score difference compared to typically developing children (Leggett et al., 2010). This discrepancy is mainly due to specific difficulties in the language domain. In fact, 70%–80% of children with SCTs show some form of language problems or impairment (St John et al., 2019; Urbanus et al., 2022; Zampini, Provera et al., 2025), both in comprehension and in expressive language (Leggett et al., 2010; van Rijn et al., 2023).

Thanks to prenatal diagnosis, which enables the identification of children with SCTs before birth, it is possible to study their developmental trajectories from the earliest stages of life. This has emphasized how challenges in language development arise very early on. At 8 months, early preverbal skills such as babbling and gaze frequency are notably lower in children with SCTs compared to typically developing children (Zampini et al., 2021). In addition, one-year-old children with SCTs showed significantly lower receptive and expressive vocabulary size than the control group (Urbanus et al., 2022). At 18 months, children with SCTs show a significantly delayed speech sound development pattern rather than an atypical one (Capelli et al., 2023), and a significantly poorer linguistic skills in preverbal (babbling and gestures), verbal (Zampini, Lorini et al., 2022), and emergent syntactic abilities (Zampini et al., 2018). These difficulties persist as children grow up, as vocabulary size is significantly smaller in children with SCTs at 24 months (Capelli et al., 2022). Furthermore, preschool children with SCTs exhibit significant deficits in expressive semantic skills (Urbanus et al., 2022), pragmatic language (Urbanus et al., 2023), narrative competence (Zampini, Silibello et al., 2022), expressive morpho-syntax (Capelli et al., 2022), and a different prosodic pattern in their speech (Zanchi, Provera et al., 2024).

While several recent studies have focused on analyzing the early competencies of children with SCTs, relatively few have investigated aspects of parent-child interaction. This investigation of the interactive context of development is particularly important, as adult-child interaction plays a fundamental role in children's linguistic and cognitive development, as demonstrated in studies on typical and atypical development (Bornstein et al., 2020; Endevelt-Shapira et al., 2024; Warren & Brady, 2007). In fact, there is substantial evidence that exposure to a stable and highly responsive parenting style throughout early childhood is associated with a wide range of benefits for children's language, cognitive, emotional and social development (Jeong et al., 2021; Warren & Brady, 2007).

Key Findings/Practitioner Points

- Mothers of infants with Sex Chromosome Trisomies (SCTs) display reduced developmentally supportive behaviors compared to mothers of typically developing children.
- Maternal differences appear to be influenced more by the awareness of the child's prenatal SCT diagnosis than by the child's current developmental skills.
- The observed maternal supportive behaviors improve significantly between 8 and 24 months, highlighting that parents of children with SCTs possess adequate resources and are suitable targets for early intervention to foster functional interactions.

Statement of relevance to infant and early childhood mental health

This research addresses infant mental health by examining parent-child interaction in the context of sex chromosome trisomies (SCTs), a developmental vulnerability factor. It substantially contributes by suggesting that maternal awareness of the prenatal diagnosis, rather than current delay, diminishes early supportive behaviors. These findings highlight the need for targeted, early, family-centered interventions to strengthen parental resources and encourage positive interactions, thereby acting as a protective factor for children with SCTs.

Diversity and Anti-Racist Scholarship

All participants were Italian and characterized as white of non-Hispanic origin.

To date, research on the interactive context in cases of SCTs has primarily focused on maternal linguistic input. At 8 months, child-directed speech addressed to children with SCTs is characterized by a lower pitch, less marked melodic contours, shorter final syllable duration (Provera et al., 2022) and by the use of more directives and questions, and less affect-salient speech compared to mothers of typically developing children (Zampini et al., 2020). At 24 months, these differences become thinner, as the input addressed to 24-month-old children with SCTs appears to be as rich and complex as that addressed to typically developing peers and tailored to the linguistic competence of the children rather than their diagnosis (Zanchi, Sacco et al., 2024).

To date, to the best of our knowledge, no studies have specifically investigated any aspects of parent-child interaction in the population of children with SCTs. Therefore, the aim of the present study is to partially fill this gap by investigating parental behaviors that support children's development in parent-child dyads with an SCT.

It is particularly interesting to analyze parent-child interaction within a population such as SCTs, in which developmental trajectories can be atypical, but only slowed down in the early stages compared to typical development. This enables us to investigate whether parents' awareness of their children diagnosed prenatal risk condition changes their behavior when interacting with them, even when the differences from typical development are not yet evident.

Parental behaviors that support children's development refer to parenting dimensions that facilitate children's development and adaptation over time (Roggman & Innocenti, 2008), both in typical and atypical conditions, such as prematurity, autism and cerebral palsy (Crowell et al., 2019; De Clercq et al., 2022; Treyvaud et al., 2009). Specific parenting dimensions have been identified as predictors of positive outcomes. In particular, emotional warmth and sensitivity, responsiveness and behaviors that promote autonomy and provide cognitive stimulation have been associated with secure attachment, and better socio-emotional, cognitive, and linguistic development (Jeong et al., 2021; Knauer et al., 2019; Landry & Smith, 2011; Petersen et al., 2017; Santana-Ferrándiz et al., 2025). Evaluating parental behaviors associated with children's developmental outcomes is essential for designing interventions to promote early childhood development (Hutchon et al., 2019). To this end, the Parenting Interactions with Children: Checklist of Observations Linked to Outcomes (PICCOLO) was developed by Roggman and collaborators (2013). This tool is suitable for observing parents interacting with children following both typical and atypical developmental trajectories (Innocenti et al., 2013, 2023). Recent studies employing the PICCOLO have begun to elucidate how developmental supportive parenting behaviors may be differentially influenced by the presence of atypical developmental trajectories. For instance, parents of toddlers with neurodevelopmental disabilities tend to exhibit less responsive behaviors and teaching behaviors, particularly with children with a moderate to severe developmental delay (Castagna et al., 2024; Vilaseca et al., 2020).

In light of these results, the first aim of the present study is to highlight possible differences between parental behaviors supporting child development in parents of children with SCTs identified before birth and parents of typically developing children. The second aim is to longitudinally observe the trend of parental behaviors supporting child development as children's age increases at two time points: 8 months and 24 months. The age of 8 months was chosen to observe parents interacting with their children in the preverbal stage, when the differences in the skills exhibited by children with SCTs and typically developing children might be milder and not salient, and the age of 24 months was chosen to examine the differences in parental behaviors when the linguistic delay might become more evident in the group of children with SCTs.

2 | METHODS

2.1 | Participants

The participants were 36 Italian mother-child dyads. The decision to focus on maternal behaviors rather than maternal and paternal behaviors was based on the fact that, in most cases, the children came to the study with only their mothers. Nineteen 8-month-old children ($M = 8.24$, $SD = .56$, range = 7–9) with SCTs (seven females with triple X, seven males with Klinefelter syndrome, and five males with XYY syndrome) and their mothers participated in the study. Additionally, 17 infants (7 females) with typical development (TD) of the same age ($M = 8.17$, $SD = .57$, range = 7–9) and their mothers were recruited. The same groups of dyads were recalled when the children were 24 months old (SCT group: $M = 24.41$, $SD = .73$, range = 24–27; TD group: $M = 24.06$, $SD = .66$, range = 23–25). Given the rarity of the condition and the complexity of the longitudinal design, a convenience sample was used. The sample size aligns with that of previous studies using the same methodology and tools with atypical populations (Montirosso et al., 2025).

Children with SCT were enrolled through the Child and Adolescent Neuropsychiatric Unit at the Foundation IRCCS Ca' Granda Ospedale Maggiore Policlinico (Milan, Italy). All participants had received a prenatal diagnosis of SCT, confirmed via amniocentesis or chorionic villus sampling. Following the prenatal diagnosis, each mother

was invited to receive genetic counselling from an experienced geneticist at the same institution. The diagnosis was never communicated by phone. Genetic counselling was offered promptly after the cytogenetic results were disclosed, before the 18th week of pregnancy. During the session, parents were informed about the potential developmental implications of SCTs for their child. Among the issues discussed, a specific time was always dedicated to describing the higher risk that these children face of developing language delays and impairments. The TD participants were recruited via a written invitation sent to parents based on birth records provided by the municipality of Milan (Italy). All participating children (in both the SCT and TD groups) demonstrated adequate auditory and visual functioning and showed no signs of neurodevelopmental disorders at the beginning of the study or at 24 months (some children showed a limited vocabulary size, but no signs of autism spectrum disorders at this stage). The Ethics Committee of the University of Milano-Bicocca approved the study. Written informed consent was obtained from the children's parents before their inclusion in the study.

2.2 | Procedure

Participants were welcomed into a quiet, comfortable room and given some time to settle in. At both 8 (T1) and 24 months (T2), children and their mothers were asked to interact during a semi-structured play session lasting 10 min. The instruction was to play as they would have normally done at home. At T1, the dyads were provided with a set of rubber toys, two rattles, a peek-a-boo box, and three touch-and-feel books. At T2, participants were provided with a toy kitchen set, a doll, and a farm play set with animals and figurines representing human characters. The sessions were conducted in the Infant Observation Laboratory at the Department of Psychology of the University of Milano-Bicocca. All the sessions were video recorded for later coding.

Mothers were also asked to complete a questionnaire about their children's language competence, the Italian version of the MacArthur-Bates Communicative Development Inventories (Il Primo Vocabolario del Bambino, PVB; Caselli et al., 2015), to assess their child's communication and language development. This instrument evaluates expressive and receptive language abilities by asking parents to report the words their child understands and produces, as well as the child's use of gestures and other communicative behaviors. The versions for infants aged 6 to 18 months and the one for toddlers aged 18 to 30 months were used at the two time points, respectively. For the present study, the number of words comprehended (PVB word comprehension) and words spontaneously produced (PVB word production) was taken into consideration at T1, and the number of words spontaneously produced at T2. Higher scores on the inventory reflect a more advanced language development. Additionally, the Griffiths Mental Development Scales (Griffiths et al., 2007) were administered individually by a developmental psychologist to each child to assess their developmental quotient (DQ) at both time points.

We also evaluated the parenting stress experienced by mothers, as measured by the 36-item Parenting Stress Index short form (PSI) (Abidin, 1995; Guarino et al., 2008). This instrument consists of three subscales: parental distress, dysfunctional parent-child interaction, and difficult child. In the present study, we considered the total stress index (PSI), which is calculated by summing the scores across the three subscales and converting them into percentiles.

2.3 | Coding

The mother-child interaction was coded using the Italian version of PICCOLO (Montirosso & Giusti, 2022; Montirosso et al., 2023). The PICCOLO is a tool designed to measure parental behaviors supporting children's development. It consists of 29 items evaluated on a 3-point scale: 0 (absent, behavior not observed), 1 (behavior present to a minor or brief extent), and 2 (clearly present, strong or frequent behavior). These ratings are based on a 10-minute video recording of parent–child interaction and can be used to code interactions with children aged 4–47 months. The items are grouped into four domains, each reflecting a different dimension of parenting:

1. Affection (7 items) reflects expressions of warmth, physical closeness, and positive emotional interactions with the child (e.g., demonstrates emotional warmth);
2. Responsiveness (7 items) captures the parent's sensitivity and timely responses to the child's cues, emotions, language, interests, and behaviors (e.g., attends to the child's activities);
3. Encouragement (7 items) encompasses active support for the child's independence, exploration, curiosity, creativity, and play (e.g., encourages the child to act autonomously);
4. Teaching (8 items) pertains to shared play and interactions that promote cognitive stimulation, learning, and exploration.

Videos were coded by five psychologists and research assistants after completing a specific training and reaching an interrater agreement of at least 80% with the expert

coder (L.C.), in accordance with the criteria outlined in the PICCOLO user's Guide (Roggman et al., 2013). To assess coding reliability, eight randomly selected videos for each time point were independently coded by all the coders. We used intra-class correlation coefficients (ICC) to assess reliability (95% confidence interval in brackets). Regarding the coding of interactions at 8 months of age, the ICC was .97 [.93 to .99] for affection, .89 [.74 to .97] for responsiveness, .87 [.67 to .97] for encouragement, and .94 [.86 to .98] for teaching. Regarding the coding of interaction at 24 months of age, the ICC was .98 [.95 to .99] for affection, .97 [.93 to .99] for responsiveness, .93 [.82 to .98] for encouragement, and .88 [.69 to .97] for teaching. Disagreements were resolved by consensus between the coders.

2.4 | Statistical analysis

Due to the small size of the groups, non-parametric tests were run using IBM SPSS Statistics version 29.0.1.0. Preliminary analyses (Mann-Whitney test for independent groups) were conducted to detect any differences between groups (SCT vs TD) in maternal (age and education) and child (age, DQ, PVB word comprehension, PVB word production) characteristics. To address the first aim of the study, the Mann-Whitney test was performed to measure between-group differences in maternal supportive behaviors, as measured by PICCOLO, at both T1 and T2. Non-parametric correlation analyses were then performed to explore whether maternal supportive behaviors were significantly related to the mothers' or children's characteristics. Finally, Wilcoxon signed-rank tests were conducted to highlight any changes in maternal behaviors from T1 to T2 within each group. For all the statistical analyses, a p-value of .05 or less was considered statistically significant. The effect size is reported using the rank-biserial correlation coefficient (r), with values of 0.10 to < 0.30, 0.30 to < 0.50, and ≥ 0.50 interpreted as small, medium, and large, respectively.

3 | RESULTS

3.1 | Description of the participants in the two groups

Descriptive statistics of maternal and children's characteristics in the two groups are reported in Table 1. Maternal age was significantly higher in the SCT group than in the TD group ($Z = -2.86$, $p = .004$, $r = .48$), whereas no significant differences were found in the number of years of education. Regarding parenting stress, no significant differences in PSI scores were found between the two groups of mothers at either 8 or 24 months.

The children in the two groups differed in their DQ with children with SCT reaching a significantly lower score than TD children, at both T1 (SCT: $M = 96$; TD: $M = 109$; $Z = -3.78$, $p = < .001$, $r = .63$) and T2 (SCT: $M = 98$; TD: $M = 112$; $Z = -3.31$, $p = < .00$; $r = .55$). No significant differences were found in linguistic competence at T1, considering both PVB comprehension and production, whereas, at T2 a significant difference between groups

TABLE 1 Participants' description and comparison (Mann–Whitney test) between groups.

	TD		SCT				
	M	*SD*	*M*	*SD*	*Z*	*p*	*r*
Mothers							
Age (in years)	34.35	4.83	38.26	3.30	−2.86	.004	.48
Years of education[a]	16.94	1.71	15.63	3.06	−1.02	.307	.17
Parenting Stress Index—T1	29.00	14.04	31.84	24.56	− .19	.864	−.03
Parenting Stress Index—T2	24.67	17.27	38.81	30.44	−1.13	.264	−.20
Children							
Age (in months)—T1	8.24	.56	8.16	.50	−.472	.637	.08
Age (in months)—T2	24.06	.66	24.58	.96	−1.59	.113	.27
DQ[b]—T1	109.47	8.65	96.37	8.65	−3.78	<.001	.63
DQ[b]—T2	112.00	5.30	98.42	16.44	−3.31	<.001	.55
PVB word comprehension[c]—T1	25.47	27.98	19.71	19.00	−.19	.852	.03
PVB word production[c]—T1	.18	.53	.16	.50	−.12	.908	.03
PVB word production[c]—T2	256.50	198.36	105.19	106.28	−2.49	.013	.42

[a]In the Italian education system: High school diploma (13 years), Bachelor degree (16 years), Master degree (18 years).
[b]Assessed by the Griffiths Mental Development Scales.
[c]Assessed by the Italian version of the MacArthur-Baters CDI.

TABLE 2 Comparison (Mann–Whitney test) of maternal supporting behaviors coded with PICCOLO between groups at T1.

	TD		SCT				
	M	*SD*	*M*	*SD*	*Z*	*p*	*r*
Affection—T1	11.29	2.36	10.68	2.54	−.658	.511	.11
Responsiveness—T1	11.82	2.378	9.05	2.88	−2.812	.005	.47
Encouragement—T1	9.35	1.90	8.84	1.89	−.870	.384	.15
Teaching—T1	8.29	1.61	7.05	1.43	−2.238	.025	.37

TABLE 3 Comparison (Mann–Whitney test) of maternal supporting behaviors coded with PICCOLO between groups at T2.

	TD		SCT				
	M	*SD*	*M*	*SD*	*Z*	*p*	*r*
Affection—T2	11.50	2.81	11.84	1.46	−.424	.672	.07
Responsiveness—T2	11.69	2.06	11.84	1.89	−.135	.893	.02
Encouragement—T2	9.50	2.37	8.84	1.39	−2.103	.036	.36
Teaching—T2	9.37	.98	9.84	1.39	−.892	.373	.15

was detected in PVB word production (SCT: $M = 105$; TD: $M = 257$; $Z = -3.33$, $p = < .001$, $r = .55$), resulting higher in the TD group than in the SCT group.

3.2 | Differences between groups in the parental behaviors supporting children's development

With reference to the possible differences between SCT and TD groups in maternal behaviors as measured by PICCOLO, as reported in Tables 2 and 3, the Mann-Whitney test revealed significant differences between groups in PICCOLO domains, at both T1 and T2. In general, mothers of children with SCTs exhibit fewer behaviors that support their children's development (see Figure 1). When the children were 8 months old, the mothers in the SCT group showed significantly less responsive ($Z = -2.812$, $p = .005$, $r = -.47$) and teaching behaviors ($Z = -2.238$, $p = .025$, $r = .37$) compared to mothers in the TD group. Conversely, when the children were 24 months old, the mothers in the SCT group showed significantly fewer encouraging behaviors ($Z = -2.103$, $p = .036$, $r = .36$).

Since the two groups differed in some maternal and child variables, we ran Spearman's correlation analyses to assess whether parental behaviors supporting children's development were significantly associated with maternal characteristics (i.e., age, education and parenting stress) and children's skills (i.e., DQ, PVB comprehension, and PVB production). At 8 months, no significant correlations were found between developmentally supportive parenting behaviors and maternal age (all $\rho s < .29$; all $ps > .23$) or education (all $\rho s < .29$; all $ps > .26$), except for a positive correlation within the SCT group between maternal age and affection behaviors ($\rho = .58$; $p = .009$). No significant associations with parenting stress emerged either (all $\rho s < -.37$; all $ps > .12$). Additionally, no significant correlations emerged between supportive parenting behaviors and the children's DQ (all $\rho s < .32$; all $ps > .18$), PVB comprehension (all $\rho s < .36$; all $ps > .19$) and PVB production (all $\rho s < .30$; all $ps > .25$) in the two groups.

Similarly, at 24 months, no significant associations were observed between developmentally supportive parenting behaviors and either maternal age (all $\rho s < .26$; all $ps > .33$) or education (all $\rho s < .41$; all $ps > .12$). No significant relationships with parenting stress emerged either (all $\rho s < -.37$; all $ps > .12$), except for a negative correlation within the SCT group between PSI score and PICCOLO encouraging score ($\rho = -.61$; $p = .012$), highlighting that mothers of children with SCTs reporting higher stress levels showed lower encouraging behaviors. No significant associations were found between developmentally supportive parenting behaviors and the children's DQ (all $\rho s < .24$; all $ps > .32$) or PVB production (all $\rho s < .32$; all $ps > .25$) in the two groups of participants.

3.3 | Longitudinal trend in the parental behaviors supporting children's development

For what concerns the trend of maternal behaviors as measured by PICCOLO at T1 and T2, Wilcoxon signed-rank test (see Table 4) indicated that mothers in the SCT group showed significantly more responsive behaviors at T2 compared to T1 ($Z = -3.188$, $p = .001$, $r = .80$). Furthermore, the same mothers showed significantly more teaching behaviors ($Z = -3.561$, $p < .001$; $r = .89$) at T2 compared to T1. Similarly, the mothers in the TD group showed

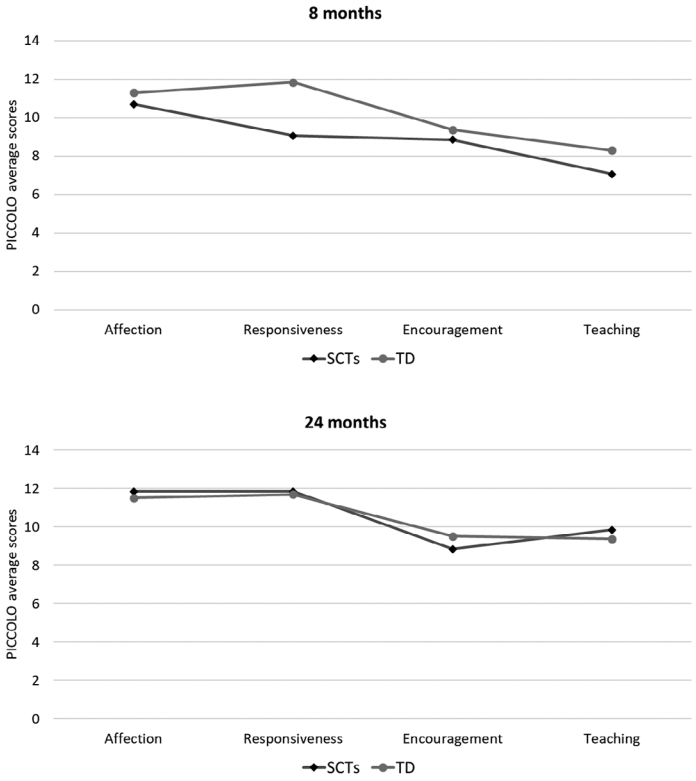

FIGURE 1 Parental supporting behaviors, as assessed by PICCOLO, in the two groups at T1 and T2.

TABLE 4 Comparison (Wilcoxon signed-rank test) of maternal supporting behaviors coded with PICCOLO at the two different time points within each group.

	T1		T2				
	M	*SD*	*M*	*SD*	*Z*	*p*	*r*
TD							
Affection	11.29	2.36	11.50	2.81	−.95	.340	.26
Responsiveness	11.82	2.37	11.69	2.06	−.08	.93	.02
Encouragement	9.35	1.90	9.50	2.37	−.85	.40	.26
Teaching	8.29	1.61	9.37	.98	−2.42	.015	.62
SCT							
Affection	10.68	2.54	11.84	1.46	−.163	.102	.04
Responsiveness	9.05	2.88	11.84	1.89	−3.19	.001	.80
Encouragement	8.84	1.89	8.84	1.39	.00	1.00	.00
Teaching	7.05	1.43	9.84	1.39	−3.561	<.001	.89

more teaching behaviors ($Z = -2.43$, $p = .015$, $r = .62$) at T2 than at T1; no differences emerged in the other behaviors supporting children's development from T1 to T2.

4 | DISCUSSION

This study aimed at identifying potential differences in supportive parental behaviors, as assessed by the PICCOLO, between mothers of children with SCTs and mothers of TD children. Additionally, it aimed to evaluate the developmental trajectory of these maternal supportive behaviors from 8 months to 24 months of age, in both groups.

The two groups of participants were matched for chronological age. No differences emerged in the mothers' level of education or in the children's word comprehension or production at the 8-month stage. However, significant differences emerged between the groups in maternal age (higher in the SCT group) and developmental quotient (higher in TD children). These differences were expected, as maternal age is a risk factor for SCTs (Blackburn et al., 2025; Harvey et al., 1990) and children with SCTs usually exhibit a lower developmental profile compared to

TD children, while remaining generally within the average range (Urbanus et al., 2022; Zampini, Lorini et al., 2025). Therefore, these differences align with expectations for the population of children with SCTs. No significant differences were found in maternal parenting stress at both 8 and 24 months of age, although previous studies highlighted higher levels of parenting stress in mothers of children with SCTs, especially considering parent-child dysfunctional interaction (Lorini et al., 2022).

When comparing the groups with a specific focus on supportive maternal behaviors, the mothers of 8-month-old children with SCTs showed significantly less responsive and teaching behaviors than mothers of TD children, with a medium effect size. Also, the same mothers showed significantly fewer encouraging behaviors (medium effect size) when their children were 24 months old. This is in line with previous research (Castagna et al., 2024), which highlights that the presence of mild/borderline or severe developmental delay in children is associated with fewer responsive and teaching behaviors in mothers compared to mothers of TD children. As these differences were not associated with the developmental quotient of the children or with their linguistic competence (in comprehension and production), we could hypothesize that the maternal awareness about the child's genetic condition, which could be a vulnerability factor for the emergence of an atypical developmental trajectory (Kuiper et al., 2022; Urbanus et al., 2020; van Rijn et al., 2023), can influence the developmental supportive behaviors that mothers address to their children. In other words, it is possible that mothers' attitudes are influenced by how the diagnosis is communicated, leading them to expect some delays or difficulties in their children's developmental trajectories and to adopt a less supportive interacting style. However, it is also possible that this attitude stems from early differences in nonverbal communication skills in children, in terms of vocalizations, gestures and eye contact with their communication partner, since previous studies showed a significantly lower production of gazes directed at the adult and fewer preverbal utterances in children with SCTs (Zampini et al., 2021). Reduced frequency of eye contact with the adult and lower output of preverbal utterances may affect parent-child interaction, as parents have fewer opportunities to capture their child's attention and encourage them to vocalize. Consequently, differences observed in children's early communication may influence parents' supportive behavior.

It is interesting to note that the differences in maternal supportive behaviors seem to diminish as the child gets older. The longitudinal observation of supportive maternal behaviors shows that mothers in the SCT group exhibit an improvement in the number of responsive and teaching behaviors from 8 to 24 months, both with a large effect size. A similar pattern in teaching behaviors (large effect size) was also detected in mothers of the TD group. These results showed that the trajectories of maternal supportive behaviors in mothers of children with SCTs follow a typical pattern, adapting to the progressive increase in their children's skills as occurs in mothers of TD children.

Different behaviors on the part of mothers at eight months were expected, given that studies on maternal input also highlighted how the child-directed speech addressed to children with SCTs is influenced by the awareness of the children's potential difficulties and the children's lower preverbal communicative skills, exposing children to a linguistic environment that is less supportive of their language development (Provera et al., 2022; Zampini et al., 2020). While these differences seem to disappear in the maternal input directed at 24-month-old children (Zanchi, Sacco et al., 2024), the present study suggests that some differences persist in terms of mothers' tendencies to encourage their children during play interactions. However, it should be noted how parental supportive behaviors increase from 8 to 24 months of age in mothers of children with SCTs and how the differences with TD mothers are less evident when the children are 24 months old. In addition, it is important to highlight that the only significant relationship between parenting stress and supportive maternal behaviors was identified at 24 months, specifically among mothers of children with SCTs, and only concerning encouraging behaviors. This association could highlight the lesser tendency of mothers with higher levels of parenting stress to encourage their children during interactions.

Another noteworthy finding is that no differences between groups were observed in affectionate behaviors at both 8 and 24 months, suggesting that the mother-child affective relationship is little affected by awareness of the SCT's condition or children's communicative skills. A similar result was found in Castagna et al.'s study (Castagna et al., 2024), which showed that the presence of an atypical trajectory was not associated with differences in affectionate behaviors, even among mothers of children with severe developmental disabilities.

4.1 | Clinical implications

The results of the present study highlight the need for specific parental support in cases of SCTs, aimed at promoting parental behaviors that support child development from the early stage of growth. In line with previous research showing that a specific intervention targeted at mothers can contribute to modifying their behaviors supporting development (Montirosso et al., 2025), this approach could be seen as a protective factor and may function as an

indirect support strategy to improve children's development in cases of SCTs. Furthermore, parents of children with SCTs can be a good target for such an intervention, as they naturally show some adequate and supportive resources, and they show a spontaneous improvement in their interaction with their children as they grow up. A specific intervention could facilitate the emergence of these resources from the earliest stages of growth, contributing to the construction of an early developmental supportive environment.

4.2 | Study limitations and future perspectives

This study is not without limitations. Firstly, the sample of children included in the present study is small. However, our sample is uniform with respect to children's age and prenatal diagnosis of SCTs, thereby reducing potential bias arising from differences in diagnosis timing and age-related developmental skills. Secondly, the PICCOLO does not account for children's willingness to interact with their mothers, thereby preventing this variable from being controlled for. Thirdly, parenting behaviors can vary significantly across communities. In particular, cultural perspectives may influence observed patterns when parenting a child with potential vulnerabilities. Therefore, the study lacks cross-cultural validity due to possible differences in patterns of parent-child interaction.

For all these reasons, future studies should consider children's behavior, temperament, and early communicative skills to control for the possible impact of these characteristics on maternal behaviors.

Furthermore, future research should explore other aspects of mother-child interaction, such as maternal touch behaviors, to enrich the understanding of mother-child relationships in the context of SCTs. Finally, it would be of interest to also include fathers, who are increasingly assuming a more prominent role in child education, growth, and developmental support (Kaźmierczak & Karasiewicz, 2019; Parker & Wang, 2013), and to extend research to other cultural contexts.

5 | CONCLUSION

This study enhances our understanding of the mother-child relationship in the context of STCs. It highlights that mothers of children with SCTs interact with their children differently from mothers of TD children. These differences are more pronounced at 8 months and tend to reduce by 24 months. At the same time, these mothers demonstrate good parental resources when interacting with their children. This has significant clinical value, as it suggests that fostering functional interactions is a protective environmental factor in the development of children with SCTs. In conclusion, the care of children with SCTs should involve the entire family system, with the final aim of monitoring the development of children who show an increased likelihood of displaying developmental delays.

ACKNOWLEDGMENTS

We would like to thank all the families who have participated in the project. We would also like to thank Elisa Frigerio, Cristian Prencipe, Marta Scolaro, Giulia Valensise and Gaia Vanelli for assistance with the coding.

Open access publishing facilitated by Universita degli Studi di Milano-Bicocca, as part of the Wiley - CRUI-CARE agreement.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

FUNDING INFORMATION

No specific funding was received for the purpose of conducting this study.

DATA AVAILABILITY STATEMENT

The data supporting this study's findings are available from the corresponding author upon reasonable request.

ORCID

Laura Cordolcini https://orcid.org/0009-0001-9338-5290

Paola Francesca Ajmone https://orcid.org/0000-0002-0624-4634

Laura Zampini https://orcid.org/0000-0002-2207-0179

REFERENCES

Abidin, R. R. (1995). *Parenting Stress Index (PSI) manual* (3rd ed.). Pediatric Psychology Press.

Abramsky, L., & Chapple, J. (1997). 47, XXY (Klinefelter syndrome) and 47, XYY: Estimated rates of and indication for postnatal diagnosis with implications for prenatal counselling. *Prenatal Diagnosis: Published in Affiliation With the International Society for Prenatal Diagnosis*, *17*(4), 363–368. https://doi.org/10.1002/(SICI)1097-0223(199704)17:4%3c363::AID-PD79%3e3.0.CO;2-O

Bishop, D. V. M. (2012). Commentary: Unravelling the effects of additional sex chromosomes on cognition and communication–reflections on Lee et al.(2012). *Journal of Child Psychology and Psychiatry, and Allied Disciplines*, *53*(10), 1082. https://doi.org/10.1111/j.1469-7610.2012.02610.x

Blackburn, J., Ramakrishnan, A., Graham, C., Bambang, K., Sriranglingam, U., & Senniappan, S. (2025). Klinefelter Syndrome: A review. *Clinical Endocrinology*, *102*(5), 565–573.

Bornstein, M. H., Putnick, D. L., Bohr, Y., Abdelmaseh, M., Lee, C. Y., & Esposito, G. (2020). Maternal sensitivity and language in infancy each promotes child core language skill in preschool.

Early Childhood Research Quarterly, *51*, 483–489. https://doi.org/10.1016/j.ecresq.2020.01.002

Capelli, E., Silibello, G., Ajmone, P. F., Altamore, E., Lalatta, F., Vizziello, P. G., Costantino, M. A., & Zampini, L. (2022). Language development in sex chromosome trisomies: Developmental profiles at 2 and 4 years of age, and predictive measures. *Developmental Neurorehabilitation*, *25*(5), 337–348. https://doi.org/10.1080/17518423.2021.2020925

Capelli, E., Silibello, G., Provera, A., Dall'Ara, F., Ajmone, P. F., Monti, F., Scionti, N., Zanchi, P., Costantino, M. A., & Vizziello, P. G. (2023). Speech sound development in 18-month-old children with sex chromosome trisomies. *American Journal of Speech-Language Pathology*, *32*(1), 287–297. https://doi.org/10.1044/2022_AJSLP-22-00118

Caselli, M. C., Bello, A., Rinaldi, P., Stefanini, S., & Pasqualetti, P. (2015). Il primo vocabolario del bambino: gesti, parole e frasi. *Forme Lunghe e Forme Brevi Del Questionario e Valori Di Riferimento per La Fascia*, 8–36. Franco Angeli.

Castagna, A., Butti, N., Cordolcini, L., Innocenti, M. S., & Montirosso, R. (2024). Severity of developmental delay and parenting behavior in toddlers with neurodevelopmental disabilities. *Frontiers in Psychology*, *14*, 1306227. https://doi.org/10.3389/fpsyg.2023.1306227

Crowell, J. A., Keluskar, J., & Gorecki, A. (2019). Parenting behavior and the development of children with autism spectrum disorder. *Comprehensive Psychiatry*, *90*, 21–29. https://doi.org/10.1016/j.comppsych.2018.11.007

De Clercq, L. E., Soenens, B., Dieleman, L. M., Prinzie, P., Van der Kaap-Deeder, J., Beyers, W., & De Pauw, S. S. W. (2022). Parenting and child personality as modifiers of the psychosocial development of youth with cerebral palsy. *Child Psychiatry & Human Development*, *53*(1), 137–155.

Endevelt-Shapira, Y., Bosseler, A. N., Mizrahi, J. C., Meltzoff, A. N., & Kuhl, P. K. (2024). Mother–infant social and language interactions at 3 months are associated with infants' productive language development in the third year of life. *Infant Behavior and Development*, *75*, 101929.

Griffiths, R., Battaglia, F. M., Savoini, M., & Huntley, M. (2007). GMDS-R: Griffiths mental development scales, revised: O-2 anni: Manuale. Giunti OS, Organizzazioni speciali.

Guarino, A., Di Blasio, P., D'Alessio, M., Camisasca, E., & Serantoni, G. 2008. *Parenting Stress Index SF*. Organizzazioni Speciali: Firenze.

Harvey, J., Jacobs, P. A., Hassold, T., & Pettay, D. (1990). The parental origin of 47. XXY males. *Birth Defects Original Article Series*, *26*(4), 289–296.

Hutchon, B., Gibbs, D., Harniess, P., Jary, S., Crossley, S., Moffat, J. V., Basu, N., & Basu, A. P. (2019). Early intervention programmes for infants at high risk of atypical neurodevelopmental outcome. *Developmental Medicine & Child Neurology*, *61*(12), 1362–1367.

Innocenti, M. S., Roggman, L. A., & Cook, G. A. (2013). Using the PICCOLO with parents of children with a disability. *Infant Mental Health Journal*, *34*(4), 307–318. https://doi.org/10.1002/imhj.21394

Innocenti, M. S., Vilaseca, R., & Roggman, L. (2023). PICCOLO: Observing and coaching caregiver-child interaction to support early development in children with and without disabilities. In Livio Provenzi, Serena Grumi, & Renato Borgatti (Eds.), *Family-Centered Care in Childhood Disability: Theory, Research, Practice* (pp. 115–147). Springer. https://doi.org/10.1007/978-3-031-34252-3

Jeong, J., Franchett, E. E., Ramos de Oliveira, C. V., Rehmani, K., & Yousafzai, A. K. (2021). Parenting interventions to promote early child development in the first three years of life: A global systematic review and meta-analysis. *PLoS Medicine*, *18*(5), e1003602. https://doi.org/10.1371/journal.pmed.1003602

Kaźmierczak, M., & Karasiewicz, K. (2019). Making space for a new role–gender differences in identity changes in couples transitioning to parenthood. *Journal of Gender Studies*, *28*(3), 271–287. https://doi.org/10.1080/09589236.2018.1441015

Knauer, H. A., Ozer, E. J., Dow, W. H., & Fernald, L. C. H. (2019). Parenting quality at two developmental periods in early childhood and their association with child development. *Early Childhood Research Quarterly*, *47*, 396–404.

Kuiper, K. C., Swaab, H., Tartaglia, N., van Buggenhout, G., Wouters, C., & van Rijn, S. (2022). The developmental impact of sex chromosome trisomies on emerging executive functions in young children: Evidence from neurocognitive tests and daily life skills. *Genes, Brain and Behavior*, *21*(6), e12811. https://doi.org/10.1111/gbb.12811

Landry, S. H., & Smith, K. E. (2011). Maternal sensitivity and responsiveness: A conceptual framework with empirical evidence. In D. W. E. Davis, & M. Logsdon (Eds.), *Maternal sensitivity: A scientific foundation for practice* (pp. 31–44). Nova Science.

Leggett, V., Jacobs, P., Nation, K., Scerif, G., & Bishop, D. V. M. (2010). Neurocognitive outcomes of individuals with a sex chromosome trisomy: XXX, XYY, or XXY: A systematic review. *Developmental Medicine & Child Neurology*, *52*(2), 119–129. https://doi.org/10.1111/j.1469-8749.2009.03545.x

Lorini, A., Zampini, L., Silibello, G., Dall'ara, F., Rigamonti, C., Ajmone, P. F., Monti, F., Lalatta, F., Costantino, M. A., & Vizziello, P. G. (2022). Children's behavior and maternal parenting stress in young children with sex chromosome trisomies. *Journal of Developmental and Behavioral Pediatrics*, *43*(3), E197–E203. https://doi.org/10.1097/DBP.0000000000001015

Messer, K., D'epagnier, C., Howell, S., & Tartaglia, N. (2013). Trisomy X Syndrome, (47, XXX). In S. Maloy & K. Hughes (Eds.), *Brenner's encyclopedia of genetics* (2nd ed., pp. 195–197). Elsevier.

Montirosso, R., Castagna, A., Butti, N., Innocenti, M. S., Roggman, L. A., & Rosa, E. (2023). A contribution to the Italian validation of the parenting interaction with children: Checklist of observations linked to outcome (PICCOLO). *Frontiers in Psychology*, *14*, 1421. https://doi.org/10.3389/FPSYG.2023.1105218

Montirosso, R., & Giusti, L. (2022). *Italian version of parenting interaction with children checklist of observation linked to outcomes (PICCOLO)* (p. 14). Hogrefe Publishing Group.

Montirosso, R., Pisoni, C., Scarano, E., Cordolcini, L., Naboni, C., Micheletti, S., Butti, N., Castagna, A., Bonino, M., & Orcesi, S. (2025). Effects of a video-feedback intervention on parenting behavior and state anxiety in mothers of children with neurodevelopmental disabilities. *Infant Behavior and Development*, *78*, 102008. https://doi.org/10.1016/j.infbeh.2024.102008

Parker, K., & Wang, W. (2013). Modern parenthood. *Pew Research Center's Social & Demographic Trends Project*, *14*, 1–66.

Petersen, R., Petermann, F., & Petermann, U. (2017). Sensitive parenting and emotion regulation in children: A systematic review. *Kindheit Und Entwicklung*, *26*(3), 147–156. https://doi.org/10.1026/0942-5403/a000226

Provera, A., Zanchi, P., Silibello, G., Dall'Ara, F., Rigamonti, C., Monti, F., Ajmone, P. F., Lalatta, F., Costantino, M. A., Vizziello, P. G., & Zampini, L. (2022). Prosodic features of maternal input to children with sex chromosome trisomies. *First Language*, *42*(5), 613–627. https://doi.org/10.1177/01427237221098553

Roggman, L. A., Cook, G. A., Innocenti, M. S., Jump Norman, V., & Christiansen, K. (2013). Parenting interactions with children: Checklist of observations linked to outcomes (PICCOLO) in diverse ethnic groups. *Infant Mental Health Journal*, *34*(4), 290–306. https://doi.org/10.1002/imhj.21389

Roggman, L. A., Boyce, L. K., & Innocenti, M. S. (2008). *Developmental parenting: A guide for early childhood practitioners*. Paul H. Brookes Publishing.

Ross, J. L., Zeger, M. P. D., Kushner, H., Zinn, A. R., & Roeltgen, D. P. (2009). An extra X or Y chromosome: Contrasting the cognitive and motor phenotypes in childhood in boys with 47, XYY syndrome or 47. XXY Klinefelter syndrome. *Developmental Disabilities Research Reviews*, *15*(4), 309–317.

Santana-Ferrándiz, M., Ibáñez-Pérez, J., & Moret-Tatay, C. (2025). Empathy and parental sensitivity in child attachment and socioemotional development: A systematic review from emotional, genetic, and neurobiological perspectives. *Children*, *12*(4), 465. https://doi.org/10.3390/children12040465

Skuse, D., Printzlau, F., & Wolstencroft, J. (2018). Sex chromosome aneuploidies. *Handbook of Clinical Neurology*, *147*, 355–376.

St John, M., Ponchard, C., van Reyk, O., Mei, C., Pigdon, L., Amor, D. J., & Morgan, A. T. (2019). Speech and language in children with Klinefelter syndrome. *Journal of Communication Disorders*, *78*, 84–96. https://doi.org/10.1016/j.jcomdis.2019.02.003

Treyvaud, K., Anderson, V. A., Howard, K., Bear, M., Hunt, R. W., Doyle, L. W., Inder, T. E., Woodward, L., & Anderson, P. J. (2009). Parenting behavior is associated with the early neurobehavioral development of very preterm children. *Pediatrics*, *123*(2), 555–561. https://doi.org/10.1542/peds.2008-0477

Urbanus, E., Swaab, H., Tartaglia, N., Boada, R., & van Rijn, S. (2022). A cross-sectional study of early language abilities in children with sex chromosome trisomy (XXY, XXX, XYY) aged 1–6 years. *Child Neuropsychology*, *28*(2), 171–196. https://doi.org/10.1080/09297049.2021.1960959

Urbanus, E., Swaab, H., Tartaglia, N., Stumpel, C., & van Rijn, S. (2023). Structural and pragmatic language in young children with sex chromosome trisomy (XXX, XXY, XYY): Predictive value for neurobehavioral problems one year later. *Clinical Neuropsychologist*, *37*(3), 650–675. https://doi.org/10.1080/13854046.2022.2067078

Urbanus, E., van Rijn, S., & Swaab, H. (2020). A review of neurocognitive functioning of children with sex chromosome trisomies: Identifying targets for early intervention. *Clinical Genetics*, *97*(1), 156–167. https://doi.org/10.1111/cge.13586

van Rijn, S., Kuiper, K., Bouw, N., Urbanus, E., & Swaab, H. (2023). Neurocognitive and behavioral development in young children (1–7 years) with sex chromosome trisomy. *Endocrine Connections*, *12*(5),. https://doi.org/10.1530/EC-22-0494

Vilaseca, R., Rivero, M., Ferrer, F., & Bersabé, R. M. (2020). Parenting behaviors of mothers and fathers of young children with intellectual disability evaluated in a natural context. *PLoS ONE*, *15*(10), e0240320. https://doi.org/10.1371/journal.pone.0240320

Warren, S. F., & Brady, N. C. (2007). The role of maternal responsivity in the development of children with intellectual disabilities. *Mental Retardation and Developmental Disabilities Research Reviews*, *13*(4), 330–338. https://doi.org/10.1002/mrdd.20177

Zampini, L., Burla, T., Silibello, G., Capelli, E., Dall'Ara, F., Rigamonti, C., Ajmone, P. F., Monti, F., Zanchi, P., Lalatta, F., Costantino, M. A., & Vizziello, P. G. (2021). Preverbal skills in 8-month-old children with sex chromosome trisomies. *First Language*, *41*(2), 200–217. https://doi.org/10.1177/0142723720962944

Zampini, L., Burla, T., Silibello, G., Dall'Ara, F., Rigamonti, C., Lalatta, F., & Vizziello, P. (2018). Early communicative skills of children with Klinefelter syndrome. *Clinical Linguistics & Phonetics*, *32*(7), 577–586. https://doi.org/10.1080/02699206.2017.1384853

Zampini, L., Ferrante, C., Silibello, G., Dall'Ara, F., Rigamonti, C., Zanchi, P., Vizziello, P. G., Lalatta, F., & Costantino, M. A. (2020). Maternal input to children with sex chromosome trisomies. *International Journal of Language and Communication Disorders*, *55*(5), 724–733. https://doi.org/10.1111/1460-6984.12557

Zampini, L., Lorini, A., Silibello, G., Zanchi, P., Dall'ara, F., Ajmone, P. F., Monti, F., Lalatta, F., Costantino, M. A., & Vizziello, P. G. (2022). Language development in the second year of life: The case of children with sex chromosome trisomies diagnosed before birth. *International Journal of Environmental Research and Public Health*, *19*(3), https://doi.org/10.3390/ijerph19031831

Zampini, L., Lorini, A., Zanchi, P., Scionti, N., Silibello, G., Dall'Ara, F., Ajmone, P. F., Monti, F., Costantino, M. A., & Vizziello, P. G. (2025). Neurodevelopment in young children with sex chromosome trisomies diagnosed before birth: A cluster analysis study. *American Journal of Medical Genetics, Part A*, *197*(2), https://doi.org/10.1002/ajmg.a.63895

Zampini, L., Provera, A., Zanchi, P., Silibello, G., Mastromattei, D., Angeleri, F., Costantino, M. A., & Ajmone, P. F. (2025). The impact of an extra chromosome on language: Developmental language disorder in sex chromosome trisomies. *Journal of Speech, Language, and Hearing Research*, 1–13. https://doi.org/10.1044/2025_JSLHR-24-00808

Zampini, L., Silibello, G., Mastromattei, D., Pagliaccia, E., Monti, F., Zanchi, P., Ajmone, P. F., Costantino, M. A., & Vizziello, P. G. (2022). Short report. Narrative competence in Italian preschool children with sex chromosome trisomies. *Research in Developmental Disabilities*, 130. https://doi.org/10.1016/j.ridd.2022.104341

Zanchi, P., Provera, A., Silibello, G., Ajmone, P. F., Altamore, E., Lalatta, F., Costantino, M. A., Vizziello, P. G., & Zampini, L. (2024). Prosody in narratives: An exploratory study with children with sex chromosomes trisomies. *Speech Communication*, *163*, 103107. https://doi.org/10.1016/j.specom.2024.103107

Zanchi, P., Sacco, G. G. A., Silibello, G., Ajmone, P. F., Costantino, M. A., Vizziello, P. G., & Zampini, L. (2024). Maternal input to 24-month-old children with sex chromosome trisomies. *International Journal of Language and Communication Disorders*, *59*(4), 1452–1462. https://doi.org/10.1111/1460-6984.13012

How to cite this article: Cordolcini, L., Riva, B., Zanchi, P., Mastromattei, D., Ajmone, P. F., Costantino, M. A., & Zampini, L. (2026). Parental behaviors supporting child development in mothers of children with sex chromosome trisomies. *Infant Mental Health Journal*, *47*, e70102. https://doi.org/10.1002/imhj.70102