

# Social withdrawal at 1 year is associated with emotional and behavioural problems at 3 and 5 years: the Eden mother-child cohort study

Antoine Guedeney · Jean-Baptiste Pingault ·  
Antoine Thorr · Beatrice Larroque ·  
The EDEN Mother-Child Cohort Study Group

Received: 30 August 2013 / Accepted: 24 December 2013  
© Springer-Verlag Berlin Heidelberg 2014

**Abstract** The objective of the study was to examine how social withdrawal in infants aged 12 months predicted emotional and behavioural problems at ages 3 and 5 years. The sample included 1,586 infants from the French Eden Mother-Child Cohort Study who had a measure of social withdrawal with the Alarm Distress BaBy scale at age 1 year; among these children, emotional and behavioural difficulties were rated by mothers using the Strength and Difficulty Questionnaire (SDQ) at 3 years for 1,257 (79 %) children and at 5 years for 1,123 (72 %) children. Social withdrawal behaviour at age

1 year was significantly associated with the SDQ behavioural disorder scale at 3 years, independently of a host of familial and child temperament confounders. The association with the relational disorder, prosocial and total difficulty scales was close to significance at 3 years after taking into account familial and temperament confounders. Social withdrawal significantly predicted the three aforementioned scales when measured at 5 years. No significant predictivity of the emotional scale and hyperactivity scale was detected at any age. This study made with a large longitudinal sample confirms the negative effects on development of social withdrawal behaviour, shedding light on the unfolding of behavioural disorders and relational difficulties in children; this calls for early detection of sustained social withdrawal behaviour, as it seems to hamper emotional development.

The EDEN Mother-Child Cohort Study Group: Annesi-Maesano, J. Botton, M.A. Charles, P. Dargent-Molina, B. de Lauzon-Guillain, P. Ducimetière, M. de Agostini, B. Foliguat, A. Forhan, X. Fritel, A. Germa, V. Goua, R. Hankard, B. Heude, M. Kaminski, B. Larroque, N. Lelong, J. Lepeule, G. Magnin, L. Marchand, C. Nabet, R. Slama, M.J. Saurel-Cubizolles, M. Schweitzer, O. Thiebaugeorges.

To the memory of Beatrice Larroque, who died accidentally as this paper was written.

A. Guedeney (✉)  
Hospital Bichat-Claude Bernard APHP, Inserm U669, University Denis Diderot Paris 7, Polyclinique Ney, 124 blvd NEY, 75018 Paris, France  
e-mail: antoine.guedeney@bch.aphp.fr

J.-B. Pingault  
GRIP-Research Unit on Children's Psychosocial Maladjustment, Sainte Justine hospital, University of Montreal, 3175 Chemin de la Côte Sainte Catherine, Montreal, QC H3T 1C5, Canada  
e-mail: jean-baptiste.pingault@umontreal.ca

A. Thorr · B. Larroque  
Inserm, UMRS 953, UPMC University Paris 6, Paris, France  
e-mail: antoinethorr.inserm@gmail.com

A. Thorr · B. Larroque  
Unité d'épidémiologie et de recherche clinique, Hospital Beaujon, APHP, Clichy, France

**Keywords** Longitudinal study · Social withdrawal behaviour · Community sample · Alarm Distress Baby Scale · Strengths and Difficulties Questionnaire SDQ · Temperament · Follow up at 3 and 5 years

## Abbreviations

AABB Alarm Distress Baby scale  
ASD Autistic Spectrum Disorder  
ICQ Infant Characteristics Questionnaire  
EAS Emotionality Activity and Sociability scale  
SDQ Strengths and Difficulties Questionnaire  
EPDS Edinburgh Postnatal Depression Scale

## Introduction

Social withdrawal behaviour in infants

Social and emotional development in early infancy has major implications for all aspects of functioning

throughout the lifespan [7, 13]. The infant's ability to relate to his or her social world develops within close and continuous interactions between parents and infant [5]. A key element in early development is the ability to synchronize communication within the parents–infant triad, particularly during the first 18 months of the infant's life [13]: synchrony is the “co-regulatory lived experience within attachment relationships that provides the foundation for the child's latter capacity for intimacy, symbol use, empathy, and the ability to read the intentions of others” (Feldman, 2007, p. 330, [13]). At a micro-analytical level, social withdrawal is a normal feature of infant behaviour in parent–infant interactions, providing a way for the infant to regulate the flow of interaction [5]. Infant withdrawal is a key element of the infant's response in the face of a non-contingent kind of relationship [20, 22]. Withdrawn social behaviour in infants is characterized by infrequent positive behaviours, e.g. eye contact, smiling, cooing or by negative behaviours (e.g. crying). Excessive withdrawal from social interactions is a sign of infant distress regardless of the cause; it reflects the problems the infant is experiencing but also those of the caregivers [20, 22, 24, 25]. Whilst reduced social behaviour in an infant may not necessarily be an indicator of disorder it should alert the clinician to the need for further assessment of both the infant and the caregiving environment. Withdrawing from interactions may undermine the normal course of development [22, 24], and may lead to further social withdrawal, as well as to internalizing or externalizing disorders [22, 25].

#### The Alarm Distress Baby Scale (ADBB)

The ADBB [18] was designed to assess social withdrawal in children aged between 2 and 24 months, in the context of routine paediatric examinations or during specific psychological assessments. To facilitate the observation of the child's behavioural reactions, the clinician engages the child in social interactions through talking, touching and smiling. The scale comprises eight items including: facial expression; eye contact; general level of activity; self-stimulating gestures; vocalizations; rapidity of response to stimulation; relationship with the observer; attractiveness to the observer. Each item is rated from 0 to 4 resulting in 0 as the minimum and 32 as the maximum ADBB total score. The higher the ADBB score, the greater the signs of social withdrawal displayed by the infant. ADBB scores may be high with children with mental retardation, attachment disorders, acute and severe pain, auditory and/or visual malfunction and with children with autistic spectrum disorders (ASD) [18, 22].

The clinical validity of the ADBB was shown to be adequate in several studies with large samples at different ages (age range 2–24 months). In the original French validation [18], the ADBB was used as a screening tool, through the evaluation of its sensitivity and specificity, for detecting the developmental risk for the infant in the following year (predictive validity). The developmental risk was, therefore, rated high or low depending on the number of risk factors in a list validated by an epidemiological study in the same district for infants under 3 [8]. The cut-off score of 5 and over yielded the best compromise between sensitivity (0.82) and specificity (0.78). This compromise was found again in several further validations, in different samples and different countries [10, 12, 22, 25, 27, 30, 31]. Exploratory factor analysis showed two different factors, consistent with the scale's construct, one factor linked with relation and interpersonal dimensions, the other being linked with non-interpersonal, more temperamental dimensions [14, 22]. Reliability was satisfactory with good internal consistency for both sub-scales (Cronbach  $\alpha$  0.80 for the first sub-scale and 0.79 for the second) and for the global scale (0.83) in the Paris study [18], which was confirmed in the Brazilian validation [12]. A cross-sectional study was conducted on 640 infants visiting a Parisian screening centre, infants' age ranged between 14 and 18 months [19]. No significant correlations were found between social withdrawal and the SES of the family, ethnic origin, rank of birth. Withdrawing from interactions may undermine the normal course of development [3, 32, 33]. In an Australian longitudinal study [28], infants who were socially withdrawn at 6 months using the ADBB showed poor communication skills at 30 months (i.e. functional communication abilities and formal expressive and receptive language skills). In a prospective study of 159 women and infants living in Cape Town, prenatal alcohol exposure was associated with infant withdrawal, as assessed with ADBB, and this was independent of post-natal alcohol use. Infant social withdrawal was associated with severity of foetal alcohol spectrum disorder (FASD) diagnosis and child depression at age 5 years and child IQ at 5 and 10 years [29]. The scale could be used in different clinical settings, provided a sufficient level of social stimulation is given to the infant in a relatively brief period of time. The scale can be used by nurses and psychologists or by medical doctors after a short period of training.

The goal of the present study was to examine the long-term contribution of social withdrawal behaviour assessed with the ADBB at 1 year to preschoolers' behavioural difficulties. As the ADBB is not a diagnostic tool, nor is the SDQ it was not in the goals of the study to screen for ASD.

## Study design

The EDEN mother–child cohort study (pre- and postnatal determinants of the child’s development and prospective health Birth Cohort Study) was designed to identify pre-natal and early postnatal nutritional, environmental and social determinants associated with children’s health and development (<http://eden.vjf.inserm.fr>). The study has been described in detail elsewhere [4, 11]. Volunteer pregnant women were recruited between 24 and 28 weeks of amenorrhoea in two major maternity wards in Poitiers and Nancy University Hospitals (France) between September 2003 and January 2006. Exclusion criteria were personal history of diabetes, multiple pregnancies, intending to deliver elsewhere or to move out of the study region within the following 3 years, or inability to speak and read French. Among women who fulfilled the inclusion criteria, 55 % agreed to participate. A total of 2,002 women were included in the study, giving birth to 1,863 children with complete birth data [4, 11] (Figure 1).

The study received ethical approval from the Ethics Committee (*Comité Consultatif pour la Protection des Personnes dans la Recherche Biomédicale*), Le Kremlin-Bicêtre University hospital, and the Data Protection

Authority (*Commission Nationale de l’Informatique et des Libertés, CNIL*). Participating women gave informed written consent for themselves and for their child to take part in the study.

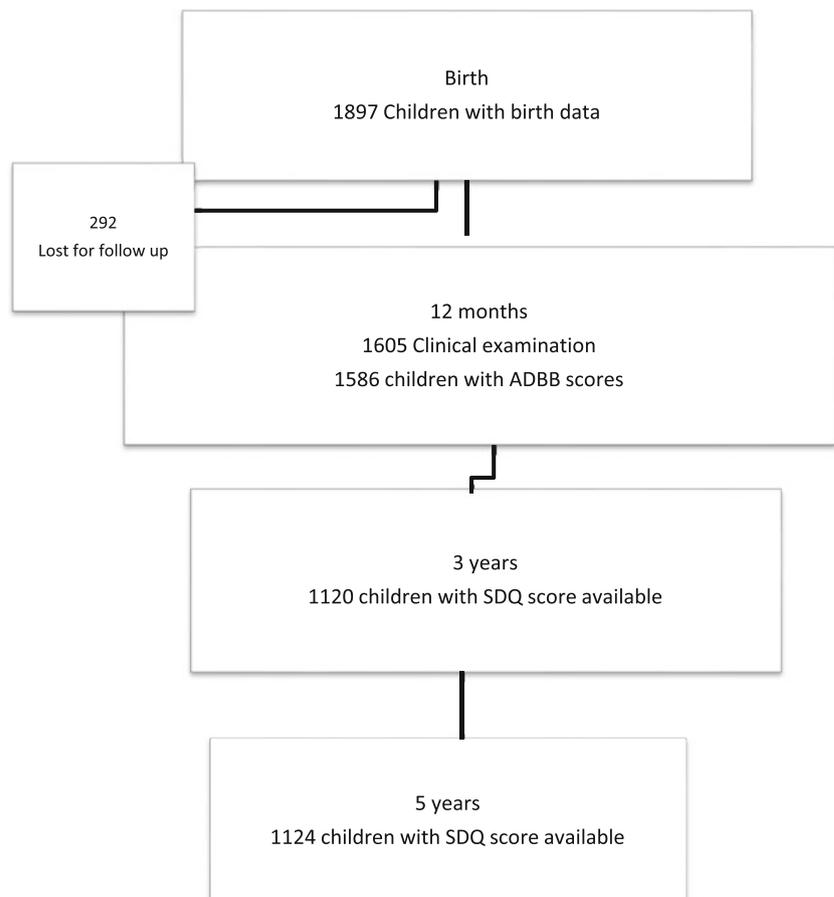
## Sample

The present analysis is based on children with an ADBB scale at the age of one. At 1 year, 1,605 infants were examined, including assessment with the ADBB scale by a midwife. Of these 1,586 completed the ADBB assessment (Fig. 1). Infants without ADBB scale at 1 year had a significantly lower socio-economic level; their mothers were younger and more likely to smoke than mothers of infants for whom an ADBB scale was available.

## Data collection

During pregnancy and at birth, social and medical data were obtained from medical records, interviews with mothers and self-completed questionnaires. When their child was 1 year old, parents were sent a questionnaire and

**Fig. 1** Flowchart of the study



were invited to an assessment. The assessment was conducted by a midwife and consisted of an interview with the mother as well as a direct physical examination of the child, measuring weight, height, and psychomotor development. This examination was used to assess social withdrawal behaviour with the ADBB scale, right after each examination.

### Instruments

1. Reliability checking between the 6 ADBB scorers at 1 year: The six midwives, all of whom had been trained by the first author to use the scale during four training sessions using a set of 30 video clips, until they reached good inter-rater reliability, assessed by a Kappa coefficient of 0.8, and no more than a one point difference on each item of the scale, without no systematic mistakes on any item. Three follow-up sessions allowed for consensus on difficult cases and for checking reliability as the study progressed.
2. The Strengths and Difficulties Questionnaire (SDQ) was completed by mothers when their child was aged 3 and 5. The SDQ is a well-known, well-validated and widely used screening questionnaire for behavioural problems in children [16]. The SDQ includes questions about 25 positive and negative attributes, divided into five sub-scales, each scoring from 0 to 10, evaluating hyperactivity/inattention symptoms, conduct problems, emotional problems, peer relationship problems, and prosocial behaviour. Scores from all but the last scale can be summed to generate a total difficulties score ranging from 0 to 40 (and not 50 as the last prosocial behaviour scale is not included in the total score). Past and ongoing studies in France have administered the SDQ to estimate inter-rater agreement between parents, teachers, and pupils, to carry out a large-scale epidemiological study, and to evaluate the efficacy of a parent training programme [15, 26].
3. Socio-economic, psychological and family variables: Other variables were extracted from birth data: maternal age, maternal level of education, family global income, parity, gender, duration of gestation; or 1-year questionnaire: maternal employment, mother's marital status at age one, maternal tobacco consumption, maternal depressive feelings defined as Edinburgh Postnatal Depression Scale (EPDS) 13 or more [9], exact age of the child at response to the 1-year questionnaire.
4. Temperament assessment [1, 6, 7]: ICQ, EAS: In the questionnaire completed by the parents when their child was 4 months old, infant temperament was assessed using the Infant Characteristic Questionnaire (ICQ) [1], using the French validation of the ICQ [2]. ICQ contains four scores: Fussy-difficult, Unadaptable

(to new events, things and people), Dull (items assessing social responsiveness) and Unpredictable (Ease of predicting the infant's needs).

When the child was 1 year old, parents completed the Emotionality Activity and Sociability scale (EAS), in the French version) [15] as a mean to assess temperamental difficulty at age one. The EAS Survey contains five scores: shyness, activity (general level of energy output), emotionality (intensity of emotional reactions), sociability (interaction with others) and a global score.

### Statistical analysis

We compared children with an ADBB score of less than 5 to those with a score of 5 or more using bivariate analyses. Chi-square tests were used for categorical variables (e.g. gender). Student t tests were used for continuous scores (e.g. SDQ scores). For continuous variables, an effect size estimate was calculated, using Hedges's *h*, which is equivalent to Cohen's *d* with a correction for unequal groups [23]. Finally, multivariate linear regressions were used to examine the contribution of the ADBB dichotomous variable to the SDQ scales at 3 and 5 years. Two models were estimated for each SDQ scale at 3 and 5 years. Model 1 included the following variables as potential confounders: exact age of child at the 1-year assessment, age of mother at birth, maternal level of education, family global income, mother's marital status at 1 year, mother's employment at age 1, parity and maternal tobacco use at the 1-year assessment. In model 2, we added temperamental dimensions which were found to be linked with social withdrawal behaviour at 1 year: from the ICQ, 'inadaptable' and 'dull', and from the EAS, 'shyness', 'activity' and 'sociability'. Statistical calculations were done with SAS System for Windows.

### Results

The ADBB was completed for 1,586 children at age 1 year (Fig. 1). At least one SDQ sub-scale was available at the age of 3 for 79 % (1,258/1,586) of the children with ADBB scales and at 5 years of age for 71 % (1,123/1,586). Non-responders when the child was 5 years old (none of the SDQ sub-scales) had a significantly lower socio-economic level, were younger and smoked more than women with children with at least one available SDQ sub-scale. Table 1 shows maternal and child characteristics of participants with and without social withdrawal at 1 year of age. There was a trend although not significant with a lower mother's level of education and less frequent maternal employment for children with social withdrawal.

**Table 1** ADBB scores at 12 months according to maternal and infant characteristics

	<i>N</i>	ADBB score at 12 months				<i>p</i>
		<5		≥5		
		<i>n</i>	%/ <i>m</i> (SD)	<i>n</i>	%/ <i>m</i> (SD)	
Age of child in months at the 1-year examination	1,543	1,325	11.8 (1.0)	218	11.7 (0.6)	0.02
Mother's age at birth of child	1,586	1,359	29.7 (4.8)	227	29.7 (4.9)	0.891
Mother's level of education at birth of child:						
Less than high school diploma	402	333	82.84	69	17.16	0.063
End of high school diploma	289	242	83.74	47	16.26	
High school + 2 years	352	308	87.50	44	12.50	
University level	519	458	88.25	61	11.75	
Family income level during pregnancy (Euros monthly)						
<1,500	213	173	81.22	40	18.78	0.136
1,501–2,300	484	411	84.92	73	15.08	
2,301–3,000	439	383	87.24	56	12.76	
>3,000	442	386	87.33	56	12.67	
Maternal employment at 1 year of age of child						
No	481	400	83.16	81	16.84	0.059
Yes	995	864	86.83	131	13.17	
Mother's marital situation at birth						
Married, divorced, widow, separated	908	774	85.24	134	14.76	0.494
Single	672	581	86.46	91	13.54	
Parity						
0	722	620	85.87	102	14.13	0.825
1+	861	736	85.48	125	14.52	
Mother's use of tobacco at 1 year of age of child						
No	1,150	990	86.09	160	13.91	0.519
Yes	333	282	84.68	51	15.32	
Mother's depressive feelings at 1 year of age of child (Edinburgh Postnatal Depression Scale ≥ 13)						
No	1,314	1,131	86.07	183	13.93	0.156
Yes	148	121	81.76	27	18.24	
Gender of child						
Male	837	717	85.66	120	14.34	0.977
Female	749	642	85.71	107	14.29	
Length of gestation						
≤36 weeks	86	67	77.91	19	22.09	0.034
>36 weeks	1,500	1,292	86.13	208	13.87	

Table 2 shows the association between the ADBB total score and ICQ and EAS temperament scales, respectively, at 4 months and 1 year of age. Children with social withdrawal behaviour had significantly higher scores for the 'unadaptable' and the 'dull' sub-scales of the ICQ. They had higher scores for shyness, and lower scores for activity and sociability with the EAS scale.

Table 3 shows the bivariate association between social withdrawal behaviour (ADBB of 5 or more) and SDQ scales at ages 3 and 5.

Table 4 shows the multivariate linear regression analyses, adjusted for familial and maternal characteristics as well as for infant temperament. At age 3 years social withdrawal behaviour at age 1 year was significantly associated with the SDQ behavioural disorder scale (Table 4). At age 5 years, social withdrawal was significantly associated with the behavioural disorders scale, the relational disorder scale and the total SDQ scale.

**Table 2** ICQ and EAS temperamental scales at, respectively, 4 months and 1 year by social withdrawal behaviour at one year

	N	ADBB score at 12 months						$p^a$	Hedges's $h^b$
		<5			$\geq 5$				
		n	m	(SD)	N	m	(SD)		
<b>ICQ at 4 months</b>									
Fussy/difficult	1,470	1,259	17.86	5.43	211	17.89	5.11	0.958	-0.01
Unadaptable	1,483	1,271	8.78	3.99	212	9.75	4.33	0.001	-0.24
Dull	1,496	1,281	5.51	2.17	215	5.88	2.49	0.022	-0.17
Unpredictable	1,485	1,273	10.59	3.58	212	10.85	3.95	0.322	-0.07
<b>EAS at 1 year</b>									
Shyness score	1,466	1,257	2.06	0.58	209	2.27	0.62	<0.001	-0.32
Emotional score	1,472	1,263	2.79	0.70	209	2.82	0.77	0.569	-0.04
Activity score	1,472	1,263	4.20	0.57	209	4.09	0.62	0.008	0.19
Sociability score	1,466	1,259	3.72	0.60	207	3.58	0.63	0.003	0.23
Global EAS score	1,457	1,250	3.19	0.32	207	3.19	0.37	0.846	<0.01

ICQ Infant Characteristics Questionnaire, EAS Emotionality Activity and Sociability scale

<sup>a</sup> Student  $t$  test

<sup>b</sup> Hedges's  $h$  for groups of different sizes

**Table 3** SDQ scales at ages 3 and 5 by social withdrawal behaviour

	N	ADBB score at 12 months						$p^a$	Hedges's $h^b$
		<5			$\geq 5$				
		n	m	(SD)	N	m	(SD)		
<b>SDQ at 3 years</b>									
Emotional scale	1,253	1,077	1.78	1.60	176	1.83	1.71	0.723	-0.03
Behavioural disorders scale	1,252	1,076	3.13	1.97	176	3.50	2.11	0.022	-0.19
Hyperactivity scale	1,250	1,075	3.45	2.20	175	3.52	2.43	0.701	-0.03
Relational disorder scale	1,249	1,074	1.41	1.41	175	1.71	1.66	0.011	-0.21
Prosocial scale	1,257	1,080	7.76	1.68	177	7.41	1.69	0.011	0.21
Total SDQ score at 3 years	1,251	1,075	9.76	4.63	176	10.56	5.23	0.038	-0.17
<b>SDQ at 5 years</b>									
Emotional scale	1,123	957	2.09	1.83	166	2.33	2.10	0.137	-0.13
Behavioural disorders scale	1,122	956	2.28	2.03	166	2.77	2.15	0.005	-0.24
Hyperactivity scale	1,123	957	3.06	2.36	166	3.14	2.54	0.686	-0.03
Relational disorder scale	1,122	956	1.14	1.31	166	1.57	1.38	<0.001	-0.33
Prosocial scale	1,121	955	8.38	1.71	166	8.23	1.54	0.274	0.09
Total SDQ score at 5 years	1,121	955	8.56	5.09	166	9.80	5.72	0.005	-0.24

SDQ Strengths and Difficulties Questionnaire

<sup>a</sup> Student  $t$  test

<sup>b</sup> Hedges's  $h$  for groups of different sizes

## Discussion

Social withdrawal behaviour at age 1 year was associated with SDQ scales at age 3 and 5 years, independently from familial and maternal characteristics and from the infants' temperament.

The present results confirm the predictive validity of the ADDBB scale and the developmental risk associated with being durably socially withdrawn in infancy [26, 27]. That withdrawal behaviour at age one is associated to relational disorders at age 3 and to behavioural disorders at age 5 is in line with Milne et al. study [26]. This study shows that this

**Table 4** Adjusted differences of SDQ scores at 3 and 5 years between children with ADBB score <5 or ≥5: multiple regression analyses

	Model 1				Model 2			
	<i>N</i>	<i>B</i>	SE	<i>p</i> value	<i>N</i>	<i>B</i>	SE	<i>p</i> value
SDQ at 3 years								
Emotional scale	1,175	0.04	0.13	0.75	1,119	−0.03	0.14	0.83
Behavioural disorders scale	1,174	0.39	0.17	0.020	1,118	0.47	0.17	0.005
Hyperactivity scale	1,172	−0.02	0.18	0.93	1,116	0.10	0.18	0.602
Relational disorder scale	1,172	0.30	0.12	0.012	1,117	0.22	0.12	0.068
Prosocial scale	1,179	−0.34	0.14	0.015	1,123	−0.22	0.14	0.119
Total SDQ score	1,173	0.73	0.39	0.060	1,117	0.76	0.39	0.053
SDQ at 5 years								
Emotional scale	1,056	0.27	0.16	0.098	1,000	0.30	0.17	0.069
Behavioural disorders scale	1,055	0.45	0.18	0.011	999	0.52	0.18	0.004
Hyperactivity scale	1,056	−0.02	0.20	0.91	1,000	0.09	0.21	0.67
Relational disorder scale	1,055	0.42	0.11	<0.001	999	0.36	0.12	0.003
Prosocial scale	1,054	−0.12	0.15	0.39	998	−0.02	0.15	0.87
Total SDQ score	1,054	1.12	0.44	0.011	998	1.27	0.46	0.006

*Model 1* adjusted for exact age of the child at 1-year assessment, maternal age, maternal level of education, family global income, maternal employment at 1 year, marital situation at 1 year, parity, maternal tobacco consumption, *Model 2* adjusted for variables in Model 1 plus temperamental scores: inadaptability, dull, shyness, activity and sociability, SDQ Strengths and Difficulties Questionnaire

effect is relatively independent of aspects of child's temperament, assessed with two theoretically different scales. It is striking that social withdrawal still makes an independent contribution to the child's behavioural development even after a stringent adjustment strategy including dimensions like shyness that are recognized as direct determinants of social withdrawal. Therefore, social withdrawal behaviour at age one brings a specific contribution to behavioural disorders as assessed with the SDQ at age 3 and 5.

Being withdrawn at age one yields a significant risk of having behavioural disorders and relational disorders at age 3 and even more at age 5. Social withdrawal behaviour bears, therefore, a middle term effect, as an interesting endophenotype [17], independently of numerous familial factors as well as child's temperamental characteristics, in particular inadaptability, dull, shyness, activity and sociability dimensions.

One limitation of the study is the possible bias in the selection of the sample, as this is a volunteer sample, and therefore not necessarily representative of the general population. The sample is socially more privileged than the general population [4]. This characteristic was further reinforced by a higher proportion lost to follow-up among poorer and less educated families. Besides, the attrition rate, though acceptable, slightly reduces the power of the study. Also, the SDQ is a parental questionnaire, and not an assessment directly made by professionals during an examination [6, 7]. Only one informant was used

The strengths of the study are the size of the sample and the longitudinal study design. Another strength of the study

was that infants were assessed not only using parental questionnaires but also by direct assessment by the midwife. The ADBB score was obtained through an assessment made independently of parents, during a paediatric routine examination The Infant Characteristics Questionnaire (ICQ), the Emotionality Activity and Sociability scale (EAS), the Strengths and Difficulties Questionnaire (SDQ), and the Edinburgh Postnatal Depression Scale (EPDS) are well-known and very valid questionnaires, all being used in their French validated form. It is important to note that a single assessment by a trained professional has a clear correlation with the behaviour of the child 5 years later, as this was already the case in the Molteni et al. study [27].

## Conclusion

Being socially withdrawn at 1 year is associated with having relational disorders at age 3 years and with having behavioural disorders at age 5 years. This relation still holds true when a host of family and mother characteristics are taken into account as well as when infant temperament is controlled for. Screening for social withdrawal behaviour could help in identifying children at risk for developing behavioural difficulties in childhood, as being clinically, socially withdrawn puts the child at risk in hampering his or her relationship abilities, and therefore increases the risk of behavioural disorders [30, 31]. Interventions designed to help socially withdrawn children to engage socially could be useful in preventing these difficulties [21].

**Acknowledgments** Thanks to Nina Burtchen, Columbia University, New York MD, PhD. and to Tim Greacen, PhD, Laboratoire de Recherches de Maison-Blanche, Paris, for editing help and to Monique Kaminsky and Barbara Heudé, INSERM Paris for help into analysing the data.

**Conflict of interest** None.

## References

- Bates JE, Freeland CA, Lounsbury ML (1979) Measurement of infant difficultness. *Child Dev* 50:794–803
- Bertrais S, Larroque B, Bouvier-Colle MH, Kaminski M (1999) Tempérament des nourrissons âgés de 6 à 9 mois: validation de la version française de l'Infant Characteristics Questionnaire, et facteurs associés à la mesure (Temperament of infants 6 to 9 months of age : french validation of the Infant Characteristics Questionnaire and factors associated with the measurement). *Revue d'épidémiologie et de santé publique* 47:263–277
- (1995) Behavioral development. Concepts of Approach/withdrawal and integrative levels. In: Hood KE, Greenberg G, Tobach E (eds) *Research in development and comparative psychology*. Garland publishing, New York, London
- Blondel B (2006) Trends in perinatal health in metropolitan France between 1995 and 2003: results from the National Perinatal Survey. *J Gynecol Obstet Biol Reprod* 35:373–387
- Brazelton TB, Koslowski B, Main M Origins of reciprocity. In: Lewis M, Rosenblum L (eds) *Mother–infant interaction*. Wiley, New York, pp 57–70
- Bus AH, Plomin R (1984) Temperament: early developing personality traits. Lawrence Erlbaum, Hillsdale
- Buss KA, Schumacher JR, Dolski I, Kalin NH, Goldsmith HH, Davidson RJ (2003) Right frontal brain activity, cortisol, and withdrawal behavior in 6-month-old infants. *Behav Neurosci* 117(1):11–20
- Choquet M, Facy F, Laurent F, Davidson F (1982) Discovery of 'risk' groups in a population of children of pre-school age by a method of typological analysis. *Early Child Dev Care* 9:255–274
- Cox JL, Holden JM, Sagovsky R (1987) Detection of postnatal depression: development of the 10-item Edinburgh Postnatal Depression Scale. *Br J Psychiatry* 150:782–786
- Dollberg D, Feldmann R, Keren M, Guedeney A (2006) Sustained withdrawal behavior in clinic-referred and non-referred infants. *Infant Mental Health J* 27(3):292–309
- Drouillet P, Forhan A, De Lauzon-Guillain B, Thiebaugeorges O, Goua V, Magnin G, Schweitzer M, Kaminski M, Ducimetiere P, Charles MA (2009) Maternal fatty acid intake and foetal growth: evidence for an association in overweight women. The 'EDEN' mother-child' cohort (study of pre- and early postnatal determinants of the child's development and health). *Br J Nutr* 101:583–591
- Facuri-Lopes S, Ricas J, Cotta-Mancini M (2008) Evaluation of the psychometric properties of the Alarm Distress Baby Scale among 122 Brazilian children. *Infant Mental Health J* 29(2):153–173
- Feldmann R (2007) Parent–infant synchrony and the construction of shared timing: physiological precursors, developmental outcomes, and risk conditions. *J Child Psychol Psychiatry* 48:329–354
- Fox NA (2004) Temperament and early experience form social behaviour. *Ann N Y Acad Sci* 1038:171–178
- Gasman I, Purper-Ouakil D, Michel G, Mouren-Simeoni MC, Bouvard M, Perez-Diaz F, Jouvent R (2002) Cross-cultural assessment of childhood temperament. A confirmatory factor analysis of the French Emotionality and Sociability (EAS) questionnaire. *Eur Child Adolesc Psychiatry* 11:1–7
- Goodman R (2001) Psychometric properties of the Strengths and Difficulties Questionnaire (SDQ). *J Am Acad Child Adolesc Psychiatry* 40:1337–1345
- Gottesman II, Gould TD (2003) The endophenotype concept in psychiatry: etymology and strategic intentions. *Am J Psychiatry* 160:636–645
- Guedeney A, Fermanian J (2001) A validity and reliability study of assessment and screening for sustained withdrawal reaction in infancy: the Alarm Distress Baby Scale. *Infant Mental Health J* 22:559–575
- Guedeney A, Foucault C, Bougen E, Larroque B, Mentre F (2008) Screening for risk factors of relational withdrawal behavior in infants aged 14–18 months. *Eur Psychiatry* 23:150–155
- Guedeney A, Marchand-Martin L, Coté SJ, Larroque B (2012) Perinatal risk factors and social withdrawal behaviour. *Eur Child Adolesc Psychiatry* 21:185–191
- Guedeney A, Wendland J, Dugravier R, Saias T, Tubach F, Welniarz B, Guedeney N, Greacen T, Tereno S, Pasquet B (2013) Impact of a randomized home visiting trial on infant social withdrawal in the CAPDEP prevention study. *Infant Mental Health J* 34(6):594–601
- Guedeney A (2013) Social withdrawal behavior in infancy: a history of the concept and a review of published studies using the Alarm Distress baby scale. *Infant Mental Health J* 34(6):1–16
- Hedges LV, Olkin I (1985) *Statistical methods for meta-analysis*. Academic Press, London
- Ivanova MY, Achenbach TM, Rescorla LA, Harder VS, Ang RP, Bilenberg N et al (2010) Preschool psychopathology reported by parents in 23 societies: testing the seven-syndrome model of the child behavior checklist for ages 1.5–5. *J Am Acad Child Adolesc Psychiatry* 49(12):1215–1224
- Mäntymaa M, Puura K, Luoma I, Kaukonen P, Raili K, Salmelin RK, Tamminen T (2008) Infants' social withdrawal and parents' mental health. *Infant Behav Dev* 31:606–613
- Marzocchi GM, Capron C, Di Pietro M, Duran Tauleria E, Duyme M, Frigerio A et al (2004) The use of the Strengths and Difficulties Questionnaire (SDQ) in Southern European countries. *Eur Child Adolesc Psychiatry* 13(Suppl 2):II/40–II/46. doi:10.1007/s00787-004-2007-1
- Matthey S, Guedeney A, Starakis N, Barnett B (2005) Assessing social behavior of infants: Use of the ADBB scale and relationship to mother's mood. *Infant Mental Health J* 26:442–458
- Milne L, Greenway P, Guedeney A, Larroque B (2009) Long-term developmental impact of social withdrawal in infants. *Infant Behav Dev* 32:159–166
- Moltano, CD, Jacobson, JL, Colin Carter, R, Dodge NC, Jacobson, SW (2013) Infant emotional withdrawal: a precursor of affective and cognitive disturbance in fetal alcohol spectrum disorders. *Alcohol Clin Exp Res*, pp 1–10. doi:10.1111/acer.12240
- Puura K, Guedeney A, Mäntymaa M, Tamminen T (2007) Detecting infants in need: how complicated measures are necessary? *Infant Mental Health J* 28(4):409–421
- Piura KE, Mäntymaa M, Luoma I, Kaukonen P, Guedeney A, Salmelin R, Tamminen T (2010) Infant's social withdrawal symptoms assessed with a direct infant observation method in primary health care. *Infant Behav Dev* 33:579–588
- Rubin KH, Lollis SP Origins and consequences of social withdrawal. In: Belsky J, Nezworski T (eds) *Clinical implications of attachment*. Erlbaum, Hillsdale, pp 219–252
- Rubin KH, Coplan RJ, Bowke J (2009) Social withdrawal in childhood. *Annu. Rev. Psychol.* 60:141–171