RUNNING TITLE: TEMPERAMENT STRUCTURE IN STUTTERING CHILDREN

Factorial Temperament Structure in Stuttering, Voice Disordered, and Normal Speaking Children.

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Abstract

The purpose of this study was to determine whether the underlying temperamental structure of the Dutch Children's Behavior Questionnaire (CBQ; Van den Bergh & Ackx, 2003) was identical for children who stutter (CWS), typically developing children (TDC), and children with vocal nodules (CWVN).

A principle axis factor analysis was performed on data obtained with the Dutch CBQ from 69 CWS, 149 TDC, and 41 CWVN. All children were between the ages of 3;0 and 8;11 years. Results indicated a three-factor solution, identified as Extraversion/Surgency, Negative Affect, and Effortful Control, for each of the participant groups, showing considerable similarity to previously published US, Chinese, Japanese, and Dutch samples. Congruence coefficients were highest for CWS and TDC and somewhat more modest when comparing CWVN and TDC. The factor 'Effortful Control' consistently yielded lowest congruence coefficients. These data confirm that while stuttering, voice disordered, and typically developing children may differ quantitatively with regard to mean scores on temperament scales, they are similar in terms of their overall underlying temperament structure. The equivalence of temperament structure provides a basis for further comparison of mean group scores on the individual temperament scales.

Key words: stuttering, voice disorders, normal speech, temperament, Children's Behavior Questionnaire

Introduction

The temperament model by Rothbart (Derryberry & Rothbart, 1984; Rothbart & Derryberry, 1981), developed in the beginning of 1980s, has received widespread attention in the scientific literature on child temperament. Rothbart (1989) has defined temperament as constitutional differences in both reactivity and self-regulation. As part of her definition, reactivity refers to somatic, autonomic, cognitive, and neuro-endocrine responses to internal and external stimuli. Self-regulation, in turn, are processes serving to modulate this reactivity, such as approach, withdrawal, inhibitory control, and effortful control of attention (Rothbart, 1989).

Within this model it is supposed that there is a continuous interaction between reactivity and self-regulation with the latter one increasing and becoming more under volitional control with increasing age (Eisenberg & Spinrad, 2004; Rothbart & Posner, 1985). Reactivity is expressed through somatic (facial, vocal, and motor), autonomic (e.g., heart rate), cognitive, and neuro-endocrine channels, and is reflected in response parameters like threshold, intensity, and rise time. Reactivity can be either positive or negative depending on stimulus intensity, signal value (e.g., intrinsic meaning), the internal psychological state of the individual, and novelty (Rothbart, 1991). Individuals differ in their threshold for and intensity of positive and negative reactions and the rise and recovery time of these reactions (Rothbart, 1989). There is evidence for at least two temperament-related control systems, namely fear or behavioral inhibition and attentional (self-regulative) control, with the first emerging earlier in the child's development than the second (Eisenberg, Fabes, Murphy, Maszk, Smith, & Karbon, 1995). Through processes like avoidance and withdrawal (fear), or shifting the attention away (attentional) these control systems play an active role in modulating reactivity.

Most current temperament theories assume a biological basis, including genetic predisposition, for individual differences, an assumption that has gained considerable support from twin and adoption studies (Goldsmith, Buss & Lemery, 1997; Loehlin, 1992; McCrae et al., 2000). Based on heritability estimates, 20 to 60% of individual variation in temperament is generally assumed to be attributed to genetic factors, although some authors provide even higher estimates (Riemann, Angleitner & Strelau, 1997). Thus, 80 to 40% of heterogeneity in the population can be considered environmentally determined, primarily through nonshared environmental influences (e.g., peers, differential parental treatment, accidents) (Saudino, 2005), starting before birth, and individual-specific experiences within the family.

Although temperament refers to relatively stable dispositions (Buss, & Plomin, 1984; Costa & McCrae, 2001), expressions of temperamental traits are susceptible to change given the interaction between temperament and environment (Caspi, 1998) as well as the inherent developmental processes involved in its biological underpinnings (Goldsmith, 1996; Rothbart, Derryberry & Hershey, 2000). It has been argued that some of these changes can be attributed to a change from predominantly reactivity-driven temperament in infants to more self-regulatory processes in older children (Putnam, Ellis & Rothbart, 2001). In addition, there is evidence that both the stability of temperament across childhood development as well as the developmental changes in temperament are to some extent genetically determined (Saudino, 2005).

A number of age-specific parent-report or self-report measurement instruments have been developed within the theoretical framework proposed by Rothbart (e.g., Capaldi & Rothbart, 1992; Gartstein & Rothbart, 2003). One of the most well-known among these is the Children's

Behavior Questionnaire (CBQ; Rothbart, Ahadi, Hershey & Fisher, 2001), a caregiver questionnaire for children between 3 and 7 years of age. This instrument consists of 15 scales. Factor analytic studies have shown that the scales can be grouped under three superfactors. The first factor, labelled as *Extraversion/Surgency*, loads positively on the scales of impulsivity, high intensity pleasure, activity level, approach, smiling/laughter, and negatively on shyness. The second factor, labelled as *Negative Affectivity*, loads positively for the scales of sadness, discomfort, anger/frustration, fear, and negatively for falling reactivity/soothability. The third factor, *Effortful Control*, is positively defined by the scales of low intensity pleasure, inhibitory control, perceptual sensitivity, and attentional focusing (Rothbart & Bates, 1998).

In recent years, there have been a growing number of studies investigating the relationship between temperament and stuttering. Using Rothbart's triad of positive and negative reactivity versus self-regulation, many of the findings from these studies can be understood as pointing towards increased reactivity or reduced self-regulation, or a combination of both in people who stutter. Evidence for an increase in positive reactivity are findings that show CWS to be (a) more sensitive and/or reactive to environmental changes (Fowlie & Cooper, 1978; Glasner, 1949; Guitar, 2003; Oyler (1988) in Zebrowski & Conture; Schwenk, Conture, & Walden, 2007; Wakaba, 1998), and (b) more active and impulsive (Embrechts, Ebben, Franke, & van de Poel, 2000). Higher ratings on scales for nervousness, anxiousness, fearfulness, and emotional reactivity point to an increase in negative reactivity (Fowlie & Cooper, 1978; Guitar, 2003; Karass, et al. 2006). Evidence for a reduced self-regulation are data suggesting that CWS are (a) less distractible (Anderson, Pellowski, Conture, & Kelly, 2003), (b) lower in adaptability (Anderson, Pellowski, Conture, & Kelly, 2003), (c) lower in inhibitory control (Embrechts, Ebben, Franke, & van de Poel, 2000), (d) less efficient in emotional and attentional regulation

(Karass, et al., 2006; Schwenk, Conture, & Walden, 2007), and (e) lower in biological rhythmicity (Anderson, Pellowski, Conture, & Kelly, 2003).

Although some of the observed differences between the stuttering and the non-stuttering participant groups in the various studies discussed so far may be taken to suggest some common traits, the results are far from unequivocal, especially since data were confounded by differences in age, gender, and test instruments used. Moreover it is not clear to what extent any temperamental differences are specific to stuttering or are shared with children who experience other forms of communication disorders. For instance, language development (Paul & Kellogg, 1997; Sajaniemi, Hakamies-Blomqvist, Makela, Avellan, Rita, von Wendt, 2001), and voice disorders (Green, 1989; Roy & Bless, 2000; Roy, Bless, & Heisey, 2000; Roy, McGrory, Tasko, Bless, Heisey, & Ford, 1997) are other speech-language disorders where possible associations with temperament are being explored. Specifically, the results of the Roy & Bless (2000) study indicated that people with vocal nodules scored higher on the extraversion trait, which is consistent with the higher scores on scales for acting out and distractibility found by Green (1989), which may make this a suitable comparison group for a study on stuttering.

When testing for mean group differences in temperament dimensions between CWS and other participant groups, it is implicitly assumed in most questionnaire-based studies that the underlying temperament structure is the same for the different groups. Byrne, Shavelson, and Marsh (1993) however, argued that this kind of multi-group analysis should ideally be preceded by testing if the structure of the underlying construct being measured is identical for the different groups. If this condition is not met, results of mean group score comparison will be difficult to interpret since possible differences in underlying construct could be confounding the results (Van den Bergh & Van Ranst, 1998).

With regard to the CBQ this assumption implies that the pattern and size of the relations between the different CBQ scales are the same across groups. This is an important assumption to be tested as it would determine whether temperamental differences observed between these groups of children constitute either real mean group differences or have possibly more to do with differences in the underlying temperamental make-up.

Therefore the purpose of this study was to examine the equivalence of the factorial temperament structure across CWS, TDC, and children with vocal nodules (CWVN), and by doing so, laying the basis for further comparison of mean group scores on the individual temperament scales (Eggers, De Nil, & Van den Bergh, 2008).

This was preceded by a reliability analysis of the Dutch version of the CBQ for 3-8 year olds since previous analysis by Van den Bergh & Ackx (2003) was only performed for a group of 8- and 9-year olds.

Method

Participants

Data were collected on 256 participants: 69 CWS (14 girls and 55 boys), 146 normal speaking children (controls, 63 girls and 83 boys), and 41 CWVN (5 girls and 36 boys). Table 1 provides participants' age ranges and mean ages per group. Because children under the age of four are only rarely referred to an ear, nose, and throat (ENT) specialist for voice problems resulting from vocal nodules (Dobres, Lee, Stemple, Klummer & Kretschmer, 1990) no CWVN were included in the youngest age group.

All of the participants were native Dutch speakers and had neither reported speech, language & hearing problems - except for stuttering in the CWS, and voice disorder in the CWVN - nor neurological, or psychological disorders. All CWS produced at least three or more within-word disfluencies (sound/syllable repetition, prolongation or blocks) and/or monosyllabic word repetition in 100 words of spontaneous speech (Conture, 2001), and scored at least ‘mild’ on a standardised stuttering severity test. Stuttering severity was assessed by the child’s own speech-language therapist, based on the Stuttering Severity Instrument-3 (SSI-3; Riley, 1994) or the Test for Stutter Severity-Readers/Non-Readers (TvS-L/NL; Boey, 2000). All therapists were qualified stuttering treatment experts who had completed a 2-year specialization training program. Seventeen percent of the stuttering children were classified as mild (7 boys and 5 girls), 65% were classified as moderate (38 boys and 7 girls), 16% were rated severe (9 boys and 2 girls), and 1% was found to be very severe (1 boy). Five of the CWS had not received fluency therapy prior to the data collection. The other 64 CWS had received fluency therapy for a period of time ranging from 1 month to 26 months (mean = 8.6 months; SD = 7.1). The CWVN were all diagnosed by an ENT-specialist during laryngoscopic examination as having vocal nodules. Eleven of the CWVN had not yet received voice therapy. The other 30 CWVN were receiving therapy at the time of testing for a period ranging from 1 month to 17 months (mean = 5.2 months; SD = 4.1).

Detection Instrument for Stuttering

The ‘Detection Instrument for Stuttering’ (DIS; Stes & Boey, 1997), a parental questionnaire, was completed by all parents. The DIS is a Dutch, validated screening instrument for stuttering. It consists of 6 questions exploring core and secondary behaviors, frequency of disfluencies, attitude of the child towards speaking, listener reactions, and time since onset of the disfluencies (e.g., ‘What kind of disfluencies does your child produce’, ’How does your child react during these disfluencies’). Each question is scored, weighed and a total score is calculated. Total scores range between 6 and 21. A score below 8 indicates the absence stuttering while scores above 12 are an indication for stuttering. Scores between 8 and 12 are in need of further testing. The instrument has a sensitivity of 0.92, a specificity of 0.88 and a predictive value of 1.05 (based on a sample of 513 children, 77 CWS and 436 controls).

In order to assure that the normally fluent children as well as the voice disordered children did not experience any stuttering difficulties, all children in the two control groups who scored higher than a ‘6’, the lowest score possible, were excluded from the study.

Temperament Questionnaire

Temperament of the participants was evaluated by making use of the Dutch version of ‘Children’s Behavior Questionnaire’ (CBQ; Van den Bergh & Ackx (2003). The CBQ is a parent-report questionnaire aimed at children between the age of 3 to 7 years (up to 9 year olds for the Dutch version), and thus incorporates traits that are present in early childhood as well as later developing traits. It originally consisted of 15 subscales. Three scales (motor activation, excitatory control, and attentional shifting) were later added by Rothbart and colleagues, as documented in Van den Bergh and Ackx (2003), resulting in a total of 234 questions (233 in the Dutch version). In order to complete the questionnaire, parents rate each item using a 7-point Likert scale (1 = extremely untrue of your child, 2 = quite untrue of your child, 3 = slightly untrue of your child, 4 = neither true nor false of your child, 5 = slightly true of your child, 6 = quite true of your child, and 7 = extremely true of your child). When the child has not been observed in a situation as described in one of the items, a “not applicable” response option is provided. The CBQ scale descriptions and sample items are presented in Appendix A.

Procedure

All of the participating CWS and CWVN were contacted through their speech-language therapist. Absence of any other speech, language, and hearing problems, and neurological or psychological disorders was checked by the SLP. Children with reported concomitant problems, or children who had ever had concomitant problems in the past, were not selected as participants. The instructions for completing the questionnaires were given by the speech-language pathologist to the parents of the participants. The parents were asked to fill out the questionnaire at home and to return it at the following treatment session. The CBQ, DIS-form, together with the scores on the standardised stuttering severity test - which was administered by the speech-language therapist -were returned in a self-addressed and stamped envelope. Since the vast majority of the questionnaires were completed by the mothers, only these were used; 7 questionnaires, completed by the father or by the father and the mother together, were discarded.

The healthy control participants were recruited from three elementary schools. The questionnaires, with the written instructions, and the DIS-forms were distributed through the schools. The questionnaires were returned in a closed envelope to the school teacher where they were collected. Absence of speech, language, and hearing problems, as well as neurological or psychological disorders was determined by a qualified speech-language pathologist (first author) and based on parental and teacher reports combined with reports from Centers for Student Guidance who evaluate each school-age child once during each academic year for speech, language, and hearing problems. Reasons for exclusion from the control group included reported language and articulation difficulties, possible ADHD, and other reported problems, which could have affected the outcome of our results.

Data analysis

Internal consistency (Cronbach α) of the CBQ scales was determined. Reliability differences between scales of different participant groups were tested using the program 'Alphatest' (Hox, 2006).

An exploratory factor analysis, using principle axis factoring, based on the matrix of intercorrelations of the scores on the original 15 CBQ scales was used to investigate the factor structure. Factor analysis is a multivariate statistical technique used to reduce a large number of variables into a smaller number of latent variables or 'factors'. In this study we wanted to uncover the underlying structure for the 15 CBQ scales. Figure 1 gives a schematic overview of the exploratory factor analysis.

The extent to which a factor plays a role in the score on an individual variable is expressed in a weighing factor ranging from 0 (no role) to 1 (fully determined), also called 'factor loading'. Mathematically this is the correlation between the variable and the factor. Therefore the squared factor loading indicates the proportion of variance in that variable explained for by the factor (common variance). The total variance for all variables explained by a factor is called the 'eigenvalue'.

To facilitate the interpretation of a factor structure it is feasible that a) every variable has a high factor loading on just one factor, b) every factor consists of more then one variable, and c) most factor loadings are either high or low. Since this is usually not the case, it is often necessary to redefine the factors using a rotation method (Figure 2). Oblique rotations allow for the factors to be correlated, while orthogonal methods do not. Analogous to Rothbart et al. (2001), we used an oblique rotation method to obtain a clear pattern of loadings. The extracted factors were rotated using a Promax rotation.

Kaiser's criterion, stating that only factors with eigenvalues greater than or equal to 1 should be retained, was used (Bryant & Yarnold, 1995; Maris, 2003).

Factor congruence coefficients were computed to asses the similarity of the mutual structure for the TDC, CWS, and CWVN. The use of congruence coefficients is quite common in literature (Korth & Tucker, 1975; Koschat & Swayne, 1991; Rolland, Parker, & Stumpf, 1998; Sakamoto, Kijima, Tomoda, & Kambara, 1998; Shek, 1988; Voeten & van den Bercken, 2003) and examines the extent to which the scales have similar loadings on two compared factors. In this analysis the scales are treated as cases and the factors as variables. The correlation is computed between the loadings that the scales have on the 3 factors in each sample. The coefficient takes values from 1.00 (perfect positive similarity) through 0 (total dissimilarity) to -1.00 (perfect negative similarity).

Different authors use different reference systems for the amount of congruence. Sakamoto et al. labeled coefficient values above .80 as 'high' and above .90 as 'very high'. Koschat and Swayne claimed factors were virtually equal above coefficient value of .85.

Results

Dutch CBQ scale reliabilities

Table 2 presents the internal reliability coefficients (Cronbach α) for the data reported in this paper and previous studies. The internal reliability coefficients of the current samples ranged from .58 (low intensity pleasure) to .91 (shyness) and all of the scales, except for the scale of low intensity pleasure in one participant group, have coefficients above .60. There was an average internal consistency of .75 for the 15 scales. These data compare favorably with previous Dutch and US data as reported by Van den Bergh and Ackx (2003) and Rothbart et al. (2001), which were also added in table 2.

Comparison of reliabilities shows that the scales of activity level and attentional focusing are more reliable in the Dutch version whereas the scale of smiling/laughter is more reliable in the English version. The scales of low intensity pleasure and shyness were less reliable for some of the participant groups in the Dutch version. Cronbach α's did not differ significantly for the other scales.

Structure of Dutch CBQ scales

Factor structure of typically developing children

Table 3 illustrates the factor pattern matrix for the 3 participant groups. For the TDC three factors were found with eigenvalues greater than 1, in total accounting for 49.77% of the explained variance.

The first factor (eigenvalue = 3.06; 20.11% explained variance) was defined by the scales impulsivity, activity level, high intensity pleasure, approach, smiling & laughter, and a negative loading on shyness. The size of the loadings were equivalent to those reported by Rothbart et al. (2001) but higher than those reported by Van den Bergh and Ackx (2003), except for a slightly lower loading for smiling/laughter and shyness. The scales approach and shyness also loaded on factor 2, consistent with the findings by Rothbart et al. and Van den Bergh and Ackx. In contrast to the study by Van den Bergh and Ackx, smiling/laughter also loaded on factor 3, analogous to Rothbart, et al.

The second factor (eigenvalue = 2.51; 16.55% explained variance) was defined by positive loadings for the scales discomfort, sadness, anger/frustration, fear, and a negative loading on the scale of falling reactivity/soothability. The size of the loadings were comparable or even higher as those in the study by Rothbart et al. (2001) except for a slight lower loading on falling reactivity/soothability. In contrast to the results in the study by Van den Bergh and Ackx (2003), anger/frustration also loaded on factor 1 although this is in line with findings by Rothbart et al. (2001) in 6 and 7 year olds.

The third factor (eigenvalue = 1.99; 13.10% explained variance) had high loadings on low intensity pleasure, perceptual sensitivity, inhibitory control, and attentional focusing. Inhibitory control also loads, although negatively, on factor 1, conform Rothbart et al. (2001) and Van den Bergh and Ackx (2003). The strength of the loadings is comparable to Rothbart et al.

Factor structure of children who stutter

The principal factor analysis of the CBQ scores obtained for the CWS identified three factors with eigenvalues greater than 1.

The three factors together explained 53.53% of the variance. The first factor (eigenvalue = 3.36; 22.22% explained variance) loaded on the same scales as those observed for the control participants, except for anger/frustration. The scales impulsivity, activity level, shyness, and inhibitory control had a higher loading whereas the loading for all the other scales was lower than that observed for the control group.

Factor 2 (eigenvalue = 3.01; 19.87% explained variance), included the same scales as the control group, except for shyness, plus the inhibitory control scale. All scales, except the fear scale, had stronger loadings to those in the control group.

The final factor (eigenvalue = 1.73; 11.44% explained variance), was composed of the same scales as those for the control group except for inhibitory control. All scales except low intensity pleasure loaded higher then the TDC.

Factor structure of children with vocal nodules

Three factors were recovered and together they accounted for 56.79% of the explained variance. In contrast to the other 2 participant groups, the strongest factor (eigenvalue = 3.68; 25.00% explained variance) for the CWVN contained the scales of anger/frustration, sadness, falling reactivity/soothability, fear, and discomfort, which complies with the second factor in the other two participant groups. Similar to the CWS but contrary to the TDC, inhibitory control also loaded negatively on this factor. The fact that perceptual sensitivity also loaded was different from Rothbart et al. (2001) but consistent with Van den Bergh and Ackx (2003). All the scales, except for discomfort loaded higher compared to the TDC.

The second extracted factor (eigenvalue = 2.85; 19.36% explained variance), had similar components as the first extracted factor in the control group, with the exception of the anger/frustration scale which did not load on this factor for the children in this group, similar to those in the stuttering group. In contrast, the discomfort scale did load on the second factor. The scales of discomfort and inhibitory control had higher loadings then for the TDC; while loadings on the other scales were lower or almost identical.

In contrast to the other participant groups, the third factor (eigenvalue = 1.83; 12.43% explained variance) comprised the approach scale. Similar to the CWS this factor did not include inhibitory control. Low intensity pleasure, attentional focusing, and approach loaded higher whereas perceptual sensitivity and smiling/laughter had a lower loading.

Factor congruence coefficients

Congruence analysis results based on the rotated factor matrices of the three participant groups are shown in Table 4. The resulting congruence coefficients ranged from .86 to .97. The highest congruence in factor structure was found between the CWS and the TDC with coefficients ranging from .94 (Effortful Control) to .97 (Extraversion/Surgency and Negative Affect). The comparable congruence coefficients for the CWVN were somewhat more modest, ranging from .86 (Effortful Control) to .94 (Extraversion/Surgency and Negative Affect). The congruence was found to be the lowest for the superfactor of Effortful Control.

Discussion

Earlier studies have already reported mean group differences in temperament dimensions between stuttering, voice disordered, and normal speaking individuals (Anderson, Pellowski, Conture, & Kelly, 2003; Embrechts, Ebben, Franke, & van de Poel, 2000; Fowlie & Cooper, 1978; Glasner, 1949; Guitar, 2003; Karass, et al., 2006; Lewis & Goldberg, 1997; Oyler (1988) in Zebrowski & Conture; Roy & Bless, 2000; Schwenk, Conture, & Walden, 2007; Wakaba, 1998) but it is unclear to what extent the underlying structure of the temperamental construct is uniform. The present study used factor analysis to investigate the presence or absence of such structural differences in the factorial temperament matrix.

Dutch CBQ scale reliabilities

Van den Bergh and Ackx (2003) translated the CBQ (Rothbart, Ahadi, Hershey & Fisher, 2001) into Dutch and their internal consistency data have already shown the Dutch version of the CBQ to be a reliable temperament questionnaire for 8- and 9-year-olds. Reliability analysis in this study shows that this also applies for 3- to 8-year-olds. Average reliability ($\alpha = .75$) was identical to Rothbart et al.'s findings in 6- and 7-year-olds and somewhat higher compared to her 4- and 5-year-old group ($\alpha = .73$). We compared scale reliabilities using Hox's Alphatest and reported on significant global differences between the Dutch and the English version. Although this test also allows for post hoc pairwise group comparison, these data would not have added significantly to our study.

Structure of temperament

The principle axis factor analysis performed on the CBQ data of the control group, revealed a three-factor solution. Because the loading on these factors was almost identical to earlier reported data based on American (Rothbart, Ahadi, Hershey & Fisher, 2001), Chinese (Ahadi, Rothbart, & Ye, 1993), Japanese (Kusanagi, 1993), and Dutch samples (Van den Bergh & Ackx, 2003), it seems justifiable to label these factors with the descriptors used in these previous studies. Therefore, we will refer to these factors as Extraversion/Surgency, Negative Affectivity, and Effortful Control. In addition, given the parallel between our results and those reported by Van den Bergh and Ackx, the obtained reliability coefficients and the factor structure confirmed both the validity of the Dutch questionnaire and the validity of our control group.

Similar to the control group, the factor analysis for the CWS and CWVN derived three superfactors. With regard to the factor *Extraversion/Surgency*, CWS had higher loadings on impulsivity, activity level, and shyness, although the last one had a negative loading. The speed in which responses are generated (impulsivity) and gross motor activity seem to be the most determining scales in this superfactor for the CWS. Absence of inhibitory control for the CWS was more associated with Extraversion/Surgency then the control group.

For the CWVN, on the other hand, the loadings for all scales were typically lower than for the other two groups, except for the loading on smiling/laughter, which was equivalent to the TDC; contrary to the other groups the absence of discomfort was also associated with this superfactor.

All of the scales related to *Negative Affect*, except for discomfort and fear, loaded higher for the CWS and the CWVN compared to the TDC. The discomfort scale loaded higher for the CWS, and fear loaded higher for the CWVN. Higher loadings compared to the control subjects was especially noticeable for the falling reactivity/soothability scale. These findings may be taken to suggest that in the two groups of children with communication disorders, this trait plays a more important role in the make-up of the three temperamental factors, compared to the typical developing children. When confronted with distressing situations, the lack of soothability will more rapidly evoke feelings of negativity such as discomfort, sadness, or frustration.

Opposite to the TDC, the absence of inhibitory control was associated with Negative Affect in CWS and to a lesser degree in CWVN. In CWVN, perceptual sensitivity was also associated with Negative Affect. It may be the case that perceptual sensitivity in this group will lead to an increase in Negative Affect.

With regard to the superfactor of *Effortful Control* the loadings on the attentional focusing scale were higher for CWS, and even more for CWVN. The attentional skills addressed in inhibitory control tasks have been related to the development of the executive attention system (Gartstein & Rothbart, 2003) and higher loadings on attentional focusing were linked to lower loadings on inhibitory control. This is consistent with the lower loadings found for the CWS and CWVN on the scale of inhibitory control. In both of these groups the capacity to plan and to suppress inappropriate responses seems less present as a contributing factor in self-control.

The fact that the loadings for low intensity pleasure gradually increase when we compared CWS, TDC, and CWVN may be explained by the increasing mean age of these participant groups.

For the same reason an increase in the loadings for perceptual sensitivity could have been expected although a different pattern emerged. In the group of CWS we saw that the perceptual sensitivity scale had higher loadings than the control group. The fact that in the CWVN group, which had the oldest mean age, this scale contributed the least to the factor of Effortful Control, probably demonstrates that this group is least able to use the detection of low intensity stimuli as a self-regulative tool.

Finally, in CWVN the amount of positive anticipation for pleasurable activities (approach) seems more related to the factor of Effortful Control compared to other groups; probably an effect that can be partly attributed to the lowest loading of all participant groups on inhibitory control.

The aforementioned findings in CWS of higher loadings on attentional focusing and perceptual sensitivity and a lower loading on inhibitory control may mean that their self-regulative system is more easily triggered by small changes in their external (e.g., being interrupted when speaking) and internal (e.g., monitoring their own speech behaviors) environment. If these changes are experienced as stressful by the children, it may be that they will tend to focus their attention on these changes more strongly, thereby maintaining or exacerbating the experienced stress level even more. This, in turn, may inhibit their ability to respond in more appropriate ways to their changing environment. Although this will need to be studied in more detail and confirmed in future studies, recent publications by Karass et al. (2006) and Schwenk, Conture, & Walden (2007) also emphasize the possible role of attentional processes in stuttering and hypothesize that CWS, who were found to be more reactive to environmental changes and less efficient in attentional regulation, when confronted with speech errors might fixate on these errors, which might contribute to an increase in negative reactivity.

Congruence of temperament structures

Congruence coefficients show that the similarity in the factorial matrix is least strong between the TDC and the CWVN. One could assume that this is partly due to mean age differences of the participant groups, with the CWVN having the highest mean age. This is also reflected in the fact that of the three superfactors, Effortful Control seemed to yield the lowest similarity between all groups, which is consistent with the idea that the self-regulative system becomes more influential with increasing age (Rothbart & Posner, 1985).

Based on the high congruence coefficients between the TDC, the CWS, and the CWVN, we can conclude that the factor structure of these three groups is highly similar. Appropriate methods, using Jöreskog and Sörbom's (2006) LISREL confirmatory factor analyses, could be applied to gain more insight in the factorial invariance, including equivalence of measurement and equivalence of structure. Van den Bergh and De Rycke (2003) describe how after establishing well-fitting baseline models for each group, equality of factor loadings, error variances per item, and correlations between factors can be tested in constrained and less restrictive models.

While we have discussed some congruence and scale loading differences between the groups in the previous section, it is important to emphasize that these differences were all very subtle differences and as such should not be overinterpreted . Given the high similarity in temperament structure between the three groups, we can tentatively conclude that possible group differences on the individual temperament scales between CWS, CWVN, and TDC reflect real differences and are not a consequence of differences in underlying temperamental construct.

What remains to be seen is whether these similarities in underlying temperament structure are specific to the model suggested by Rothbart et al. (2001) or can be confirmed in other theoretical models as well. It also remains to be investigated whether differences on temperamental scales result in measurable differences in observable behavior between these groups of children. Further research, based on direct observations, behavioral experiments, psychophysical, and/or psycho physiological measures is therefore needed for a multidimensional and more in depth view of possible differences and relationships. This would also overcome possible limitations of parental questionnaires, as addressed by some authors (e.g., Kagan, 2001; Strelau, 1998; Vaughn, Taraldson, Cuchton, & Egeland, 2002), i.e. susceptibility to parental bias and low interparental agreement, but contested by others (e.g., Rothbart & Bates, 1998; Slabach, Morrow, & Wachs, 1991), who would argue for the satisfactory test-retest reliability, cross-time stability, as well as a moderate to strong degree of validity of these questionnaires.

Finally, it remains to be seen whether temperamental differences can be translated into disorder specific, diagnostic, and therapeutic intervention strategies.

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APPENDIX A

CBQ scale descriptions and sample items

Activity Level. The level of gross motor activity including rate and extent of locomotion. Sample item: Moves about actively (runs, climbs, jumps) when playing in the house.

Anger/Frustration. The amount of negative affect related to interruption of ongoing tasks or goal blocking. Sample item: Gets quite frustrated when prevented from doing something s/he wants to do.

Approach. The amount of excitement and positive anticipation for expected pleasurable activities. Sample item: Becomes very excited while planning for trips.

Attentional focusing. The tendency to maintain attentional focus upon task-related channels. Sample item: When picking up toys or other jobs, usually keeps at the task until it's done.

Discomfort. The amount of negative affect related to sensory qualities of stimulation, including intensity, rate or complexity of light, movement, sound or texture. Sample item: Is quite upset by a little cut or bruise.

Falling reactivity/Soothability. The rate of recovery from peak distress, excitement or general arousal. Sample item: Calms down quickly following an exciting event.

Fear. The amount of negative affect, including unease, worry or nervousness related to anticipated pain or distress and/or potentially threatening situations. Sample item: Is afraid of loud noises.

High intensity pleasure. The amount of pleasure or enjoyment related to situations involving high stimulus intensity, rate, complexity, novelty and incongruity. Sample item: Likes to play so wild and recklessly that s/he might get hurt.

Impulsivity. The speed of response initiation. Sample item: Usually rushes into an activity without thinking about it.

Inhibitory control. The capacity to plan and to suppress inappropriate approach responses under instructions or in novel or uncertain situations. Sample item: Can easily stop an activity when s/he is told “no”.

Low intensity pleasure. The amount of pleasure or enjoyment related to situations involving low stimulus intensity, rate, complexity, novelty and incongruity. Sample item: Enjoys “snuggling up” next to a parent.

Perceptual sensitivity. The amount of detection of slight, low intensity stimuli from the external environment. Sample item: Is quickly aware of some new items in the living room.

Sadness. The amount of negative affect and lowered mood and energy related to exposure to suffering, disappointment and object loss. Sample item: Becomes upset when loved relatives or friends are getting ready to leave following a visit.

Shyness. Slow or inhibited approach in situations involving novelty or uncertainty. Sample item: Sometimes prefers to watch rather than join other children playing.

Smiling/Laughter. The amount of positive affect in response to changes in stimulus intensity, rate, complexity and incongruity. Sample item: Laughs a lot at jokes and silly happenings.

Motor activation. The amount of excess repetitive small-motor movement, such as finger tapping. Sample item: Fidgets during quiet activities, such as hearing a story, looking at pictures.

Excitatory control. The capacity to perform an action when there is a strong tendency to avoid it. Sample item: Forces her/himself to complete projects, even when tired.

Attentional shifting. The ability to transfer attentional focus from one activity/task to another. Sample item: Can easily shift from one activity to another.

Table 1

Age Ranges and Mean Ages of CWS (n = 69), Controls (n = 146) and CWVN (n = 41) for 3- & 4-, 5- & 6-, and 7- & 8-Year Olds.

	CWS			Controls			CWVN		
Age group	***n***	***Range***	***M***	***n***	***Range***	***M***	***n***	***Range***	***M***
Age 3 & 4	26	3;02 - 4;11	4;01	40	3;01 - 4;11	3;10	0	-	-
Age 5 & 6	22	5;00 - 6;11	5;10	38	5;00 - 6;11	6;01	20	5;00 - 6;11	5;11
Age 7 & 8	21	7;02 - 8;11	8;03	68	7;00 - 8;11	8;00	21	7;01 - 8;11	8;01

Table 2

CBQ scales internal reliability coefficients (Cronbach α) for the current study, the Dutch samples (Van den Bergh & Ackx, 2003), and the US samples (Rothbart, Ahadi, Hershey, & Fisher, 2001).

	Current study			**Previous studies**		
Scales	**TDC[a] (3;01 - 8;11)**	**CWS[b] (3;02 - 8;11)**	**CWVN[c] (5;00 - 8;11)**	**Dutch[d] (8;10 – 9;02)**	**US[e] (4;00 – 5;11)**	**US[f] (6;00 – 7;11)**
Activity level **	.79	.87	.81	.83	.75	.75
Anger/frustration	.80	.80	.83	.84	.80	.81
Approach	.71	.80	.75	.81	.74	.77
Attentional focusing***	.83	.80	.80	.87	.67	.69
Discomfort	.72	.73	.82	.66	.73	.67
Falling reactivity/soothability	.69	.67	.60	.47	.66	.67
Fear	.77	.75	.65	.73	.70	.70
High intensity pleasure	.76	.83	.79	.77	.79	.77
Impulsivity	.74	.78	.74	.72	.74	.78
Inhibitory control	.78	.75	.73	.82	.76	.78
Low intensity pleasure *	.75	.58	.69	.55	.64	.73
Perceptual sensitivity	.77	.67	.79	.71	.64	.71
Sadness	.68	.61	.79	.56	.69	.71
Shyness **	.88	.90	.91	.84	.92	.92
Smiling/laughter **	.64	.70	.68	.67	.75	.80

[a] *N* = 146, [b] *N* = 69, [c] *N* = 41, [d] *N* = 71, [e] *N* = 228, [f] *N* = 183

Results overall p-value Alphatest: *p < .05, **p < .01, ***p < .0001

Table 3

Factor pattern based on 15 subscales of the Children's Behavior Questionnaire (CBQ; Rothbart, Ahadi, Hershey, & Fisher, 2001) of the TDC (n = 146), CWS (n = 69), and CWVN (n = 41).

Scales	Factor loadings								
	Factor 1			Factor 2			Factor 3		
	TDC	CWS	CWVN	TDC	CWS	CWVN	TDC	CWS	CWVN
Extraversion/Surgency									
Impulsivity	.858	.917	.824	-.292	-.096	-.109	.014	-.020	-.067
Activity level	.750	.850	.721	-.004	-.055	.272	-.181	-.059	-.262
High intensity pleasure	.754	.708	.662	-.144	-.118	-.066	-.103	.052	-.054
Approach	.517	.489	.478	.346	.377	.615	.253	.110	.361
Shyness	-.510	-.555	-.472	.415	.271	.479	-.047	-.049	-.070
Smiling/laughter	.498	.399	.493	-.042	-.068	-.153	.623	.636	.373
Negative Affect									
Discomfort	-.074	-.196	-.466	.737	.750	.646	.125	.126	.069
Sadness	-.046	.044	-.081	.695	.832	.766	.068	.069	-.099
Anger/frustration	.394	.247	.191	.647	.751	.815	-.101	-.013	.038
Fear	-.201	-.283	-.257	.544	.467	.661	.141	-.063	-.190
Falling reactivity/soothability	.213	.209	.078	-.455	-.729	-.735	.230	.026	-.103
Effortful Control									
Low intensity pleasure	-.061	-.188	-.191	.160	.071	-.104	.733	.651	.827
Perceptual sensitivity	-.009	.046	-.128	.191	.191	.411	.622	.695	.507
Inhibitory control	-.332	-.565	-.351	-.292	-.377	-.351	.529	.279	.196
Attentional focusing	-.225	-.093	.087	-.142	-.092	-.087	.430	.543	.660

Note. Factor loadings > /.30/ are highlighted.

Table 4

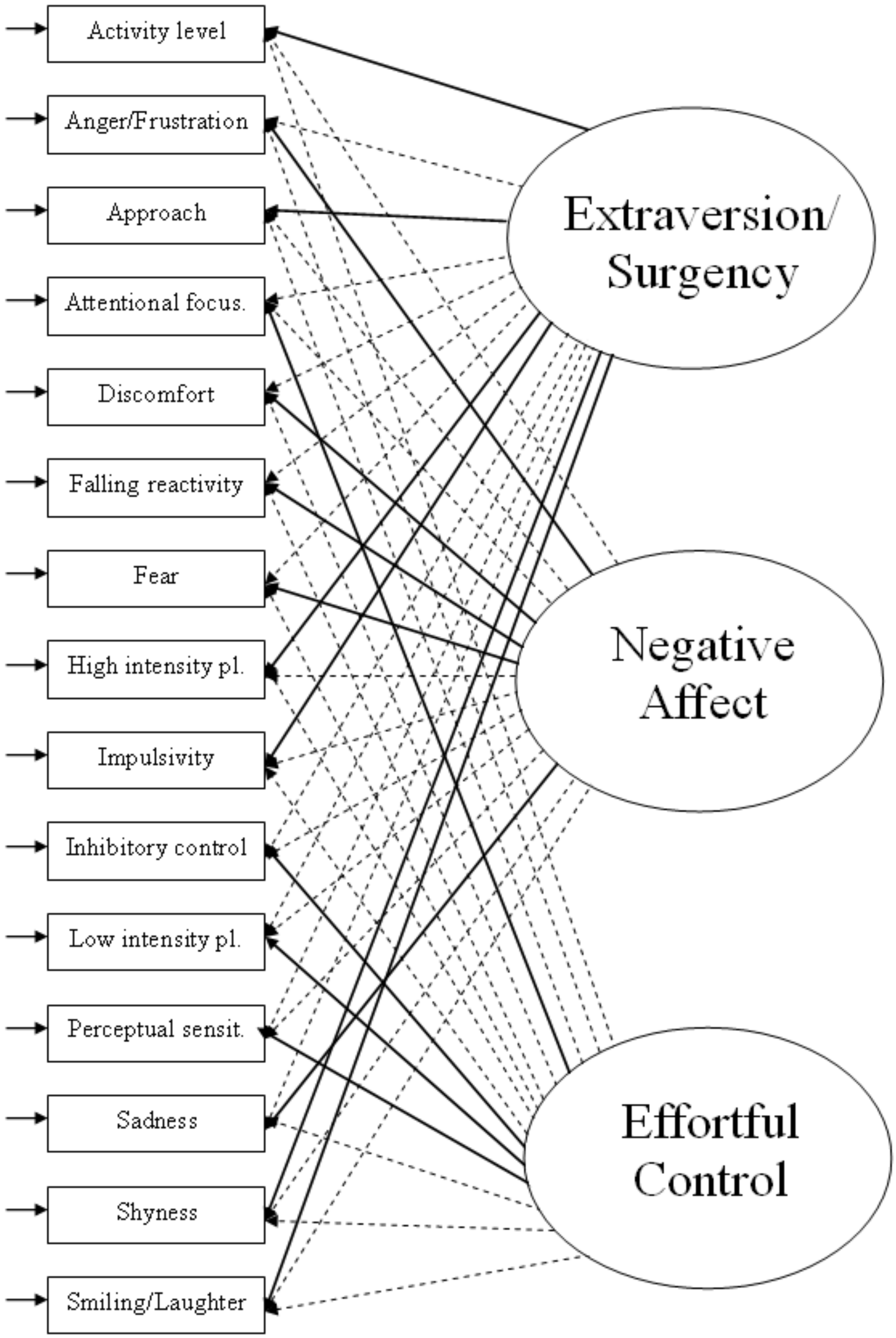
Factor congruence coefficients based on the comparison of the TDC (n = 146; mean age = 6;4), CWS (n = 69; mean age = 5;1), and CWVN (n = 41; mean age = 7;1).

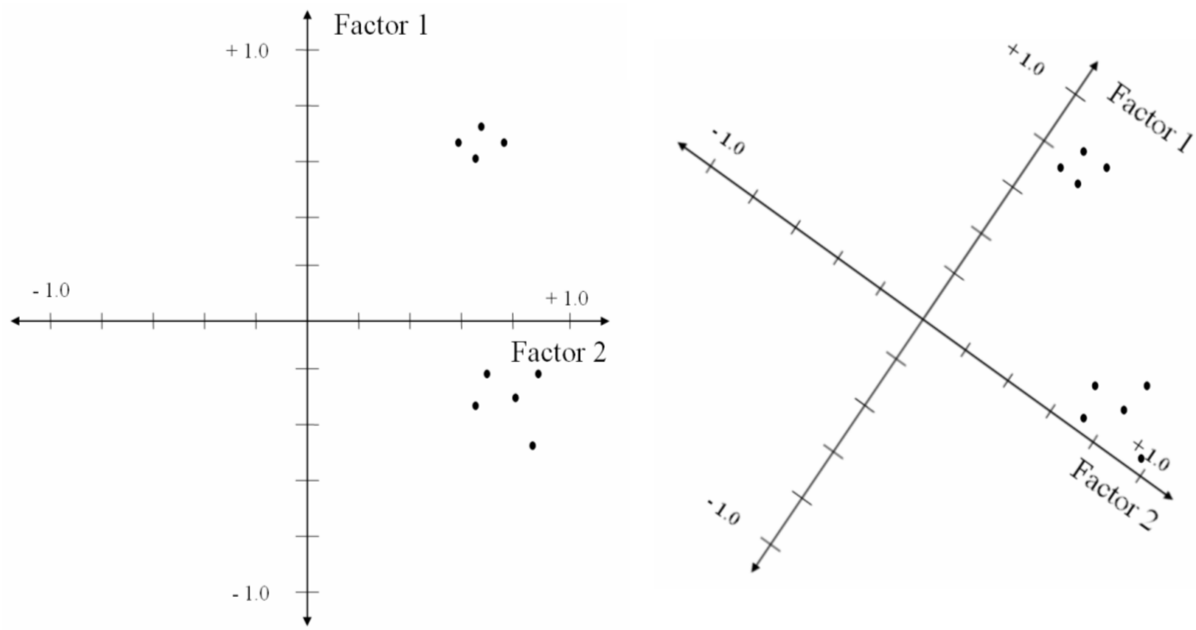
	Factor		
	1	**2**	**3**
Groups	**Extraversion/Surgency**	**Negative Affect**	**Effortful Control**
TDC versus CWS	.975	.974	.938
CWS versus CWVN	.961	.951	.905
TDC versus CWVN	.940	.940	.858

Figure Captions

Figure 1. Schematic overview of the exploratory factor analysis.

Figure 2. Illustration of rotation of a 2-factor solution after initial factor analysis.


Activity level
Anger/Frustration
Approach
Attentional focus.
Discomfort
Falling reactivity
Fear
High intensity pl.
Impulsivity
Inhibitory control
Low intensity pl.
Perceptual sensit.
Sadness
Shyness
Smiling/Laughter
Extraversion/
Surgency
Negative
Affect
Effortful
Control



Factor 1
+ 1.0
- 1.0
+ 1.0
Factor 2
- 1.0
+1.0
Factor 1
-1.0
+1.0
Factor 2
-1.0