Identifying Finnish Children's Impulsivity Trajectories from Kindergarten to Grade 4: Associations with Academic and Socio-Emotional Development

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Abstract

Research Findings: The purpose of this study was to identify the developmental trajectories of impulsive behavior among 378 Finnish children who were followed from kindergarten to fourth grade. In addition to ratings of children's impulsivity, the analyses included measures of motivation, cognitive skills, socio-emotional adjustment, and teacher–student relationship. Four latent groups were identified that differed in the level and change of the children's impulsive behavior across time: first, a group with low impulsivity; second, a group with decreasing impulsivity; third, a group with moderate impulsivity; and, fourth, a small group with a contradictory trajectory showing an upward trend in impulsivity. The "decreasing" group showed compromised behavioral regulation in kindergarten but not thereafter, and it was the poorest performing group in reading. Both the "moderate" and "decreasing" groups received negative ratings from their teachers with respect to socio-emotional adjustment and relationships with the teacher. The "moderate" group predominantly included boys, whereas the "low impulsivity" group had a higher ratio of girls. *Practice or Policy:* By linking the different trajectories of impulse control development to children's socio-emotional adjustment and teacher–student relationships in a meaningful way, the findings highlight the importance of behavioral regulation skills in the classroom.

Keywords: behavioral regulation, developmental trajectories, early school years, impulsive behavior, self-regulation, socio-emotional adjustment, teacher-student relationships

Identifying Finnish Children's Impulsivity Trajectories from Kindergarten to Grade 4: Associations with Academic and Socio-Emotional Development

It is widely acknowledged that self-regulation as manifested in children's ability to monitor, modulate, and direct their cognitive functions, attention, emotions, and behavior (e.g., Berger, Kofman, Livneh, & Henik, 2007; McClelland & Cameron, 2012) is critical for children's school readiness and successful adjustment (e.g., McClelland et al., 2007; Ponitz, McClelland, Matthews, & Morrison, 2009). Children's ability to control impulses and, thus, regulate their behavior in the classroom context contributes to how they benefit from that environment with respect to learning and adjustment outcomes (Morrison, Ponitz, & McClelland, 2010). Behavioral regulation has been shown to be an important predictor of both academic (McClelland, Acock, & Morrison, 2006; Valiente, Lemery-Chalfant, Swanson, & Reiser, 2008) and social functioning (Eisenberg et al., 1995; Fabes et al., 1999), and to have associations with teacher-student relationship quality (Henricsson & Rydell, 2004; Ladd, Birch, & Buhs, 1999). Ability to regulate impulsive behavior as a component of self-regulation is highly relevant in the classroom context where children are expected to be able to sit still, to wait for their turn, to follow instructions, and to think before acting. Yet, the development of impulse control and regulation skills across early school years has thus far received less attention than the development of these skills in the preschool years and in kindergarten (for exceptions, see Aro, Eklund, Nurmi, & Poikkeus, 2012; Klenberg, Korkman, & Lahti-Nuuttila, 2001). The present study aimed to identify developmental trajectories of Finnish children's regulation of impulsive behavior over a five-year period across the transition from kindergarten to first grade and further to fourth grade, and to examine potential differences in academic and social functioning between the identified subgroups of children.

Development of Regulation of Impulsive Behavior

The domain of self-regulation most directly linked to impulsivity is behavioral regulation which has been defined as the ability to engage in inhibitory control, to sustain attention, and to form situationally appropriate behavioral responses (McClelland et al., 2007) by listening and following instructions, resisting distractions, and inhibiting impulsivity (e.g., von Suchodoletz, Trommsdorff, Heikamp, Wieber, & Gollwitzer, 2009). Behavioral regulation requires the use of basic executive functions, such as attention, working memory, and inhibitory control (McClelland et al., 2007; Ponitz et al., 2009). According to Olson, Schilling, and Bates (1999), the executive function skills of inhibitory control, speed of response initiation, resistance to temptation, and ability to delay gratification are important subdimensions of impulsivity. Following these definitions, we focused in the present study on children's *regulation of impulsive behavior*.

Impulse control as a component of self-regulation develops through a continuum of phases which, after infancy, first take the form of control of behavior and emotions based on an awareness of externally set demands and monitoring (Kopp, 1982; see also Kochanska, Coy, & Murray, 2001), and later is manifested as control in the absence of external monitors. Different components of regulation and executive function skills develop at different times (see Cartwright, 2012; Klenberg et al., 2001). For example, by age 3, children's working memory and ability to shift attention show considerable development, whereas inhibitory control skills keep improving between the ages of 3 and 6 (see Cartwright, 2012). Rapid gains in children's ability to control their behavior and mental processes are associated with physiological maturation and structural changes in the prefrontal cortex that is responsible for goal-directed behavior (Cartwright, 2012; von Suchodoletz et al., 2013; Zelazo et al, 2013; Zhou et al., 2007).

In addition to these naturally occurring neurobiological processes, the development of impulse control is influenced by experiences and social interactions of the individuals with

their environments (Blair & Diamond, 2008; Morrison et al., 2010; Zelazo et al., 2013). The way in which caregivers and peers react to children's attempts to regulate their own behavior can either maintain the level of their impulse control or turn the course of its development. Consequently, the development of impulse control does not stop at any given time point but can be expected to continue across school years as children gain more experiences and interact with their interpersonal environments.

The development of behavioral regulation has been avidly charted concerning the preschool and kindergarten period. However, less is known about the development of regulation skills and impulse control among school-aged children (Macdonald, Beauchamp, Crigan, & Anderson, in press; Olson et al., 1999; Zhou et al., 2007). Significant individual differences have been reported in the development of behavioral regulation at kindergarten age (Ponitz et al., 2009; von Suchodoletz et al., 2013), but it is unclear whether these differences remain or diminish at school age. Cross-sectional evidence suggests that older children are faster and more accurate in inhibitory control tasks (Klenberg et al., 2001; Macdonald et al., in press; Williams, Ponesse, Schachar, Logan, & Tannock, 1999). Motor inhibition and impulse control are among the first executive function skills to develop in early childhood, and maturity can be reached in simple tasks of motor inhibition and impulse control at 6 or 7 years of age (see Klenberg et al., 2001) after which the development of these skills levels off. It is likely, however, that in tasks that require inhibition in conjunction with more complex executive functions, such as planning and sustained attention, skill development and individual differences continue through school years. For example, in their longitudinal study of children from ages 5 to 10, Zhou and colleagues (2007) identified three stable developmental trajectories for attention focusing: those with low, moderate, and high levels. Concerning attentional and behavioral persistence, however, they identified non-linear trajectories of high-and-stable, moderate-and-generally-stable, and low-and-rising persistence.

These findings suggest that children's regulatory abilities may be partly stabilized but partly still developing during the transition from kindergarten to elementary school. Similarly, it is plausible that individual variability can be found in the development of impulsive behavior, especially when observed in challenging learning situations requiring planning, persistence, and attention focusing. This variation can reflect individual differences in neurobiological development, in the amount of previous experiences in similar situations, and in the environmental feedback and models available. In the present study, we assumed that the development of impulse control does not follow the same path for all children, and we deployed a growth mixture modeling technique in order to identify subpopulations of children that differ in the extent of impulsive behavior as well as in the rate that this behavior changes across time.

In the present study, we observed children's impulsive behavior in situations that resembled natural learning and achievement situations. Children's behavior was rated in situations during which they worked on a number of literacy- and numeracy-related tasks and were also interviewed. Our measure of tester-rated impulsive behavior tapped a student's volition to manage their behavior to meet their goals, to comply with rules and to manifest socially acceptable behavior in a demanding situation. Instead of focusing on a single test of inhibitory control or impulse regulation, our measure aggregated children's behavior across several potentially stress-evoking moments.

Gender Differences in Behavioral Regulation

Gender differences favoring girls are typical in studies on behavioral regulation and executive functions. For instance, girls have been shown to perform better than boys in tasks requiring working memory, inhibitory control, and attention (e.g., Matthews, Ponitz, & Morrison, 2009; Neuenschwander, Röthlisberger, Cimeli, & Roebers, 2012; Olson et al., 1999). Moreover, girls receive higher scores in behavioral regulation also when they are rated

by their parents or teachers (Matthews et al., 2009; Neuenschwander et al., 2012; von Suchodoletz et al., 2013). There is also some evidence suggesting that boys show more variation than girls in behavioral regulation: girls tend to be more homogenous as a group and cluster more tightly toward the high end of the scale (Matthews et al., 2009).

One explanation for these gender differences could be that girls are more self-disciplined (Duckworth & Seligman, 2006) or more willing to comply with what is expected of them. Gender differences are often stronger in teacher, parent, or tester ratings of behavioral regulation than in more objective and direct measures of self-regulation (von Suchodoletz et al., 2013; Wanless, McClelland, Acock, Chen, & Chen, 2011; see also Matthews et al., 2009), suggesting that observers evaluate girls' and boys' behaviors more on the basis of what they think is typical or appropriate for females and males.

Relation between Behavioral Regulation and Academic and Socio-Emotional Development in the Classroom

As children make the transition to formal education, classroom environments set multiple demands for their behavior (McDonald et al., 2013): children are expected to be able to control their attention and impulses, inhibit inappropriate behavior and thoughts, follow multiple task instructions, switch between tasks, and direct their focus to tasks while ignoring external distractions. To benefit from instruction and to successfully function in the classroom, a high level of behavioral, cognitive, and emotional control is needed (Cuevas, Hubble, & Bell, 2012). High behavioral regulation skills are typically related to high academic skills, whereas problems in regulation have been shown to lead to lower learning outcomes (e.g., Clark, Pritchard, & Woodward, 2010; McClelland et al., 2007; Neuenschwander et al., 2012; Wanless, McClelland, Acock, Ponitz et al., 2011). Poor behavioral regulation is manifested in children's problems with paying attention, remembering instructions, and focusing on the task at hand (McClelland et al., 2007), all of

which hinder task completion and skill development. Children with low levels of behavioral regulation tend to be disruptive and impulsive and have weak rule internalization and self-control (Macdonald et al., in press; Valiente, Lemery-Chalfant, & Castro, 2007).

Compliance and behavior regulation are considered important also in social interactions with teachers and peers (e.g., Denham, Warren-Khot, Bassett, Wyatt, & Perna, 2012; Eisenberg, Valiente, & Eggum, 2010). Previous studies have shown that poor regulation skills are associated with low levels of social competence in school-aged children (Denham et al., 2012; Eisenberg et al., 1995; Fabes et al., 1999) and high rates of externalizing problems in both children and adolescents (Eisenberg et al., 2000; Lengua, 2002). Different dimensions of regulation may have different antecedents and trajectories, as indicated by King's and colleagues' (2013) findings that between 8 and 12 years of age, increases in effortful control but not impulsivity were associated with the level and rate of change in positive adjustment and adjustment problems.

Self-regulation and motivation are believed to be reciprocally linked in the academic context because in order to achieve the learning goals that students value and strive for, they need to apply regulation skills (Wigfield, Hoa, & Klauda, 2008). Motivation has an important role in the development of children's academic skills (Wigfield, Eccles, Schiefele, Roeser, & Davis-Kean, 2006) through, for instance, the effects that students' task value (interest in a particular school subject) has on their choices of tasks and effort (Eccles et al., 1983), and through the employment of task focus or avoidance strategies (Onatsu-Arvilommi & Nurmi, 2000). Studies examining the relations between behavioral regulation skills (such as impulse control) and children's motivation in the classroom context (such as task value and task-avoidant behavior), however, continue to be few (cf. Brock, Rimm-Kaufman, Nathanson, & Grimm, 2009; Neuenschwander et al., 2012). A rare exception is the study by Olson and colleagues (1999) in which it was found that levels of children's overt impulsive behavior

decreased between 6 and 8 years of age in tasks in which they were offered incentives for task-oriented performance, whereas level of impulsivity in non-incentive tasks did not decrease. This suggests that motivational factors may play a critical role in children's impulse control. Consequently, in the present study we aimed to examine the relationship between children's impulsive behaviors and literacy-related interests and teacher-ratings of task avoidance.

Children's ability to regulate their behavior may also evoke different kinds of affective responses and instructional efforts from their teachers (Hargreaves, 2000; Nurmi, 2012). Children with poor impulse control may interrupt classroom routines by taking up their teachers' time and resources (Ladd & Burgess, 2001), thereby requiring teachers to increase their focus on classroom management and discipline. This may have consequences on teachers' relationships with the particular students by eliciting stress and negative reactions (Hamre & Pianta, 2001). Several studies have been conducted on the relations between children's externalizing problem behavior and teacher-child relationships (for a meta-analysis, see Nurmi, 2012). For example, Thijs, Koomen, and van der Leij (2008) found that kindergarten teachers reported a greater level of socio-emotional support toward hyperactive children compared to average children. Moreover, teachers typically report less closeness and more conflict in relationships with children who have problems in their behavioral regulation, such as externalizing or internalizing problems (e.g., Buyse, Verschueren, Doumen, Van Damme, & Maes, 2008; Henricsson & Rydell, 2004; Jerome, Hamre, & Pianta, 2009). Relatedly, teachers report more negative affect toward children with low regulation skills (for reviews, see Nurmi, 2012; Sutton & Wheatley, 2003), whereas pro-social behavior by students is likely to activate positive affective responses among teachers. In the present study, we examined children's regulation of impulsive behaviors in relation to student-teacher relationship and children's socio-emotional adjustment in the classroom.

Education in Finland

The present study was conducted in Finland where compulsory formal education consists of nine years of comprehensive school. Elementary school begins at age seven, which is later than in many other countries. However, all six-year-olds are entitled to a kindergarten education at day-care centers or schools for one year before starting basic education. The goals of the kindergarten education curriculum place greater emphasis on fostering children's personal and social development than on the formal instruction of academic skills in the classroom, although children's school readiness and the development of their pre-academic skills are also fostered (National Board of Education, 2010). The kindergartens and schools set up their own curricula on the basis of the national core curriculum (National Board of Education, 2004, 2010). High professional competence of both kindergarten (bachelor's degree) and elementary school teachers (master's degree) is the norm.

Some features of the Finnish educational system may have an effect on children's regulation skills in the beginning of their school career. First, Finnish children enter school at an age at which natural maturation has taken a longer course than in many other cultures, and thus, the majority of Finnish children should have acquired a sufficient level of impulse control by the time they enter first grade. In addition, the strong emphasis of the kindergarten curriculum (National Board of Education, 2010) on social development means that children's behavioral and emotional regulation skills are given both attention and support. In the kindergartens, the curriculum is less formal and the activities include more playful elements than in the elementary school, and for some children regulation skills may not yet be well advanced when they move on from kindergarten to first grade.

The Present Study

The aim of this study was to examine how regulation of impulsive behavior develops from kindergarten to the fourth grade of elementary school. Impulsive behavior was rated by trained investigators after the children had been individually tested for several cognitive skills. The following research questions were examined:

(1) What kinds of subgroups can be identified on the basis of children's trajectories of impulsive behavior in kindergarten and Grades 1 to 4? Due to lack of previous studies on individual trajectories of impulsive behavior in this particular age range, no exact hypotheses were set regarding the number of subgroups. As the majority of children at this age have typically developed an adequate level of impulse control (see Klenberg et al., 2001), we expected to find a large group of children who have a low level of impulsive behavior already in kindergarten and maintain this low level through the early school years. In addition, we expected to find one or several smaller groups of children with difficulties in their impulse control in comparison with their better-regulated classmates. Because some of the children with low early impulse control can be expected to have gained experiences that support the development of impulse control, and to have reached more mature neurobiological stage of behavioral regulation at the time of moving from kindergarten to elementary school education, at least one group was expected to show a decreasing trend in impulsive behavior indicating adaptive growth but slower pace of maturation.

(2) To what extent do the identified subgroups of children differ (a) in their background (gender, age, family socioeconomic status); (b) in their pre-literacy and reading skills and motivation (interest, task avoidance); (c) in their socio-emotional adjustment (social competence, socio-emotional characteristics); and (d) in their relationships with their teachers (teachers' positive and negative affect, individual support)? We hypothesized that boys (in comparison to girls; Matthews et al., 2009; Neuenschwander et al., 2012; von Suchodoletz et al., 2013) and younger children (in comparison to their classmates born earlier

the same year; Klenberg et al., 2001; Macdonald et al., in press) would be less self-regulated and end up in the high impulsive group(s). Parental education and family SES were expected to have an influence on children's behavioral regulation so that children in the high impulsivity group(s) would more likely be from families with lower SES (cf. Zhou et al., 2007; Wanless, McClelland, Acock, Ponitz et al., 2011). Moreover, we expected children in the high impulsivity group(s) to show lower skill levels in literacy (e.g., Clark et al., 2010; McClelland et al., 2006; Neuenschwander et al., 2012) than children in the low impulsivity group(s), but we did not set a specific hypothesis on the relations between impulsive behavior and motivation due to insufficient literature on this age group (see, however, Rhodes et al., 2013 for self-regulation and motivation on adolescents). Finally, we expected the high impulsive group(s) to show poorer social competence (Denham et al., 2012; Eisenberg et al., 1995; Fabes et al., 1999) and less positive relationships with their teachers (Henricsson & Rydell, 2004; Valiente et al., 2008) in comparison to the low impulsivity group(s). Relatedly, we expected that teachers would provide more individual support for children in the high impulsivity group(s) than children in the low impulsivity group(s) (Nurmi, 2012; Valiente et al., 2007).

Method

Participants

The present study was part of a larger follow-up (name of the study removed for reviewing purposes, 2006) investigating children's development during kindergarten and elementary school in the family and school context. The original sample of 1,880 children was drawn from four Finnish municipalities (one urban, one rural, and two both urban and semirural). At the beginning of the study, the children's parents and teachers were asked for their written consent to participate. The sample was highly homogeneous in ethnic and

cultural background, which is typical of a school population outside of the metropolitan regions in Finland.

The participants of this study consisted of a more intensively followed subsample of 378 children (182 girls, 196 boys) that was randomly selected from the original sample. The random selection of the sample was carried out from classrooms in a stratified fashion so that the aim was to select three students from each classroom. Due to the variation in classroom size, the number of children from different classrooms ranged between one and six, with a median of three. Target sampling was necessary to ensure that the data collection demands placed on teachers were not too heavy. The children's age at the beginning of the kindergarten year ranged from 68 to 89 months (M = 74.1, SD = 3.5).

Due to attrition of the participants, data were available for 377 children in kindergarten, 374 in Grade 1, 360 in Grade 2, 362 in Grade 3, and 346 in Grade 4. Teacher ratings were available for 370 children in kindergarten, 341 in Grade1, 317 in Grade 2, 298 in Grade 3 and 272 in Grade 4. Missing value analysis indicated that children with missing data in Grade 2 performed poorer in the spatial visualization test in kindergarten than children with no missing data. Children with missing data in Grade 3 were younger, received higher scores in task avoidance in Grade 1, and performed better in the reading comprehension test in Grade 2 than children with no missing data. Children with missing data in Grade 4 received lower scores in positive affect and higher scores in negative affect from their teachers in Grade 1, as well as higher scores in task avoidance, conduct problems and peer problems in Grade 1, in comparison with children without missing data.

The parents of the participants were asked to report their own and their spouse's professional status when their children were in kindergarten. Based on the classification of socioeconomic groups by Statistics Finland (1989), the parents were classified into seven categories according to professional status: (1) entrepreneurs, (2) higher white collar

professions, (3) lower white collar professions, (4) workers, (5) students, (6) pensioners, and (7) other professions. Each family's socioeconomic status was determined by choosing the higher of the two professions (either the mother's or the father's). In the present sample, socioeconomic status could not be identified for 6.3% of the families because of missing data. Of the families with data available, 9.0% were classified as entrepreneurs, 41.8% had higher white collar professions, 39.3% had lower white collar professions, 9.6% were workers, and 0.3% pensioners. The representativeness of the family socioeconomic status with respect to the general Finnish population was good (Statistics Finland, 2007).

Procedure and Measures in Kindergarten

The children's performance in pre-literacy tests and in a nonverbal ability test (spatial visualization) were assessed in the spring of their kindergarten year (April), and at the same time children were interviewed about their interest in literacy-related tasks. All tests were administered by trained investigators in individual test situations during a kindergarten day. Immediately after the testing session, the investigator rated the child's impulsive behavior in the situation. Kindergarten teachers were also asked to fill in questionnaires and evaluate the children's task-avoidant behavior and social competence in the spring of kindergarten.

Impulsive behavior. Children's impulsive behavior was assessed with a subscale from the JLD Behavior and Attention Rating Scale (Poikkeus, Puolakanaho, & Eklund, 1999). The rating was done by the investigators based on the children's overt manifestation of impulsive behavior during the individual assessment of academic skills and language. The rating scale was developed to assess attention focusing and shifting, hyperactivity, impulsivity, planning, and disruptiveness in test-taking situations. The scale consisted of 19 items rated on a scale from 1 (not at all) to 7 (always or almost all the time). The items were loosely based on DSM-IV diagnostic criteria for ADHD (American Psychiatric Association,

2000) and the Five to Fifteen questionnaire (FTF; Kadesjö et al., 2004; Korkman, Jaakkola, Ahlroth, Pesonen, & Turunen, 2004) developed in the Nordic countries to screen behavioral or developmental problems, such as executive dysfunction, in children and adolescents. Four composite factors of the 19 items were created on the basis of exploratory factor analysis. For the purpose of this study, a factor describing children's impulsive behavior was seen to best represent behavioral regulation. The scale consisted of four items (e.g., "Gives an answer before the question has been fully presented"; "Has difficulties in waiting for his/her turn, e.g., in tasks cannot wait for instructions"). The Cronbach's alpha reliability for the scale in kindergarten was .87.

Preliminary inspection of the distributions of the impulsivity variables showed substantial skewness and kurtosis at all measurement points. A large proportion of the children were rated to have "not at all" impulsive behavior, thus receiving a score of 1 on a scale of 1 to 7. A total of 50.3% of children received the score 1 in kindergarten, 47.1% in the first grade, 45.8% in the second grade, 45.8% in the third grade, and 54.1% in the fourth grade. Very few children were given ratings in the high end of the scale, that is, scores 6 and 7.

Task avoidance. The kindergarten teachers were asked to evaluate the children's task-avoidant behavior using the Behavior Strategy Rating Scale (BSR; Onatsu-Arvilommi & Nurmi, 2000), which was rated on a five-point scale (1 = *not at all*; 5 = *to a great extent*). The following five items were used: (a) Does the child have a tendency to find something else to do instead of focusing on the task at hand?; (b) If the activity or task is not going well, does the child lose his/her focus?; (c) Does the child give up easily?; (d) Does the child actively attempt to solve even difficult situations and tasks? (reversed); (e) Does the child demonstrate initiative and persistence in his/her activities and tasks? (reversed). The Cronbach's alpha reliability for the task avoidance scale was .92.

Social competence. The kindergarten teachers were also asked to evaluate each child's social competence using the Multisource Assessment of Social Competence Scale (MASCS; Kaukiainen, Junttila, Kinnunen, & Vauras, 2005; see also Junttila, Voeten, Kaukiainen, & Vauras, 2006). In the process of adapting the MASCS to the Finnish context, the number of items was cut down from 65 to 15, and the original six scales of the SSBS by Merrell and colleagues (Merrell, 1993; Merrell & Gimpel, 1998) were reduced to four scales (see psychometric properties of MASCS in Junttila et al., 2006). The two scales falling under the dimension of prosocial behavior were named co-operative skills (five items, e.g., "Offers help to other students") and empathy (three items, e.g., "Is sensitive to the feelings of others"). The two scales falling under the dimension of antisocial behavior were named impulsiveness (three items, e.g., "Has temper outbursts or tantrums") and disruptiveness (four items, e.g., ''Teases and makes fun of other students''). The 15 items were rated by the teachers on a four-point scale (1 = *never*; 4 = *very frequently*). The Cronbach's alphas for the four subscales of social competence were as follows: co-operative skills = .84; empathy = .87; impulsiveness = .90; and disruptiveness = .90.

Phoneme identification. Initial phoneme identification was assessed using a 10-item test (ARMI; A tool for assessing reading and writing skills in grade one; Lerkkanen, Poikkeus, & Ketonen, 2006). For each item, the child was presented with four pictures of objects along with their names and was asked to select the correct picture on the basis of the oral presentation of an initial phoneme relating to one target. The total score corresponded to the number of correct items (maximum value of 10; Kuder-Richardson reliability = .74).

Letter knowledge. Letter knowledge was assessed using a naming test of all 29 letters in the Finnish language. The letters were presented as uppercase letters in three rows and were shown to the child one row at a time (ARMI; Lerkkanen et al., 2006). The total

score corresponded to the number of correctly named items (maximum value of 29; Kuder-Richardson reliability = .95).

Rapid automatized naming (RAN). Rapid serial naming was assessed using a standard procedure (Denckla & Rudel, 1976) in which the child was asked to name, as rapidly as possible, a semi-randomly arranged series of five pictures of objects. The total matrix (five rows of ten targets) completion time in seconds was used as the score. The split-half correlation was .80.

Spatial visualization. Spatial visualization was measured with the Spatial Relations subtest from the Woodcock-Johnson test battery (Woodcock & Johnson, 1977). The test requires identifying a subset of pieces needed to form a complete shape (i.e., "Two of these pieces (a, b, c, d) go together to make this (e). Tell me which two pieces."). The test measures the ability to manipulate complicated spatial information (i.e., to detect spatial forms or shapes and to rotate or manipulate them in mind). A maximum of 31 tasks can be attempted within a three-minute time limit. The maximum score in the present sample was 20. The Kuder-Richardson reliability for the test was .72.

Interest in literacy. Children were interviewed about their interest in literacy-related tasks using the Task Value Scale for Children (TVS-C; Nurmi & Aunola, 1999; see also Nurmi & Aunola, 2005). This scale is based on the ideas presented by Eccles et al. (1983) concerning the interest that children show in particular school subjects. The scale consists of three items measuring children's interest in (the liking of) literacy-related tasks ("How much do you like letter/pre-reading tasks?"; "How much do you like doing letter/pre-reading tasks in kindergarten?"; How much do you like doing letter/pre-reading tasks at home?"). There were three items concerning pre-reading tasks and three items for letter tasks. All of the questions were read aloud to the children. The children were asked to indicate on a 5-point scale of faces ranging from a big frown to a big smile, which best described their interest in

particular tasks (1 = *I do not like it at all/I dislike doing those tasks*; 5 = *I like it very much/I really enjoy doing those tasks*). The scale was explained to the children and the procedure practiced prior to presenting the actual test items. The Cronbach's alpha reliability for the six items of literacy-related interest was .78.

Procedure and Measures in Grades One to Four

The children's working memory was tested in an individual test situation in the spring of first grade, and reading comprehension was assessed in group situations in the spring of Grades 1 to 4. The children rated their interest in literacy in an individual test situation in the spring of first and second grade and in a group situation in the spring of third and fourth grade. All assessments took place on school premises during normal school hours. Investigators evaluated each child's impulsive behavior after individual testing sessions in all grades. In the spring of each grade, classroom teachers rated the child's task-avoidant behavior, socio-emotional characteristics, and their own affect and the amount of individual support they had given to the target child.

Impulsive behavior. As in kindergarten, the children's impulsive behavior was rated by the investigators using a subscale from the JLD Behavior and Attention Rating Scale (Poikkeus et al., 1999). The Cronbach's alpha reliabilities for impulsive behavior in Grades 1 to 4 were .86, .84, .84, and .84, respectively.

Task avoidance. Classroom teachers rated children's task-avoidant behavior using the Behavior Strategy Rating Scale (BSR; Onatsu-Arvilommi & Nurmi, 2000). The Cronbach's alpha reliabilities for task avoidance in Grades 1 to 4 were .87, .91, .92, and .92, respectively.

Socio-emotional characteristics. In Grades 1 to 4, the teachers filled in the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997; Goodman & Scott, 1999) for their students participating in the follow-up. The questionnaire has been shown to have

good psychometric properties among Finnish children and adolescents (Koskelainen, Sourander, & Kaljonen, 2000). Teachers rated 25 items on a scale of 1 to 3 (1 = *not true*, 2 = *somewhat true*, and 3 = *certainly true*). Of the five SDQ subscales, four were used in the present study: hyperactivity, conduct problems, peer problems, and prosociality (five items in each scale). The Cronbach's alpha reliabilities in Grades 1 to 4 were as follows: hyperactivity = .88, .88, .90, and .87; conduct problems = .77, .81, .80, and .75; peer problems = .71, .73, .71, and .69; and prosociality = .85, .85, .85, and .82, respectively.

Working memory. The children's memory span was measured in the spring of first grade with the Digit Span subtest from the Finnish version of the Wechsler Intelligence Scale for Children – III (WISC-III; Wechsler, 1999).

Reading comprehension. The children's reading comprehension was measured four times, at the end of Grades 1 to 4. In the nationally normed reading comprehension task (ALLU; Lindeman, 1998), the children were asked to silently read a factual story and then answer 12 multiple choice questions. The children received one point for each correct answer (maximum score of 12). They completed the task at their own pace, but the maximum time allotted was 45 minutes. The test battery is directed to children in grades one to six, and the story and the questions are different at each grade level. The topics include "Judo" (Grade 1), "Guidelines to Gymnastics" (Grade 2), "Function of Camera" (Grade 3), and "The Light Requirements of Plants" (Grade 4). The Kuder-Richardson reliabilities for the reading comprehension test in Grades 1 to 4 were .85, .80, .75, and .76, respectively.

Interest in literacy. The children rated their interest in literacy-related tasks using the Task Value Scale for Children (TVS-C; Nurmi & Aunola, 1999). In the first and second grades, the items concerned literacy-related and letter tasks (three items each), whereas in the third and fourth grade, the items concerned reading and writing tasks (three items each). The

Cronbach's alpha reliabilities for the scale in Grades 1 to 4 were .83, .84, .92, and .91, respectively.

Teachers' affect. The teachers were asked to rate their affect regarding working with a particular student by using test items modified from Poulou and Norwich (2002). The teachers' negative affect when teaching an individual child was measured by two items ("When you teach this child, to what extent do you feel the following: (1) I feel helpless (2) I feel frustrated/stressed.") and positive affect by two items ("When you teach this child, to what extent do you feel the following: (1) I feel satisfied (2) I feel joy.") on a five-point scale (1 = *not at all*; 5 = *very much*). The Cronbach's alpha reliabilities in Grades 1 to 4 were .80, .81, .83, and .88 for negative affect and .90, .86, .91, and .88 for positive affect.

Teacher's support. The teachers were asked to rate, on a five-point scale, the extent to which they provided individual support for and gave attention to a particular child during class time as compared to the time and attention they gave to other children in the classroom. The original five-point scale ranging from -2 to +2 was recoded into a scale ranging from 1 to 5 in the following way (original scale values shown in parentheses): 1 (-2) = *Substantially less than to other students*, 2 (-1) = *Somewhat less than to other students*, 3 (0) = *An equal amount as to other students*, 4 (+1) = *Somewhat more than to other students*, and 5 (+2) = *Substantially more than to other students*. In the first grade, the score for the teacher's support of a particular child was a mean score of three questions concerning their support in reading, writing, and math. In Grades 2 to 4, a mean score was created from four questions concerning support in reading, writing, arithmetical assignments, and math verbal assignments. The Cronbach's alpha reliabilities in Grades 1 to 4 were .79, .90, .90, and .92, respectively.

Analytical Strategy

To identify groups of students with different developmental trajectories of impulsive behavior, we employed growth mixture modeling (Muthén & Muthén, 2000) using the Mplus 6.12 statistical package (Muthén & Muthén, 1998-2011). First, a latent growth curve model (LGM) was fitted to the data to describe the average development of the whole sample and individual variation around the growth factor means. The model was estimated with maximum likelihood estimation with robust standard errors (MLR). The best-fitting growth curve model was chosen by comparing an intercept-only, a linear, and a quadratic growth model. In the intercept-only model, only the level of impulsive behavior was estimated and no change across time was assumed. In the linear model, a linear change (constant increase or decrease) from kindergarten to fourth grade was estimated together with the initial level. In the quadratic model, a quadratic growth (gradual acceleration or deceleration of change) was estimated together with the initial level and a linear trend. The best-fitting model was chosen by comparing the Akaike (AIC), Bayesian (BIC), and sample-size adjusted Bayesian information criteria (aBIC) and the model fit indices of each model type. Model fit was assessed with chi-square values, the comparative fit index (CFI), the Tucker-Lewis Index (TLI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). Because of the hierarchical structure of the data, stratification and non-independence of observations was taken into account by using the COMPLEX option in Mplus, which estimates the model at the whole sample level but makes corrections to the standard errors and chi-square test of model fit (Muthen & Muthen, 1998−2011). School in Grade 1 was chosen as a cluster variable because of highest intraclass correlation value (.11) and design effect (1.42), and because of the fact that children typically stayed in the same schools for the whole study period. According to the AIC, BIC, and adjusted BIC values, the quadratic model had the best fit to the data (see Table 1). The model had a good fit also according to the model fit indices. Consequently, the quadratic model was chosen. In

this model (see Figure 1), the variances of the intercept, linear, and quadratic factors were statistically significant, indicating inter-individual differences in the level and growth of the children's impulsive behavior across time.

Second, a mixture analysis technique was used to identify subgroups of students that differed in the rate and shape of the developmental trend (growth factors). When identifying latent classes of individuals using mixture models, the classes are often allowed to differ only in respect to the growth factor means, or alternatively, in respect to the growth factor means and the variances around the factor means. However, constraining the variances equal across the groups or allowing them to differ between the groups resulted in negative variances in one or several of the growth factors, suggesting the models were not appropriate for the data. Consequently, we used a model in which all growth factor variances were fixed to zero for all groups. This special type of growth mixture modeling is called latent class growth analysis (LCGA; Muthén & Muthén, 2000). The final model was estimated with MLR and the COMPLEX option was used to take into account stratification and non-independence of observations. The number of groups was decided by considering the model fit, the entropy values and the average latent class probabilities of group membership, and the theoretical meaningfulness of the groups. More specifically, the model fit was evaluated with log-likelihood values (log L), the AIC, BIC, and aBIC values, and the Vuong-Lo-Mendell-Rubin (VLMR) and Lo-Mendell-Rubin Adjusted (LMR) likelihood ratio test statistics.

The model fit indices and class sizes of the 1- to 6-class solutions for the final LCGA model are provided in Table 2. Comparing the class solutions showed that no solution was clearly superior to others. According to the LMR and VLMR test statistics, the two-class solution was only subtly better than the one-class solution. Non-significant test statistics for the following models indicated that model fit did not improve with a higher number of classes. In contrast, the AIC, BIC, and adjusted BIC values kept decreasing even for solutions

with more than 6 classes indicating a better fit with a higher number of classes. BIC is considered as the most reliable index in mixture modeling with small sample sizes ($n < 500$) (Nylund, Asparouhov, & Muthén, 2006; Tolvanen, 2007). A low BIC value indicates that a model has a high likelihood value but is parsimonious without using many parameters (Muthén & Muthén, 2000). The entropy values were very high for all models, giving no clear advantage to any solution over the others. Because of the rather inconsistent fit indices, we based our choice of the final solution on theoretical meaningfulness and usefulness of the latent classes (see Muthén & Muthén, 2000). In solutions with 3 or more classes, there was at least one class with less than 20 students, which can be considered problematic for further analyses. The 5- and 6-class solutions were rejected for this reason. The trajectories of the 2-, 3-, and 4-class solutions are shown in Figure 2. The 2-class solution identified two groups with seemingly stable trends across time, differing in respect to the overall level of impulsivity. In the 3-class solution, one group with a low and stable trajectory emerged, a second with somewhat higher level and a slightly decreasing trend, and a third with an upward trend. In the 4-class solution, the group with a low and stable trend and the group with a moderate and slightly decreasing trend were very similar to the 3-class solution. The group with an upward trend was somewhat smaller than in the 3-class solution. In addition, a fourth group with a clear, decreasing trajectory emerged. Theoretically, we found the 4-class solution most meaningful, and consequently, it was chosen as the final model. In this model, the average posterior probabilities for each latent class for individuals whose highest probability is for that class ranged from .90 to .99, indicating a good quality of classification (Muthén & Muthén, 2000).

Finally, the determined groups were compared in relation to the criterion variables using univariate analyses of variance (ANOVA) in IBM SPSS Statistics 20. For measures

with several time points, repeated-measures ANOVA was used with time as a within-subject variable and group as a between-subject variable.

Results

Identification of the Impulsive Behavior Groups

The trajectories for the final four classes are shown at the bottom of Figure 2. The first group included 33 children (8.7%) who showed a moderate level of impulsive behavior in kindergarten (mean of intercept = 2.14). The means of the linear (0.78, $p = .23$) and quadratic growth components (-0.18, $p = .31$) were not significant for this group, indicating that the children remained at the same level in their behavior from kindergarten to fourth grade, although the trajectory seemed to show a slight increase from kindergarten till second grade and a slight decrease from second till fourth grade. This group was labeled "Moderate IB (impulsive behavior)".

The second group comprised of only 11 children (2.9%) who started off relatively high in impulsive behavior in kindergarten (mean of intercept = 3.27). The means of the linear (-1.62, $p < .05$) and quadratic growth (0.50, $p < .01$) were significant, suggesting an increase in impulsivity and an acceleration of this growth across time. From the group trajectory we can observe that the impulsive behavior of these children in fact first decreased from kindergarten to second grade and then significantly increased from second to fourth grade. This group was labeled "Contradictory IB".

The third group consisted of 312 children (82.5%) for whom the initial level of impulsive behavior was low in kindergarten (mean of intercept = 1.28). The means of the linear (0.17, $p < .001$) and quadratic growth components (-0.05, $p < .001$) were significant, suggesting that there was an increase in the impulsivity of these children from kindergarten to fourth grade and that this increase was more rapid in the beginning. This group was labeled "Low IB".

Finally, the fourth group included 22 children (5.8%), who started very high in their impulsivity in kindergarten (mean of intercept = 4.09). The means of the linear (-1.69, $p <$ .001) and quadratic growth components (0.26, $p < .001$) were significant for this group, suggesting that their impulsivity decreased across time and that this decrease was more rapid in the later grades. This group was labeled "Decreasing IB".

Because the "Contradictory IB" group was so small in size ($n = 11$), it was excluded from further analyses and the following group comparisons were conducted only for the three bigger groups. In comparing the means of the three remaining groups in their impulsivity, significant differences were found at each of the five time points. In kindergarten, all three groups significantly differed from each other ($F(2, 362) = 325.12$, $p < .001$; partial $\eta^2 = .64$): the "Low IB" group was rated lowest, the "Moderate IB" group second highest, and the "Decreasing IB" group was highest in their impulsivity. Also in Grade 1, all three groups significantly differed from each other ($F(2, 351) = 113.84$, $p < .001$; partial $\eta^2 = .39$): the "Low IB" group was lowest in impulsivity, but the "Decreasing IB" group was now rated second highest and the "Moderate IB" group highest. In Grade 2 ($F(2, 345) = 39.72$, $p < .001$; partial $\eta^2 = .19$), Grade 3 ($F(2, 343) = 39.51$, $p < .001$; partial $\eta^2 = .19$), and Grade 4 ($F(2, 329) = 151.15$, $p < .001$; partial $\eta^2 = .48$), the "Low IB" and "Decreasing IB" groups were both rated lower than the "Moderate IB" group.

Differences among the Impulsive Behavior Groups

Next, we compared the three identified groups in various criterion variables. With categorical variables, we assessed group differences using cross-tabulations with Pearson's chi-square test as an indicator of significant differences and adjusted standardized residuals as indicators of significant differences between observed and expected counts. With continuous variables, differences between the groups were assessed using analyses of variance. Univariate analyses were conducted for single-time point variables and repeated-measures

design was used for variables measured across time points. Post hoc comparisons (using Bonferroni test or Tamhane's T2 in case the homogeneity of variances assumption was not met) were run to detect which groups specifically differed from each other. The means and standard deviations of the tested variables are provided in Tables 3 and 4 for each group.

Background variables. Differences between the three groups were examined with regard to the children's gender, age at kindergarten entry, and family socioeconomic status. The results showed that there was a significant gender difference in the group membership ($\chi^2(2) = 13.49$, $p < .01$; Cramér's V = .19): boys were overrepresented in the "Moderate IB" group (78.79%, adjusted residual = 3.35) and girls were overrepresented in the "Low IB" group (52.88%, adjusted residual = 3.50). Group membership was not related to family's socioeconomic status ($\chi^2(8) = 7.03$, $p = .53$; Cramér's V = .10). There were no differences when comparing the mean age of the children in each group (see Table 3; $F(2, 364) = 1.10$, $p = .33$; partial $\eta^2 = .01$).

Because gender was related to the latent group membership and to some of the criterion variables, it was controlled for in the following ANOVAs by adding it as an independent variable (as a between-subject variable in the repeated-measures analyses) along with group membership.

Pre-literacy and cognitive skills. The groups were compared in several cognitive and pre-literacy tests (see Table 3). A significant group difference was found in respect to letter naming in kindergarten ($F(2, 362) = 3.20$, $p < .05$; partial $\eta^2 = .02$): the "Low IB" group performed significantly better than the "Decreasing IB" group. In rapid automatized naming in kindergarten, the results showed that children in the "Low IB" group performed significantly faster in the naming test than children in the "Decreasing IB" group ($F(2, 362) = 6.12$, $p < .01$; partial $\eta^2 = .03$). The children's reading comprehension was assessed longitudinally, comparing the means of the groups in Grades 1 to 4. The results showed a

statistically significant effect for group ($F(2, 322) = 3.04$, $p < .05$; partial $\eta^2 = .02$), with the "Low IB" group performing significantly better than the "Decreasing IB" group over time. There were no significant differences between the groups in phoneme identification ($F(2, 362) = 1.52$, $p = .22$; partial $\eta^2 = .01$) and spatial visualization ($F(2, 362) = 1.37$, $p = .26$; partial $\eta^2 = .01$) in kindergarten or in working memory in the first grade ($F(2, 354) = 0.26$, $p = .77$; partial $\eta^2 = .00$).

Motivation. The mean level differences between the groups in literacy-related interest and teacher-rated task-avoidant behavior were assessed longitudinally from kindergarten to fourth grade. In interests, a significant group x time interaction was found and, consequently, additional analyses were run separately across groups at each time point and for each group across time. There were no significant differences between the groups at any of the five time points (*p*s > .11). Moreover, there were no significant main effects for time in the "Moderate IB" ($F(4, 112) = 0.89$, $p = .47$; partial $\eta^2 = .03$) and "Decreasing IB" groups ($F(4, 68) = 0.74$, $p = .57$; partial $\eta^2 = .04$), whereas in the "Low IB" group a significant time effect was found ($F(3, 923) = 26.33$, $p < .001$; partial $\eta^2 = .09$): the interest of the children in this group decreased from kindergarten to Grade 1 and from Grade 2 to Grade 3.In teacher-rated task avoidance, a significant main effect for group was found ($F(2, 217) = 20.95$, $p < .001$; partial $\eta^2 = .16$): the "Low IB" group was rated significantly lower in task avoidance than the "Decreasing IB" and "Moderate IB" groups over time.

Social competence. The groups were next compared in teacher-rated disruptiveness, empathy, impulsiveness, and co-operative skills in kindergarten. There were no differences between the groups in co-operative skills ($F(2, 355) = 1.88$, $p = .15$; partial $\eta^2 = .01$), but significant differences emerged in teacher-rated disruptiveness ($F(2, 355) = 20.30$, $p < .001$; partial $\eta^2 = .10$), empathy ($F(2, 355) = 10.14$, $p < .001$; partial $\eta^2 = .05$), and impulsiveness

($F(2, 355) = 21.72$, $p < .001$; partial $\eta^2 = .11$). In all of them, the "Low IB" group was rated lower than both the "Moderate IB" and "Decreasing IB" groups.

The groups were also compared in teacher-rated hyperactivity, prosociality, conduct problems, and peer problems in Grades 1 to 4. In hyperactivity, significant main effects were found for time ($F(3, 527) = 3.04$, $p < .05$; partial $\eta^2 = .02$) and group ($F(2, 206) = 16.37$, $p < .001$; partial $\eta^2 = .14$): Children's hyperactivity was found to decrease from Grade 3 to Grade 4 regardless of group. Moreover, the "Low IB" group was rated lower than both of the other two groups over time. Similarly, main effects for time ($F(3, 540) = 3.24$, $p < .05$; partial $\eta^2 = .02$) and group ($F(2, 206) = 8.72$, $p < .001$; partial $\eta^2 = .08$) were also found in conduct problems: Fewer conduct problems were rated in Grade 4 than in Grade 3 for all groups, and the "Low IB" group received lower ratings than the other groups over time. In peer problems, a small group effect was found ($F(2, 206) = 4.44$, $p < .05$; partial $\eta^2 = .04$): the "Low IB" group was rated to have fewer problems than the "Moderate IB" group over time. There were no significant time or group effects in prosociality.

Student-teacher relationship. The elementary school teachers also rated their affect and individual support toward the individual children in classroom situations in Grades 1 to 4. In teachers' positive affect, a significant group x time interaction was found, and consequently, additional analyses were run separately across groups at each time point and for each group over time. There was no significant time effect in any of the groups (ps > .12). However, teachers reported more positive affect for the "Low IB" group than for the "Decreasing IB" group in the second grade ($F(2, 302) = 3.26$, $p < .05$; partial $\eta^2 = .02$), and more positive affect toward the "Low IB" group than toward the other two groups in the third grade ($F(2, 280) = 12.00$, $p < .001$; partial $\eta^2 = .08$) and fourth grade ($F(2, 258) = 15.75$, $p < .001$; partial $\eta^2 = .11$). In negative affect, a significant group effect ($F(2, 208) = 12.98$, $p < .001$; partial $\eta^2 = .11$) indicated that the teachers reported having less negative affect toward

the children in the "Low IB" group than toward the children in the "Moderate IB" and "Decreasing IB" groups over time. Moreover, a significant group effect ($F(2, 208) = 13.31$, $p < .001$; partial $\eta^2 = .11$) in teachers' reports of individual support indicated that they reported giving different levels of individual support to the groups: the "Low IB" group was reported to have received less support than both the "Moderate IB" and "Decreasing IB" groups over time.

The "Contradictory IB" group was too small in size to be included in the group comparisons, but some general inspection of the group statistics was performed. The children in this group were mainly boys ($n = 9$; 81.8%). The children came from 10 classrooms in 9 schools. As a group, they performed relatively well in phoneme identification and letter naming in kindergarten, but they showed a low level of interest in literacy from kindergarten to Grade 3 (see Table 3). Furthermore, the children received seemingly low ratings from their teachers in empathy and co-operation skills in kindergarten and in prosocial skills in Grades 1 to 4 (see Table 4). Teachers also reported relatively high levels of negative affect toward the children in this group.

Discussion

The first aim of the study was to identify latent groups of Finnish children that differed in the development of their impulsive behavior from kindergarten to fourth grade. Four latent groups with distinct developmental trajectories in impulsive behavior were identified. Two of the groups followed rather stable trajectories, one at a low level of impulsive behavior and another at moderate level. The third group started with high impulsive behavior, but significantly decreased in impulsivity across time. The fourth, small group of children had a moderate level of impulsive behavior in the beginning, but later significantly increased in their impulsivity. Second, we aimed to examine to what extent the groups differed in several background, academic skill, motivation, social competence, and

teacher-student relationship variables. The groups differed especially in gender distribution, socio-emotional adjustment, and teacher-student relationships.

The largest group represented a normative group that consisted of more than 80% of the children. This group expressed low levels of impulsive behavior from kindergarten to fourth grade. As expected, the majority of these children were girls, which supports previous findings proving that girls outperform boys in behavioral regulation (e.g., Matthews et al., 2009; von Suchodoletz et al., 2013; Zhou et al., 2007). This group was the most adaptive in all respects, performing best in pre-literacy and reading skills, ranking highest in motivation and social competence, and showing the most positive relationship with their teachers. This is not surprising considering previous findings on the positive effect of regulation skills on academic achievement (e.g., Clark et al., 2010; McClelland et al., 2007; Wanless, McClelland, Acock, Chen, & Chen, 2011), social competence (Denham et al., 2012; Eisenberg et al., 1995; Fabes et al., 1999), and teachers' affective responses (Nurmi, 2012; Sutton & Wheatley, 2003).

In addition to the large, normative group, three significantly smaller groups were identified. One of them, labeled the "moderate" group, consisted of roughly one-tenth of the participants. These children were rated higher in impulsive behavior than the normative group at each time point and there were no significant changes in their impulsivity across time. Boys were overrepresented in this group, which is in line with previous studies reporting that boys in general have lower regulation skills than girls do (cf. Matthews et al., 2009; Olson et al., 1999; Zhou et al., 2007). This group was performing at a moderate level in many respects, but teacher-ratings of their behavior proved that they were showing more hyperactive, task-avoidant, and impulsive behavior than their well-regulated classmates both in kindergarten and in later school grades. Somewhat surprisingly, this group did not differ significantly from the well-regulated group in their performance in pre-literacy and reading

skills. Because regulation skills, such as impulse control, working memory, and attention orienting and shifting, are important in academic tasks (e.g., Clark et al., 2010; Neuenschwander et al., 2012), we expected the children with better impulse regulation to benefit from their skills and to outperform the less-regulated children. However, there are also findings from kindergarten-age children showing that the role of behavioral regulation in academic skill development may be different across domains, being stronger, for example, for mathematics than for reading and language development (Matthews et al., 2009; Ponitz et al., 2009). Differences between domains may be due to task difficulty and familiarity: even the children with compromised behavioral regulation are able to concentrate on tasks and complete them if they are cognitively not too demanding. Reading-related tasks may be particularly easy for Finnish-speaking children, because the transparent orthography of the Finnish language makes it very easy for children to learn letter-sound correspondences in kindergarten and decoding skills in the first semester of Grade 1 (e.g., Lerkkanen, Rasku-Puttonen, Aunola, & Nurmi, 2004). Alternatively, the lack of association between impulsive behavior and reading skill development for this group could be explained by the way the impulsivity was assessed. Observing and rating the children's behavior in a one-to-one testing situation may not correspond to the challenges of actual learning situations in the classroom. For example, children who would normally have difficulties in controlling their cognition, emotions, and behavior in the classroom may have been able to stay attentive and focused in the one-to-one situation.

Around five per cent of the children constituted a group that showed a decreasing trend in their impulsive behavior. In kindergarten, they were ranked high in impulsivity, but after the kindergarten year, their impulsive behavior began to decrease and was ranked as low as that of the low impulsivity group from the second school year onward. This decrease illustrates a naturally occurring improvement in impulse control, although taking place

somewhat later than would have been expected on the basis of the children's age (cf. Klenberg et al., 2001). The difference between this group and the moderate group was that while this group showed improvement in their impulse regulation skills after kindergarten, the moderate group stayed at the same level across time. What was also interesting with this particular group was that although their behavioral regulation skills seemed to significantly improve during the first school years, their reading skills, socio-emotional competence, or relationship with their teachers did not show similar kind of improvement. In reading comprehension, the children lagged behind the other children. Moreover, teachers rated these children high in task-avoidant behavior, hyperactivity, and conduct problems at each time point. Teachers also reported feeling low positive affect and high negative affect toward these children, and giving them more individual support than to other children in their class. It is possible that although the children in this group improved their impulse control enough to stay attentive and focused when working alone with only the investigator present, they were still facing difficulties in more demanding learning situations in the classroom. Alternatively, it is possible that teachers' ratings were biased by their previous experiences with these children and their observations about the children's difficulties, thus reflecting children's previous rather than current level of impulsivity. Nevertheless, it is obvious that this group of children needs special attention because they could not make use of their developing regulation skills in the classroom learning situations. A promising sign is, however, that they showed signs of improvement in the one-on-one situations.

The remaining eleven children comprised a group that showed a rather contradictory path of development. In the beginning, their impulsive behavior was at a moderate level, but from Grade 2 to Grade 4 it quickly increased to a level much higher than that of the other groups. This could reflect the fact that school becomes more demanding after the second grade because of a higher level of difficulty, new subjects, and in most classrooms, also a

new teacher. Moreover, the increase of impulsivity may be related to children's loss of motivation at school. These children did, indeed, show a lower level of interest in reading, possibly indicating a more general lack of interest and unwillingness to invest effort in learning tasks. However, the children were predominantly boys that have in general been found to show less interest in reading than girls (cf. Eccles, Wigfield, Harold, & Blumenfeld, 1993). More importantly, the size of this group was too small for drawing any generalized conclusions on the development of their impulsive behavior and the reasons behind it. A larger sample size is warranted to further investigate this type of developmental trajectory.

The findings of the study showed that, in general, children who showed high levels of impulsive behavior at one or several measurement points received more negative ratings from their teachers regarding their empathy, peer problems, teacher's affect and teacher's individual support. These findings were expected, because having problems in behavioral regulation has been found to relate to students' relationships with teachers and peers (Eisenberg et al., 2010; Henricsson & Rydell, 2004). However, it is important to note that although rated higher than the well-regulated group in impulsive behavior, the mean scores for the other groups were still lower than mid-range on the rating scale. This may indicate that the assessment situation did not bring out the most severe forms of behavioral dysregulation, but it may also suggest that at this age, most children have already acquired a sufficient level of impulse regulation skills necessary for adaptive functioning in academic settings.

Contrary to our expectations, the children's age at kindergarten entry was not related to the different developmental trajectories of impulsive behavior. For example, we would have expected the group that decreased in their impulsivity over time to consist of the youngest children of the sample, because they were showing poor regulation of impulsive behavior in kindergarten, but improved and caught up to their well-regulated classmates by

Grade 2. This improvement could have been a sign of the youngest children being less mature in the beginning, but following their classmates' development with a small time lag. The decreasing impulsivity group did, in fact, consist of somewhat younger children than the well-regulated group, but the age difference was not statistically significant. Our results suggest that although age plays a bigger role in the development of behavioral regulation in early childhood (see Olson et al., 1999; von Suchodoletz et al., 2013), at school-age the level of regulation skills is no longer a question of age.

Our findings further showed that a family's socioeconomic status was not related to the children's impulsive behavior. Although this is in contrast with findings from some other cultures (Zhou et al., 2007; Wanless, McClelland, Acock, Ponitz et al., 2011), in Finland it is less surprising that SES does not play a significant role in school-related outcomes (Itkonen & Jahnukainen, 2007). The Finnish demography is relatively homogeneous with a low percentage of students coming from very disadvantaged backgrounds. Regardless of their background, all children are entitled to uniform schooling, including cost-free materials, meals, healthcare services, and transportation. In addition, nationwide maternity and child care facilities ensure that families with under-school-aged children get the information and support they need in bringing up their children. Families are entitled to regular visits to the clinics, where children's physical, mental and social development are being monitored (Ministry of Social Affairs and Health, 2004). Special attention is given to the identification of possible difficulties in children's psycho-social or cognitive development and thus, children with a need for special support can be identified before school-age. The maternity and child care facilities are free of charge to all families regardless of their social and economic status.

When studying developmental processes, it is important to bear in mind that individuals can vary significantly both in terms of the level, rate, and timing of the

development. Our approach to the data was to use a mixture modeling technique. If we had examined our sample as a whole, variation between the children in the level and changes of their impulsivity would have been dismissed and their impulsive behavior across time would have seemed to follow a low and rather stable trajectory, that of the largest group that was dominating the sample. In contrast, by using a mixture modeling technique, three smaller groups with clearly diverging trajectories of development stood out. However, the identified groups were small in size. To gain better understanding of individual differences in the development of children's impulsive behavior, there is an evident need to examine larger samples of children in future research.

Practical Implications

The study also provided some practical implications. In particular, children with high or moderate levels of impulsive behavior seem to be vulnerable to poor socio-emotional skills and negative affective reactions from their teachers, which might compromise their adaptation and ability to benefit from the classroom environment. Thus, teachers need to pay special attention to these children and to the promotion of their behavioral regulation. Teachers should become aware of the affective reactions that children with high impulsive behavior evoke in them. Parents and teachers are important role models for children in learning how to regulate their behavior and emotions. In the classroom, providing organization, consistency, and structure has proven to be important for children's behavioral regulation (Morrison et al., 2010). Moreover, Merritt and colleagues (2012) have recently shown that teachers' emotional support is an important contributor to first graders' self-regulation skills. Thus, interventions targeted at improving children's behavioral regulation skills should focus on both emotional and organizational aspects of the classroom, as well as warm and supportive teacher-student relationships.

Limitations

The study has some limitations that need to be considered when generalizing the findings. First, our measure of impulsive behavior was an investigator rating conducted after one-to-one test-taking situations. A situation like this is somewhat different from everyday learning situations in the classroom; thus, the behavior the investigator observed may not reflect the level of impulse control the children are typically able to show in the classroom. The children's behavior could have been affected, for example, by the suspense (or alternatively, by the organized structure) of the testing situation. Second, beside family socioeconomic status, we did not assess group differences in any other parental measures. It is possible that parenting styles, for example, would explain the differences in the children's ability to regulate their impulsive behavior. Third, we did not control for school- or teacher-related variables such as class size, the teachers' work experience, the teachers' well-being, and teaching practices, which may have affected the children's regulation skills or the teachers' ratings. Finally, regarding academic skills, the groups were compared only in pre-literacy and reading skills and not, for example, in mathematical skills. A wider selection of academic skills should be studied to achieve a better understanding of the relationship between impulsive behavior and skill development.

Conclusion

Previous studies have shown that behavioral regulation skills play a significant role in children's academic and social functioning (e.g., Fabes et al., 1999; McClelland et al., 2006; Valiente et al., 2008). The present study contributed to this research by examining the developmental trajectories of impulsive behavior from kindergarten to fourth grade in a sample of Finnish children. The findings showed that the majority of the children were showing a high level of impulse regulation already in kindergarten, or improved their regulation skills during the first grades of elementary school. However, a small group of children with compromised levels of impulsive behavior did not make any improvement in

their regulation skills by the fourth grade, and consequently, faced difficulties in their functioning at school. Corresponding to the results found in other countries and cultures, we found that Finnish children's behavioral regulation skills were closely associated with their socio-emotional adjustment at school, such as positive teacher-student relationships and a lack of hyperactivity and conduct problems.

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Table 1

Comparison of the different latent growth models

Model	AIC	BIC	aBIC	Chi square	df	*p*-value	CFI	TLI	SRMR	RMSEA
Intercept-only	4529.97	4557.51	4535.30	20.72	13	.08	0.92	0.94	.07	.04
Linear	4524.47	4563.82	4532.09	16.74	10	.08	0.93	0.93	.06	.04
Non-linear	4546.91	4582.32	4553.77	33.21	11	.00	0.77	0.79	.09	.07
Quadratic	**4512.91**	**4568.00**	**4523.58**	**6.33**	**6**	**.39**	**1.00**	**.99**	**.04**	**.01**

Note. AIC = Akaike information criterion; BIC = Bayesian information criterion; aBIC = adjusted Bayesian information criterion; df = degrees of freedom; CFI = comparative fit index; TLI = Tucker-Lewis index; SRMR = standardized root mean square residual; RMSEA = root mean square error of approximation.

Table 2

Comparison of the growth mixture models, solutions with 1 to 6 classes

Number of classes	log L	AIC	BIC	aBIC	LMR (*p*-value)	VLMR (*p*-value)	Entropy	Class 1 *n*	Class 2 *n*	Class 3 *n*	Class 4 *n*	Class 5 *n*	Class 6 *n*
1	-2350.68	4717.36	4748.84	4723.46	n/a	n/a	n/a	378					
2	-2166.42	4356.84	4404.06	4365.98	.05	.06	.95	46	332				
3	-2075.75	4183.49	4246.45	4195.69	.26	.27	.97	327	37	14			
4	-2022.65	4085.29	4163.99	4100.53	.63	.64	.96	34	10	312	21		
5	-1968.10	3984.20	4078.64	4002.49	.18	.18	.97	3	26	24	312	13	
6	-1933.80	3923.60	4033.78	3944.94	.22	.23	.96	298	3	23	24	9	21

Note. log L = log likelihood value; AIC = Akaike information criterion; BIC = Bayesian information criterion; aBIC = adjusted Bayesian information criterion; LMR = Lo-Mendell-Rubin adjusted likelihood ratio test; VLMR = Vuong-Lo-Mendell-Rubin likelihood ratio test.

Table 3

Means (M) and standard deviations (SD) of children's age, skill, and motivation variables for the latent groups

	Low IB		Moderate IB		Decreasing IB		Contradictory IB		Total sample	
Measures	*n*	*M (SD)*	*n*	*M (SD)*	*n*	*M (SD)*	*n*	*M (SD)*	*n*	*M (SD)*
Age	312	74.18 (3.49)	33	74.00 (3.28)	22	73.05 (3.47)	11	73.36 (3.08)	378	74.07 (3.46)
Pre-literacy skills										
Phoneme identification Kindergarten	311	9.01 (1.57)	33	8.58 (1.86)	22	8.27 (2.16)	11	9.18 (0.98)	377	8.93 (1.63)
Naming letters Kindergarten	311	23.63 (6.08)	33	22.27 (7.55)	22	19.73 (8.29)	11	23.73 (4.36)	377	23.29 (6.38)
Spatial visualization Kindergarten	311	14.43 (2.29)	33	14.18 (1.76)	22	13.59 (3.11)	11	13.82 (2.64)	377	14.34 (2.32)
Memory span Grade 1	303	9.31 (1.79)	33	9.00 (2.19)	22	9.00 (1.57)	11	8.64 (2.62)	369	9.24 (1.85)
RAN Kindergarten	311	67.68 (15.22)	33	74.41 (15.77)	22	78.81 (28.02)	10	68.11 (15.16)	376	68.93 (16.49)
Reading comprehension										
Grade 1	310	5.87 (3.27)	33	5.03 (3.53)	21	3.81 (2.80)	10	4.90 (2.18)	374	5.66 (3.28)
Grade 2	297	8.68 (2.69)	32	7.63 (3.30)	21	6.67 (2.76)	10	8.00 (3.02)	360	8.45 (2.80)
Grade 3	299	9.33 (1.88)	32	8.78 (2.93)	21	8.33 (2.65)	10	9.20 (2.39)	362	9.22 (2.06)
Grade 4	286	8.34 (2.47)	31	7.65 (2.69)	19	6.84 (2.46)	10	7.90 (2.33)	346	8.18 (2.50)
Interest in literacy										
Kindergarten	311	3.90 (0.84)	33	3.55 (1.26)	22	3.56 (1.10)	11	3.36 (1.05)	377	3.83 (0.91)
Grade 1	303	3.71 (0.88)	33	3.40 (0.98)	22	3.63 (1.03)	11	3.02 (0.91)	369	3.65 (0.90)
Grade 2	296	3.72 (0.79)	31	3.28 (1.05)	21	3.41 (0.86)	10	2.97 (0.54)	358	3.64 (0.83)
Grade 3	298	3.41 (0.97)	32	3.26 (1.10)	21	3.67 (1.03)	10	2.40 (0.94)	361	3.38 (1.00)

Grade 4	286	3.46 (0.95)	31	3.13 (1.04)	19	3.33 (0.93)	10	3.15 (0.87)	346	3.42 (0.96)
Task avoidance										
Kindergarten	308	2.15 (0.92)	32	3.23 (1.18)	22	2.94 (1.08)	11	3.17 (1.27)	373	2.32 (1.03)
Grade 1	280	2.32 (1.01)	31	2.95 (0.90)	19	3.60 (0.94)	11	3.16 (1.03)	341	2.48 (1.05)
Grade 2	258	2.29 (0.99)	26	3.02 (0.95)	17	3.62 (0.85)	10	3.08 (1.23)	311	2.45 (1.05)
Grade 3	246	2.18 (1.01)	25	3.30 (0.97)	17	3.27 (1.01)	10	2.90 (1.28)	298	2.36 (1.09)
Grade 4	220	2.06 (0.94)	27	2.95 (1.06)	15	3.25 (0.82)	10	2.98 (1.16)	272	2.25 (1.02)

Note. IB = impulsive behavior; RAN = rapid automatized naming.

Table 4

Means (M) and standard deviations (SD) of social competence and teacher-student relationship variables for the latent groups

	Low IB		Moderate IB		Decreasing IB		Contradictory IB		Total sample	
Measures	*n*	*M (SD)*	*n*	*M (SD)*	*n*	*M (SD)*	*n*	*M (SD)*	*n*	*M (SD)*
Disruptiveness Kindergarten	306	1.70 (0.68)	31	2.46 (0.83)	22	2.42 (0.62)	11	2.34 (0.60)	370	1.83 (0.74)
Empathy Kindergarten	306	3.25 (0.63)	31	2.69 (0.76)	22	2.88 (0.64)	11	2.55 (0.72)	370	3.16 (0.67)
Impulsiveness Kindergarten	306	1.63 (0.67)	31	2.45 (1.05)	22	2.33 (0.73)	11	2.29 (0.88)	370	1.76 (0.77)
Cooperation Kindergarten	306	3.10 (0.59)	31	2.85 (0.74)	22	2.93 (0.53)	11	2.82 (0.51)	370	3.06 (0.60)
Hyperactivity										
Grade 1	251	1.56 (0.54)	28	2.06 (0.63)	18	2.17 (0.59)	10	2.04 (0.72)	307	1.66 (0.59)
Grade 2	262	1.52 (0.54)	28	2.08 (0.55)	17	2.29 (0.67)	10	2.06 (0.69)	317	1.63 (0.60)
Grade 3	242	1.50 (0.53)	25	2.17 (0.54)	17	2.16 (0.65)	10	2.12 (0.78)	294	1.62 (0.61)
Grade 4	219	1.42 (0.46)	26	1.99 (0.54)	15	1.99 (0.52)	10	2.36 (0.59)	270	1.54 (0.54)
Prosociality										
Grade 1	251	2.24 (0.52)	28	2.04 (0.58)	18	2.16 (0.53)	10	1.80 (0.50)	307	2.20 (0.53)
Grade 2	262	2.24 (0.51)	28	2.11 (0.63)	17	2.05 (0.47)	10	1.82 (0.53)	317	2.21 (0.53)
Grade 3	242	2.20 (0.50)	25	1.94 (0.51)	17	2.02 (0.52)	10	1.74 (0.38)	294	2.15 (0.51)
Grade 4	219	2.24 (0.49)	26	1.93 (0.49)	15	2.09 (0.47)	10	1.69 (0.38)	270	2.18 (0.50)
Conduct problems										
Grade 1	251	1.22 (0.34)	28	1.52 (0.47)	18	1.58 (0.55)	10	1.53 (0.36)	307	1.28 (0.39)
Grade 2	262	1.24 (0.38)	28	1.49 (0.46)	17	1.67 (0.51)	10	1.45 (0.36)	317	1.29 (0.41)
Grade 3	242	1.22 (0.37)	25	1.52 (0.47)	17	1.58 (0.32)	10	1.68 (0.43)	294	1.28 (0.40)

Grade 4	219	1.16 (0.30)	26	1.42 (0.40)	15	1.45 (0.30)	10	1.50 (0.25)	270	1.21 (0.32)
Peer problems										
Grade 1	251	1.31 (0.33)	28	1.56 (0.46)	18	1.43 (0.39)	10	1.46 (0.52)	307	1.34 (0.36)
Grade 2	262	1.32 (0.36)	28	1.43 (0.42)	17	1.54 (0.34)	10	1.40 (0.37)	317	1.34 (0.37)
Grade 3	242	1.34 (0.36)	25	1.48 (0.46)	17	1.58 (0.42)	10	1.50 (0.38)	294	1.37 (0.38)
Grade 4	219	1.30 (0.33)	26	1.44 (0.42)	15	1.59 (0.39)	10	1.48 (0.34)	270	1.34 (0.35)
Teacher's positive affect										
Grade 1	255	4.23 (0.77)	29	4.07 (0.92)	18	3.72 (0.86)	10	3.75 (0.68)	312	4.17 (0.80)
Grade 2	261	4.18 (0.74)	28	3.88 (0.82)	17	3.68 (0.56)	9	3.72 (0.79)	315	4.11 (0.75)
Grade 3	242	4.24 (0.77)	25	3.64 (0.88)	17	3.38 (0.76)	10	3.40 (0.88)	294	4.11 (0.83)
Grade 4	220	4.25 (0.68)	27	3.50 (0.99)	15	3.50 (0.60)	10	3.80 (0.95)	272	4.12 (0.77)
Teacher's negative affect										
Grade 1	255	1.63 (0.89)	29	2.14 (1.08)	18	2.36 (1.30)	10	2.40 (0.91)	312	1.75 (0.96)
Grade 2	261	1.67 (0.89)	28	2.27 (1.15)	17	2.76 (1.05)	9	2.56 (0.58)	315	1.81 (0.96)
Grade 3	242	1.57 (0.84)	25	2.46 (0.95)	17	2.56 (1.16)	10	3.10 (1.15)	294	1.75 (0.97)
Grade 4	220	1.58 (0.89)	27	2.33 (1.15)	15	2.30 (1.08)	10	2.55 (0.80)	272	1.73 (0.97)
Teacher's support										
Grade 1	255	2.69 (0.97)	29	3.14 (0.80)	18	3.63 (0.69)	10	2.93 (1.26)	312	2.79 (0.98)
Grade 2	261	2.60 (1.07)	28	3.20 (0.95)	17	3.60 (0.94)	10	2.70 (1.36)	316	2.71 (1.09)
Grade 3	247	2.66 (1.02)	25	2.97 (1.05)	16	3.55 (0.94)	10	3.10 (1.13)	298	2.75 (1.04)
Grade 4	214	2.61 (1.07)	27	3.06 (0.99)	15	3.67 (0.69)	10	2.63 (1.40)	266	2.72 (1.09)

Note. IB = impulsive behavior.

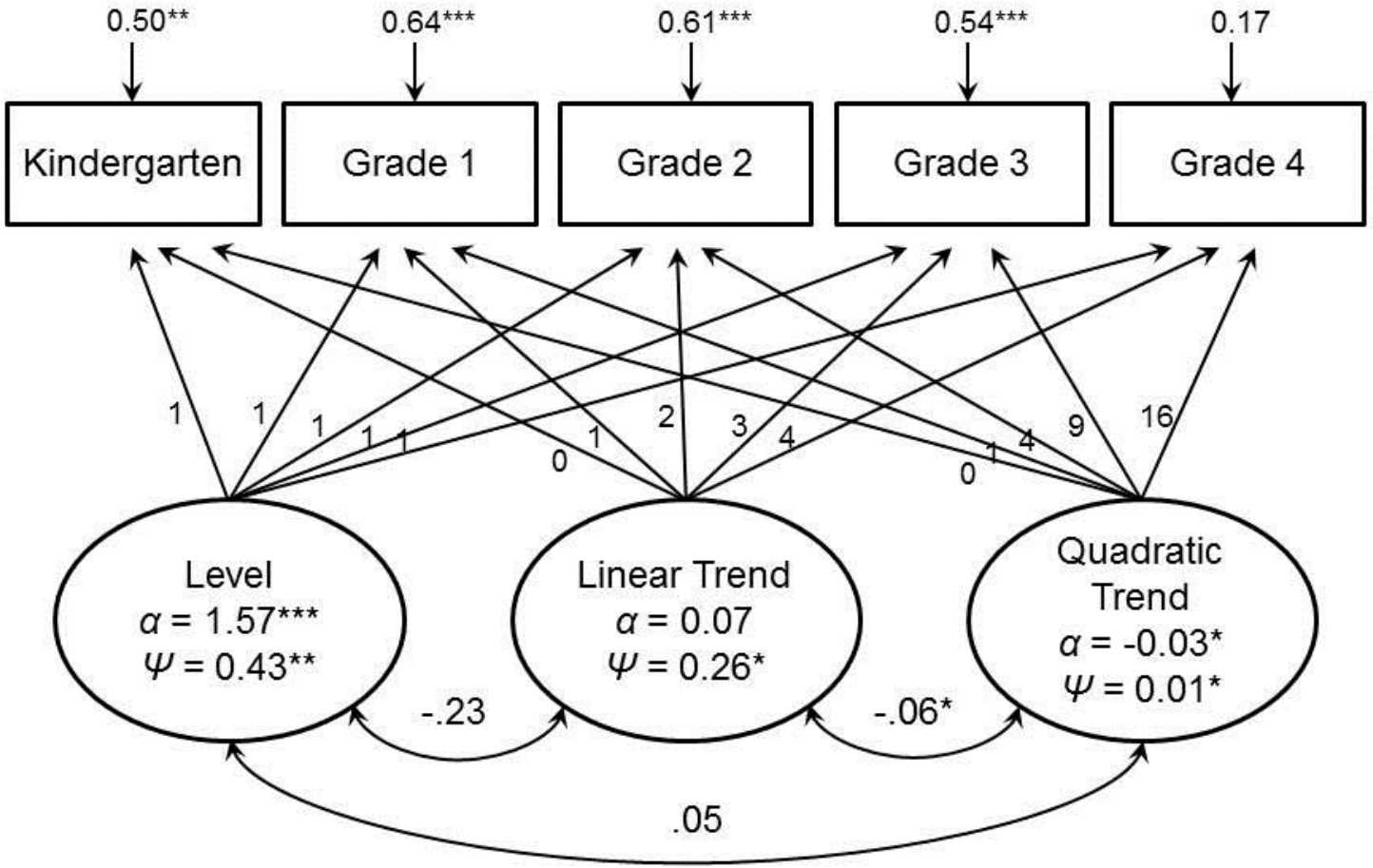

Figure 1. The final latent growth model for the whole sample of participants (n = 378), unstandardized estimates. *Note*. α = estimated mean value of the latent growth factor; ψ = estimated variance of the latent growth factor. * $p < .05$. ** $p < .01$. *** $p < .001$.

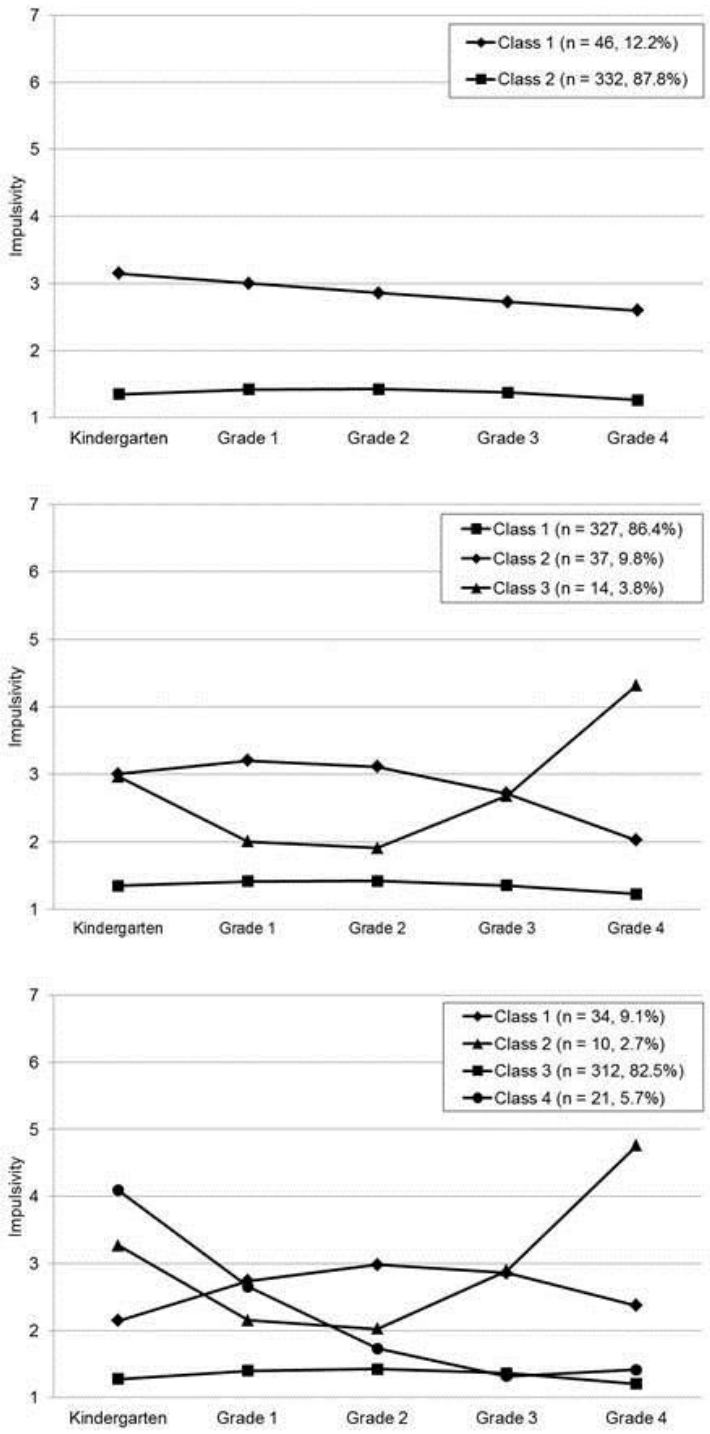

Figure 2. Growth trajectories of the latent classes (estimated means), two-class (top), three-class (middle), and four-class solutions (bottom).