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A Household Study of Self-Regulation in Children: Intergenerational Links and Maternal Antecedents

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Abstract. Delay of gratification (DoG) and delay discounting (DD) are behavioral measures of self-regulation and impulsivity. Whereas DoG refers to the postponement of gratification, DD involves the devaluation of a reward over time. Previous studies have demonstrated associations between paternal self-control, paternal personality traits, parenting styles, maternal intelligence, and children's self-regulation. The present study explored intergenerational links between mothers' and child's self-regulation and maternal antecedents of children's DoG. We analyzed 267 mother-child dyads in the German Socio-Economic Panel (SOEP) Children's Study. Measures included an experiment using gummy bears as

rewards to assess DoG in children and monetary choice procedures to assess DD in mothers. Additionally, cognitive abilities and personality traits of mothers and children were assessed. The main result was that children's age and breastfeeding were significant predictors of DoG in children, even when we controlled for other influences such as maternal cognitive abilities and personality traits. We explain the result in the context of previous findings concerning attachment security, bonding, maternal sensitivity, children's self-regulation of energy intake, neuroscientific evidence, and breastfeeding. Further studies should use equivalent measures of DoG in children and parents and further explore this link between breastfeeding and DoG in a genetically sensitive design.

Keywords: intergenerational links, maternal antecedents, breastfeeding, self-regulation, delay of gratification, delay discounting

The old adage, “The apple doesn’t fall far from the tree,” implies that children naturally take after their parents. But does this apply to self-regulation? And if so, what specific variables contribute most to children’s ability to self-regulate, that is, the human capacity to change behavior in the pursuit of goals (Baumeister, Vohs, & Tice, 2007)? Specific aspects of self-regulation include, among others, delay of gratification, compliance, and inhibition (Winsler, Diaz, McCarthy, Atencio, & Chabay, 1999). *Delay of gratification* (DoG) is the ability to reject immediate rewards in favor of later, better rewards (W. Mischel, Shoda, & Rodriguez, 1989). *Delay discounting* (DD), also called *temporal discounting*, is a similar construct and refers to the individual’s devaluation of a reward over time (Reynolds, de Wit, & Richards, 2002). Both DoG and DD can be interpreted as behavioral measures of self-regulation because they involve the active management of goals (Freund & Baltes, 2002).

Interestingly, the literature provides no answer to the question of whether self-regulation deficits in mothers are associated with similar deficits in children and which maternal antecedents contribute most to children’s DoG. This might be surprising as self-regulatory deficits have been found to be linked with a range of problematic behaviors and behavioral problems in both children and adults (Krueger, Caspi, Moffitt, White, & Stouthamer-Loeber, 1996), for example, attention-deficit/hyperactivity disorder (ADHD; Barkley, 1997; Byrne, DeWolfe, & Bawden, 1998; Schweitzer & Sulzer-Azaroff, 1995), substance abuse (Baumeister & Heatherton, 1996; de Wit, 2009), violence, and crime (Baumeister & Heatherton, 1996; Cherek, Moeller, Dougherty, & Rhoades, 1997). The long-term developmental outcomes are particularly noteworthy: Children’s ability to overcome the temptation of immediate rewards is a significant predictor of cognitive, motivational, and social functioning as well as well-being (W. Mischel, Shoda, & Peake, 1988). In adulthood

and old age, DoG predicts satisfaction with life and well-being (Forstmeier, Drobetz, & Maercker, 2011; Rosenbaum & Ben-Ari Smira, 1986).

We define intergenerational links as mother-child links with respect to the same variable, such as self-regulation, and maternal antecedents as variables assessed in mothers such as maternal years of education or personality traits. First, children of mothers with high self-regulation might have high DoG. Second, maternal antecedents such as years of education, duration of breastfeeding, cognitive abilities (fluid and crystallized intelligence), and personality traits (e.g., Big Five) might also contribute to children's DoG. For instance, mothers with higher education, higher cognitive abilities, higher agreeableness, higher conscientiousness, and lower extraversion might have children with higher DoG. Third, the duration of breastfeeding, another maternal antecedent, might predict children's DoG. The next section will elaborate on intergenerational links and maternal antecedents in self-regulation.

Intergenerational Links and Maternal Antecedents in Self-regulation

Research aiming to explain individual differences in self-regulation must contend with numerous interacting variables. On the one hand, biological factors and maturation affect children's ability to self-regulate (e.g., Kopp, 1982; Newman & Wallace, 1993; Posner & Rothbart, 2000; Rothbart, 1989). On the other hand, early mother-child and father-child interactions, parental attachment, parenting styles, and discipline strategies also play a crucial role (e.g., Olson, Bates, & Bayles, 1990; Winsler et al., 1999).

With respect to intergenerational links in or intergenerational transmission of self-regulation, findings suggest that parental levels of self-control predict children's levels of self-control. One explanation is that parents with low self-control instill high self-control in their children to a lesser extent than do parents with high self-control. Furthermore, parents

with lower self-control might show less effective parenting styles that do not enable children to develop high self-control (Boutwell & Beaver, 2010).

Previous studies exploring maternal antecedents have found that maternal intelligence is positively correlated with children's self-regulation (Colman, Hardy, Albert, Raffaelli, & Crockett, 2006). Associations between parenting and the self-regulation capacities of preschoolers were confirmed by a meta-analysis by Karreman, Tuijl, Aken, and Deković (2006). Another meta-analysis strongly supported links between parental Big Five personality traits and parenting styles: Higher extraversion, agreeableness, conscientiousness, and openness as well as lower neuroticism were found to be linked to more warmth and behavioral control, whereas higher agreeableness and neuroticism were related to more autonomy support (Prinzle, Stams, Deković, Reijntjes, & Belsky, 2009). Negative parental power-assertive control strategies such as intrusive control or coercive power were predictors of deficits in self-regulation. In contrast, warm, responsive caregiving as well as positive directive control such as low to moderate power-assertive limit setting and clear and encouraging guidance proved to be linked with self-regulation (Karreman et al., 2006; Vondra, Shaw, Swearingen, Cohen, & Owens, 2001). One possible explanation might be that overcontrolling parenting prevents children from developing their own useful self-regulatory strategies (Karreman et al., 2006). In fact, better parental autonomy support is positively correlated with higher self-regulation in children (Grolnick & Ryan, 1989).

One variable that might lead to positive long-term outcomes is the duration of breastfeeding. Breastfeeding can be seen as extra physical and psychological contact between mother and infant that contributes to the child's development in the first year. Above all, the duration of breastfeeding indicates the interest, amount of time, and energy a mother is willing to give to her child. Additionally, a breastfeeding mother might also invest more time interacting with her offspring across their lifespan (Mortensen, Michaelsen, Sanders, &

Reinisch, 2002). Nonetheless, formula-feeding mothers might be able to offer their children the same amount of time, energy, and so forth, as breastfeeding mothers. With respect to long-term psychological outcomes, the duration of breastfeeding has been linked to better cognitive development, academic achievement, executive function, perceptual performance, and social competence in childhood and adulthood (Mortensen et al., 2002; Oddy, Li, Whitehouse, Zubrick, & Malacova, 2011; Smith, Durkin, Hinton, Bellinger, & Kuhn, 2003). One meta-analysis showed that the duration of breastfeeding is associated with better cognitive development, even when confounding variables such as maternal socio-economic status and education were controlled for (Anderson, Johnstone, & Remley, 1999). The breastfeeding context (physical and psychological contact between mother and child) might contribute to development, and variables correlating with both breastfeeding and cognitive development, as well as unidentified and uncontrolled mediators and moderators, might also play a role (Mortensen et al., 2002; Rodgers, 1978).

Furthermore, the duration of breastfeeding has been linked with mothers' positive attitudes towards breastfeeding, better family support, and more adequate bonding between mother and child even when education and other confounding factors are controlled for (Cernadas, Noceda, Barrera, Martinez, & Garsd, 2003). In addition, the duration of breastfeeding is negatively correlated with children's attention/behavior problems and attention-deficit/hyperactivity disorder (ADHD) (Julvez et al., 2007), and breastfeeding has been shown to be a protective factor against obesity in childhood and later stages of life (Arenz, Ruckerl, Koletzko, & von Kries, 2004; Owen, Martin, Whincup, Smith, & Cook, 2005; von Kries et al., 1999). Moreover, both ADHD and obesity are associated with self-regulatory deficits (e.g., Barkley, 1997; Bonato & Boland, 1983).

Aims of the Study

First, we investigated intergenerational links in self-regulation between mothers and children and maternal antecedents of children's DoG. To the best of our knowledge, this is the first study to measure self-regulation in mothers and children. Second, the present study explored the most significant predictors of children's DoG (intergenerational links and maternal antecedents). Specifically, we predicted that high self-regulation (high DD, low impulsivity, high patience, high willingness to take risks) in mothers would be intergenerationally linked with high DoG in children. Furthermore, we hypothesized that maternal antecedents (years of education, cognitive abilities, Big Five personality traits, duration of breastfeeding) would be positively associated with children's DoG. Additionally, we investigated whether maternal satisfaction with life is related to children's DoG since previous studies have suggested that high satisfaction with life is linked to high DoG (e.g., Rosenbaum & Ben-Ari Smira, 1986).

Method

We analyzed data from the German Socio-Economic Panel Study (SOEP). In 2008, the SOEP conducted the SOEP Children's Study, which is a companion study to the well-known SOEP (G. G. Wagner, Frick, & Schupp, 2007). For more details on this data set, see Siegel, Jänsch, and Stimmel (2008); for studies by economists using these data, see Bartling et al. (2010) and Bartling, Fehr, Maréchal, and Schunk (2009).

Participants

Our original sample consisted of 291 children and their mothers. For the intergenerational analysis, we excluded two children who did not understand the instructions of the gummy bear experiment as well as 19 children who, according to their mothers, did not like gummy bears as the experiment requires real incentives that stimulate motivation (Wulfert, Block, Santa Ana, Rodriguez, & Colsman, 2002). In sum, the sample consisted of 267 mother-child

dyads. The children's ages ranged from 61 to 84 months ($M = 72.1$, $SD = 6.8$); the mothers' ages ranged from 24 to 55 years ($M = 36.3$, $SD = 5.3$). Further characteristics of the sample of children are given in Table 1.

Table 1

Characteristics of the Sample of Children

Characteristics	Total	DoG	Non-DoG	t/χ^2
<i>N</i> (%)	267	209 (78.3)	58 (21.7)	31.96***
Age (years), <i>M</i> (<i>SD</i>)	5.5 (.5)	5.5 (.5)	5.4 (.5)	-1.43
Age (months), <i>M</i> (<i>SD</i>)	72.1 (6.8)	72.7 (6.4)	70.1 (7.5)	-2.61*
Gender (% female)	44.6	44.0 (34.5)	46.6 (10.1)	.12
Breastfeeding in infancy (%)	83.1	81.3 (63.7)	89.7 (19.5)	2.24
Breastfeeding in infancy (in months), <i>M</i> (<i>SD</i>)	4.3 (4.3)	4.6 (4.5)	3.3 (3.0)	-2.68**
Attention-deficit/hyperactivity disorder (%)	4.1	4.3 (3.4)	3.4 (.7)	.09
Number of people living in household, <i>M</i> (<i>SD</i>)	4.0 (1.0)	4.0 (1.0)	3.8 (.8)	-1.22
Number of siblings, <i>M</i> (<i>SD</i>)	1.5 (2.0)	1.5 (1.9)	1.6 (2.4)	.08
Attending kindergarten (%)	73.4	72.2 (56.6)	77.6 (16.9)	1.28
Attending school (%)	25.5	26.3 (20.6)	22.4 (4.9)	1.28
At home (%)	1.1	1.4 (1.1)	.0 (.0)	1.28

Note. DoG = children who delayed gratification, Non-DoG = children who did not delay gratification. *t* values (*t*) and χ^2 values (χ^2) refer to differences between DoG and non-DoG children with respect to variables of interest. Absolute values of % are in brackets. * $p < .05$, ** $p < .01$, *** $p < .001$.

Materials (for Children)**Delay of gratification (the gummy bear experiment)**

The experiment measured DoG in children using organic gummy bears as incentives, that is, small, colored, and rubbery-textured confectioneries consisting entirely of natural, non-toxic ingredients without any artificial additives. On the whole, this behavioral DoG experiment is a comparable but modified version of the classic “marshmallow paradigm” (W. Mischel et al., 1989). The experimenter presented the child with one open and one un-opened

packet of gummy bears by placing them on the table in clear view of the child. After that, the examiner told the child that she could have both packets if she waited until the interview with the mother was over (no information was given about how long the interview would actually last). Additionally, the experimenter told the child that if she wanted to eat any gummy bears during the interview, she could just take them from the open packet and eat them. However, if she did, she would not get to have the second packet. If the child ate any gummy bears from the open packet, the experimenter recorded the time and ended the experiment. Hence, the outcome of the experiment distinguished between delaying (DoG children) and non-delaying children (non-DoG children).

Culture Fair Intelligence Test

The Culture Fair Intelligence Test (CFT 1; Cattell, Osterland, & Weiss, 1997) is a measure of general (fluid) intelligence comprised of non-verbal items that was designed to be free of bias against any cultural group. The SOEP Children's Study used two subtests of the CFT 1. In the subtest "Classifying," participants are to find the distracter among five pictures. Whereas four pictures or figures have something in common (e.g., four different circles), one picture or figure (e.g., a triangle) does not share this common feature with the others. In the subtest "Solving matrices," children are to choose one of five items that complete a given pattern (i.e., a square consisting of four figures). The two subtests were combined into a composite measure.

The reliability coefficients of the CFT 1 subscales "Classifying" and "Solving matrices" are between $r = .70$ and $r = .79$. Furthermore, the CFT 1 is significantly correlated with the Hamburg Wechsler Intelligence Scale for Children ($r = .66$), thus demonstrating good validity (Cattell et al., 1997).

Peabody Picture Vocabulary Test

Verbal intelligence was measured with the short German version of the Peabody Picture Vocabulary Test (PPVT) for ages three and older (Dunn & Dunn, 1997; Rossbach, Tietze, & Weinert, 2005). This version of the PPVT has 61 items (with four pictures each). For each item, the examiner says a word (e.g., “doll”) that identifies one of the four pictures and asks the child to point to the picture that the word represents (i.e., the picture of a doll).

The internal consistency (Cronbach’s α) of the PPVT is .93; the 1-month retest reliability is between $r = .91$ and $r = .93$. With respect to validity, the US version of the PPVT is significantly correlated with the Wechsler Intelligence Scale for Children ($.82 \leq r \leq .92$), the Kaufman Adolescent and Adult Intelligence Test ($.76 \leq r \leq .91$), and the Kaufman Brief Intelligence Test ($.62 \leq r \leq .82$) (Dunn & Dunn, 1997; Rossbach et al., 2005).

Big Five Questionnaire for Children

Ten items assessed the children’s Big Five personality traits (extraversion, emotional stability, openness to new experience / culture, agreeableness, and conscientiousness) using the parental bipolar adjective Big Five scales (Asendorpf, 1998; Asendorpf & Van Aken, 2003). Mothers rated their child (“How would you judge your child compared to other children of the same age?”) by means of bipolar adjective pairs (on an 11-point scale) like: “My child is: well-tempered – irritable.”

With respect to parental ratings, the internal consistencies (Cronbach’s α) of the five subscales are between .83 and .91 with a median α of .86 (Asendorpf, 1998).

Materials (for Mothers)

Delay discounting

In a paradigm developed and evaluated by Dohmen, Falk, Huffman, and Sunde (2007) participants are to choose between two hypothetical monetary rewards. The experimenter shows a choice table consisting of 20 rows, each containing two different sums of money. For example, individuals choose between a fixed sum of €100 now (approximately \$140) and a successively increasing amount of money in six months (between €101.20 and €124.80). We calculated correspondent delay discounting rates (k) using the equation for the paradigm $k = \log [(B/100 - 1) / 6]$ with B = chosen higher and delayed amount of money in B (Kirby, Petry, & Bickel, 1999). The higher the chosen amount of money (B), the higher k is. A higher k means greater DD behavior and therefore higher impulsivity (lower self-regulation).

Generally, DD paradigms have proven to be reliable and valid measures of impulsivity (e.g., Ainslie, 1975; Green, Fry, & Myerson, 1994; Rachlin & Green, 1972).

Digit Symbol Test

The Digit Symbol Test (DST), a computerized adaptation of the Digit Symbol Test of the Wechsler Adult Intelligence Scale–Revised (WAIS-R; Wechsler, 1981), measures fluid intelligence (perceptual motor speed, incidental learning). The DST consists of nine digit-symbol pairs (e.g., 1/-, 8/X, 9/=) and asks participants to type the corresponding digit under each symbol as quickly as possible. Since the DST is a speed test, the total score measures the number of correct digits typed within 90 seconds.

Cronbach's α (internal consistency) of the WAIS-R is .93 for fluid intelligence (full test: .97), split-half reliability is $r = .95$. Further, the WAIS-R is significantly correlated with other IQ tests (e.g., Stanford-Binet Test), indicating that the WAIS-R is a valid measure of global intelligence (Wechsler, 1981).

Multiple-Choice Vocabulary Test

The Multiple-Choice Vocabulary Test (MWT; Lehrl, Triebig, & Fischer, 1995) is a multiple-choice instrument consisting of 37 items (with five words each) measuring verbal (crystallized) intelligence. On each item, only one of the five words is a real word; the others are all distracters. Participants are to cross out the real word on each item. The level of difficulty progressively increases from item to item.

The internal consistency (Cronbach's α) of the MWT is .95. The MWT is significantly correlated with the global intelligence quotient ($r = .72$) (Lehrl et al., 1995).

Big Five Inventory–SOEP

The Big Five Inventory–SOEP (BFI-S; Lang, John, Lüdtke, Schupp, & Wagner, 2011; Schupp & Gerlitz, 2008) is a short, 15-item self-report questionnaire on the Big Five personality traits, that is, extraversion, neuroticism, openness to new experience, agreeableness, and conscientiousness. Participants rated the statements, for example, “I am somebody who is communicative, talkative,” on a seven-point scale from *not at all true* to *completely true*.

This short but adequate inventory is already established in the international psychological literature (e.g., Donnellan, Baird, Lucas, & Oswald, 2006; Lang et al., 2011). The internal consistencies (Cronbach's α) of the five subscales are between .50 and .74, indicating the substantial breadth of these personality traits (Lang et al., 2011; Schupp & Gerlitz, 2008). Furthermore, upon comparison with the German version of the NEO-FFI and other external validation criteria, the validity of the BFI-S was found to be satisfactory (Gerlitz & Schupp, 2005; Lang, 2005).

Other measures

The mothers rated their impulsivity, patience, and willingness to take risks (one item for each personality domain) on an 11-point bipolar adjective scale. An 11-point bipolar scale from *very unsatisfied* to *very satisfied* measured general satisfaction with life (SWL). This is a well-established and frequently used question for measuring SWL (e.g., Diener & Lucas, 1999; Headey, 2010; Headey, Muffels, & Wagner, 2010). The SOEP Children's Study assessed the level of completed education, which we transformed into years of education. Furthermore, the experimenters asked the participating mothers whether and for how many months they had breastfed their child.

Procedure

Data were collected by trained interviewers from TNS Infratest, the fieldwork institute running the main SOEP study. After the experimenters explained the purpose of the study, they obtained informed consent from all participating mothers. The gummy bear experiment took place during the assessment (in the mother's and child's home). Before the mothers' DD behavior was measured at the end of the interview, the delaying children received a second packet of gummy bears.

Data Analysis

The data were analyzed using IBM SPSS Statistics 19. To explore relationships among the intergenerational variables, the maternal antecedents and other variables (e.g., child's age), we calculated bivariate correlations (Pearson and point-biserial correlations). Additionally, independent *t*-tests compared group differences between DoG and non-DoG children with respect to variables significantly correlated with DoG.

Furthermore, χ^2 tests (test of independence) determined whether paired observations on two variables were independent of each other, for example, between the dichotomous

variables of DoG and gender (see Table 1). In a post hoc analysis, we assessed the correlations between DoG and children's fluid and crystallized intelligence.

A regression analysis explored intergenerational predictors and maternal antecedents of children's DoG. Since the gummy bear experiment measured children's self-regulation dichotomously, we used binary logistic regression analysis with interval-scaled predictors. All variables were included in a single regression analysis (enter method). As children's age was significantly correlated with DoG, we included this predictor besides intergenerational variables (delay discounting, impulsivity, patience, and willingness to take risks). Due to previous findings, we entered maternal antecedents (duration of breastfeeding, education, fluid and crystallized intelligence, Big Five personality traits, satisfaction with life) into the regression model predicting children's DoG.

In a post hoc binary logistic regression analysis, we examined whether the duration of breastfeeding and age remained significant predictors of children's DoG when we included the children's crystallized intelligence. In addition, mediators (maternal crystallized intelligence, years of education, and openness) of the relationship between duration of breastfeeding and DoG were analyzed using binary logistic regression models in a post hoc analysis.

We set the significance level (α) of all computations (correlations, t -tests, χ^2 tests, binary logistic regression analysis) to .05 (5%). Effect sizes were calculated using Cohen's d , whereby $d = .2$ indicates a small, $d = .5$ a medium, and $d = .8$ a large effect size (Cohen, 1988).

Results

Intergenerational Links and Maternal Antecedents in Children's Self-regulation

Correlation Analysis

Table 2 provides an overview of correlations between intergenerational links, maternal antecedents, and children's DoG. The analysis of the data revealed low but significant correlations between duration of breastfeeding, maternal years of education, and self-regulation in children.

The DoG children ($M = 4.6$, $SD = 4.5$) had been breastfed as infants significantly longer than the non-DoG children ($M = 3.3$, $SD = 3.0$), $t(265) = -2.68$, $p = .008$ (two-tailed), $d = .35$. The range of duration of breastfeeding was 0 to 24 months in DoG and 0 to 12 months in non-DoG children. The DoG children ($M = 72.7$ months, $SD = 6.4$) were significantly older than the non-DoG children ($M = 70.1$, $SD = 7.5$), $t(265) = -2.61$, $p < .005$ (two-tailed), $d = .40$.

A post hoc correlation analysis showed significant relations between children's DoG and crystallized intelligence ($r = .12$, $p < .05$), but not fluid intelligence ($r = -.00$, $p = .98$).

Table 2

Correlations Between Children's Self-Regulation and Intergenerational Variables and Maternal Antecedents

Variables	<i>M (SD)</i>	<i>R</i>	<i>p</i>
Intergenerational variables			
Delay discounting	-3.8 (.9)	-.11	.07
Impulsivity	5.8 (2.2)	-.01	.88
Patience	6.4 (2.2)	.07	.23
Willingness to take risks	4.6 (2.3)	-.06	.34
Maternal antecedents			
Breastfeeding (in months)	4.3 (4.3)	.13*	.03
Household income (in euros)	2418.2 (1042.9)	.30	.67
Education (in years)	10.6 (1.6)	.05	.34
Fluid intelligence (DST)	32.9 (9.2)	-.04	.53
Crystallized intelligence (MWT)	30.8 (3.5)	.07	.23

Extraversion	15.61 (3.3)	.07	.30
Agreeableness	17.0 (2.8)	.03	.59
Conscientiousness	17.7 (2.5)	.09	.13
Openness	14.2 (3.5)	.06	.35
Neuroticism	12.1 (3.6)	.04	.49
Satisfaction with life	7.3 (1.9)	.03	.60

Note. $N = 267$. M = mean, SD = standard deviation. r represent point-biserial correlations between the dichotomous variable DoG / non-DoG and continuous variables. $p = p$ value. DST = Digit Symbol Test, MWT = Multiple Choice Vocabulary Test. $*p < .05$

Regression Analysis

Table 3 summarizes the results of a binary logistic regression analysis. All in all, children's age (*odds ratio [OR] = 1.06, $p < .05$*) and duration of breastfeeding were the only predictors of DoG (*OR = 1.11, $p < .05$*), even when we controlled for maternal years of education and other variables (see Table 3). This model explained 12% of the variance.

A post hoc binary logistic regression analysis showed that duration of breastfeeding (*OR = 1.1, $p < .05$*) and age (*OR = 1.06, $p < .05$*) remained significant predictors of children's DoG when we included children's crystallized intelligence (*OR = 1.0, $p = .19$*).

Table 3

Intergenerational Variables and Maternal Antecedents as Predictors of Children's Self-Regulation

Variables	B	$SE B$	<i>Odds ratio</i>	.95 confidence intervals	
				lower limit	upper limit
Age of child (in months)	.06	.03	1.06*	1.01	1.11
Intergenerational variables					
Delay Discounting	-.30	.21	.74	.49	1.11
Impulsivity	-.02	.09	1.02	.86	1.21

Patience	.08	.08	1.08	.92	1.27
Willingness to take risks	-.10	.08	0.91	.76	1.06
<hr/>					
Maternal antecedents					
Breastfeeding (in months)	.10	.05	1.11*	1.01	1.22
Education (in years)	-.04	.12	.96	.76	1.21
Fluid intelligence (DST)	-.02	.02	.97	.95	1.02
Crystallized intelligence (MWT)	.04	.05	1.05	.95	1.15
Extraversion	.06	.06	1.06	.95	1.19
Agreeableness	-.01	.08	0.10	.86	1.13
Conscientiousness	.08	.07	1.08	.93	1.26
Openness	.00	.05	1.00	.91	1.11
Neuroticism	.08	.05	1.08	.97	1.19
Satisfaction with life	-.07	.09	.93	.78	1.12

Note. $N = 267$. Binary logistic regression: Enter method. B = regression coefficient, SE = standard error of regression coefficient. R^2 (coefficient of determination) = .12 ($p < .001$). * $p < .05$.

Maternal Variables as Mediators Between Breastfeeding and DoG

In a post hoc analysis, we found significant correlations between duration of breastfeeding and mother's crystallized intelligence ($r = .16, p < .05$), openness ($r = .13, p < .05$), and years of education ($r = .33, p < .001$). In a subsequent post hoc analysis, we questioned whether any of these variables might be a mediator between breastfeeding and children's DoG. However, in all three mediation models, the duration of breastfeeding remained a significant predictor for children's DoG. Neither maternal crystallized intelligence ($OR = 1.05, p = .18$), nor openness ($OR = 1.03, p = .47$), nor years of education ($OR = 1.03, p = .74$) mediated the significant relationship between breastfeeding and DoG ($p < .05$ in all three models).

Discussion

The main aim of the present study was to explore the links between mothers' and child's self-regulation and maternal antecedents of children's self-regulation in a sample of children and their mothers. The key contribution of the study is the novel demonstration of an association between duration of breastfeeding in infancy (as a maternal antecedent) and children's later ability to delay gratification (DoG). Furthermore, breastfeeding remained a significant predictor of DoG when we controlled for other variables like maternal years of education and children's fluid and crystallized intelligence.

All in all, various factors influence the emergence of self-regulation and the development of self-regulatory behavior in children. We have shown that breastfeeding in infancy might be a possible antecedent of DoG in childhood. Bartling et al. (2010) explored the determinants of children's patience using a different sample of the SOEP Children's Study. The authors found that maternal patience, duration of breastfeeding, children's birth weight, age, and verbal IQ were significant predictors of children's patience (in some cases when using a significance level of $\alpha = .10$). As the authors were focusing on intergenerational persistence, they excluded breastfeeding mothers. Unlike our study, Bartling et al. (2010)—which took an economic perspective—focused primarily on child variables, calculating interest rates based on the date of the DD questionnaire and running a probit analysis.

Children's age was another significant predictor of children's DoG. This strongly supports previous findings: With increasing age, children are better able to delay gratification by distracting themselves from rewards (H. N. Mischel & Mischel, 1983; Yates, 1987; Yates, Lippett, & Yates, 1981).

Potential Explanations of the Findings

The duration of breastfeeding can be interpreted as an indicator of the mother's investment of time, energy, and interest in the child (Mortensen et al., 2002). Of course, there

are several potential mediating processes that might explain the link between breastfeeding in infancy and children's later DoG. First, the evidence suggests a relationship between breastfeeding and attachment security. More precisely, breastfeeding mothers were found to show higher sensitivity during early infancy, which might result in attachment security (Britton, Britton, & Gronwaldt, 2006). Furthermore, higher maternal sensitivity was found to lead to a longer duration of breastfeeding (Britton et al., 2006). In addition, early mother-child interactions and attachment have been shown to contribute to the development of children's self-regulation (Winsler et al., 1999).

Second, studies demonstrating differences in self-regulation between breastfed and formula-fed infants support our findings. Exclusively breastfed infants showed a higher self-regulation of energy intake and were better able to drink only what they needed (Dewey & Lönnerdal, 1986). Furthermore, breastfed infants consumed a smaller amount of breast milk when their mothers started giving them solid foods. In contrast, bottle-fed infants did not show any change in the amount of formula consumed. Additionally, children who had been bottle-fed were significantly more likely to finish the bottles or cups offered to them in late infancy as compared to children who had been breastfed (Li, Fein, & Grummer-Strawn, 2010). These findings concerning early self-regulation differences between breastfed and non-breastfed children might also account for later DoG differences. Indeed, the learned self-regulation of energy intake also serves as explanation for the protective factor of breastfeeding in childhood obesity (Arenz et al., 2004; Dewey, 2003) that is associated with deficits in DoG (Bonato & Boland, 1983).

Third, maternal variables linked with breastfeeding might mediate the relationship between breastfeeding and children's DoG. In the present study, the three maternal variables years of education, crystallized intelligence, and openness significantly correlated with duration of breastfeeding. These results support studies showing that a low number of years

of maternal education resulted in a lack of breastfeeding (Bertini et al., 2003), breastfeeding mothers scored higher on an intelligence test (Morrow-Tlucak, Haude, & Ernhart, 1988), and openness and extraversion were significant predictors of breastfeeding (C. L. Wagner et al., 2006). Although we tested for mediating effects, breastfeeding remained the only significant predictor of children's DoG. Nevertheless, we can hypothesize that mothers with higher crystallized intelligence, level of education, and openness may be more likely to implement parenting methods including teaching the child to postpone gratification. When parents encourage their children to work through problems on their own and when they provide them with guidance and teaching, they enhance effective self-regulation (Karreman et al., 2006; Stifter, Spinrad, & Braungart-Rieker, 1999). Another mediating mechanism underlying and explaining the beneficial outcome of breastfeeding might be responsiveness.

Fourth, DoG processes are associated with the prefrontal cortex (e.g., Zelazo & Müller, 2002). The frontal cortex increases in volume throughout pre-adolescence (Giedd et al., 1999) and since breast milk, which contains polyunsaturated fatty acids, contributes to brain development and brain growth (Lauritzen, Hansen, Jorgensen, & Michaelsen, 2001), the duration of breastfeeding may influence frontal cortex maturation, eventually resulting in higher DoG in childhood.

Are DoG and DD Different and Separable Constructs?

Boutwell and Beaver (2010) demonstrated intergenerational links in self-control between parents and their children. However, this study used self-reports for self-control in parents and proxy ratings (primary caregiver) of children's self-control (Boutwell & Beaver, 2010). Why did the present experimental study only find a low and negative intergenerational link in self-regulation–DoG in children and DD in mothers (note that low DD means higher self-regulation)? The correlation observed only represented a trend and failed to reach

significance. If the gummy bear experiment and the DD questionnaires do not assess equivalent constructs, they are different measures. This would be in line with Reynold's and Schiffbauer's (2005) hypothesis that DoG and DD do not measure one and the same facet of self-regulation. In the present study, the five- and six-year-old children were to overcome the temptation of the gummy bears in front of them. To delay gratification, the children had to sustain their decision to wait for the second packet of gummy bears during the temporal delay interval. In contrast, DD procedures involve commitment or initial decisions, that is, unchangeable and separate decisions for either the immediately available or the postponed stimulus in each trial without having to sustain the decision (Reynolds & Schiffbauer, 2005). Another explanation for the small, non-significant correlations between self-regulation in children and their mothers might be found in the evidence that food is more sensitive to failure in self-regulation and self-control (Odum & Rainaud, 2003). Odum and Rainaud (2003), for instance, found reduced self-control with regard to food and alcohol, but not money.

Limitations

Since the SOEP Children's Study had a cross-sectional design, we are unable to draw causal conclusions such as that non-breastfed children are more impulsive and primarily prefer immediate gratification. However, studying the link between maternal breastfeeding (in infancy) and DoG (in childhood) can be seen as a longitudinal approach. We are aware that the effect is relatively small and must thus be viewed cautiously and not as strong evidence of, for example, intergenerational transmission.

The SOEP Children's Study focused on maternal antecedents and intergenerational links between children and their mothers. Naturally, fathers as well as mothers contribute to the development of children's self-regulation behavior. In fact, 74.5% of the 267 mothers

were married, 2.6% were married but living apart from their husbands, 13.5% were single, 8.2% were divorced, and 1.1% were widowed. A χ^2 test revealed no significant differences between these groups in children's DoG, $\chi^2(4) = 1.89, p = .76$. However, another limitation is that paternal variables were not assessed; they should be included in future studies.

The one-item measurement of impulsivity, patience, and willingness to take risks has to be criticized. We are aware that these concepts are multidimensional. The SOEP Children's Study was a household study (like the main SOEP study); thus, economic aspects (especially assessment time minimization) had to be considered. Therefore, not all aspects were able to be measured extensively, but self-report questionnaires such as the Barratt Impulsiveness Scale could be used to measure impulsivity in further research (Patton, Stanford, & Barrat, 1995).

Implications

Above all, the link between breastfeeding in infancy and children's later DoG deserves greater attention. More precisely, future studies should use a genetically sensitive (e.g., twin, adoption) design to further explore the link between breastfeeding and DoG observed in this study. Whereas the gummy bear experiment has proven to be an adequate measure of DoG in children, future studies could measure the number of gummy bears non-DoG children actually eat and also assess the impulsivity of mothers and fathers with respect to food in contrast to hypothetical monetary rewards so that the same facet of self-regulation is measured in both children and parents. For instance, the recently developed and validated Delay of Gratification Test for Adults (Forstmeier et al., 2011) uses food as incentives.

Future longitudinal studies should also control for parenting style and attachment. The present study only measured maternal Big Five personality traits—as a meta-analysis confirmed relations between the parents' Big Five traits and their parenting styles (Prinz et

al., 2009)–and parenting aims. More precisely, mothers were to rank their most important parenting aims (good social manners, obedience, patience, ambition, and autonomy).

However, there were no significant differences between mothers of DoG and non-DoG children. Further studies should also control for children’s mood state as experiments have demonstrated that positive-mood children more often choose to delay gratification whereas negative-mood children were more likely to choose immediate gratification (e.g., Moore, Clyburn, & Underwood, 1976).

As described above, the present study only demonstrated a weak association between duration of breastfeeding and DoG. Nonetheless, the result might be of interest to breastfeeding intervention (studies) and public health professionals. In fact, breastfeeding contributes significantly to infants’ and children’s health as the maternal milk consists of the most complete form of nutrition (e.g., docosahexaenoic acid, leptin, etc.) (Gillman, 2011; Liu, Rosenberg, & Sandoval, 2006). Thus, the World Health Organization (WHO) and the United Nations Children’s Fund (UNICEF) explicitly recommend breastfeeding (World Health Organization, 2007). However, formulas containing better and better supplements might be a real alternative for non-breastfeeding mothers. Finally, particularly noteworthy are the long-term psychological outcomes of breastfeeding such as better cognitive development, higher intelligence, higher executive function, better perceptual performance, better social competence, and lower risk of ADHD in childhood and adulthood (Julvez et al., 2007; Mortensen et al., 2002; Smith et al., 2003).

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Table 1

Characteristics of the Sample of Children

Characteristics	Total	DoG	Non-DoG	t/χ^2
<i>N</i> (%)	267	209 (78.3)	58 (21.7)	31.96***
Age (years), <i>M</i> (<i>SD</i>)	5.5 (.5)	5.5 (.5)	5.4 (.5)	-1.43
Age (months), <i>M</i> (<i>SD</i>)	72.1 (6.8)	72.7 (6.4)	70.1 (7.5)	-2.61*
Gender (% female)	44.6	44.0 (34.5)	46.6 (10.1)	.12
Breastfeeding in infancy (%)	83.1	81.3 (63.7)	89.7 (19.5)	2.24
Breastfeeding in infancy (in months), <i>M</i> (<i>SD</i>)	4.3 (4.3)	4.6 (4.5)	3.3 (3.0)	-2.68**
Attention-deficit/hyperactivity disorder (%)	4.1	4.3 (3.4)	3.4 (.7)	.09
Number of people living in household, <i>M</i> (<i>SD</i>)	4.0 (1.0)	4.0 (1.0)	3.8 (.8)	-1.22
Number of siblings, <i>M</i> (<i>SD</i>)	1.5 (2.0)	1.5 (1.9)	1.6 (2.4)	.08
Attending kindergarten (%)	73.4	72.2 (56.6)	77.6 (16.9)	1.28
Attending school (%)	25.5	26.3 (20.6)	22.4 (4.9)	1.28
At home (%)	1.1	1.4 (1.1)	.0 (.0)	1.28

Note. DoG = children who delayed gratification, Non-DoG = children who did not delay gratification. t values (t) and χ^2 values (χ^2) refer to differences between DoG and non-DoG children with respect to variables of interest. Absolute values of % are in brackets. * $p < .05$, ** $p < .01$, *** $p < .001$.