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Excellence and student background characteristics

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Introduction

The aim of this study is to investigate to what extent the prevalence of excellence differs between certain groups of children. We specifically look at three background characteristics of children: education level of their parents, the region they live in, and their gender. For the analysis we use a large and unique dataset on the educational development of children in the southern part of the Dutch province Limburg (hereafter South-Limburg). For about 200 primary schools, we have results from a high stakes achievement test at age 12 ("Eindtoets Basisonderwijs"), teacher assessments in 6th grade and the results of an intelligence test at the age of 12.

We use three indicators of excellence: (1) the teacher assessment of whether a child is gifted; (2) whether the children reach a top score (top 5%, 10% or 20%) on a high-stakes test in 6th grade; and (3) whether the children reach a top score (top 5%, 10% or 20%) on a short IQ-test. Our findings show that the higher the education level of the parents, the higher the shares of children indicated as excellent by the teacher. The same pattern exists for the excellence indicators based on the CITO and IQ tests, although the extent of the differences is less extreme. Boys are more likely to be indicated as being excellent, yet it depends on which measure of excellence is used how large the difference is. According to teachers, boys are twice as likely to be gifted as girls. Using the CITO and IQ indicators of excellence, the differences are rather small, and often not significant. Finally, we find that excellence is more prevalent certain regions than in others, with higher prevalence in Maastricht-Heuvelland than in Parkstad or Westelijke-Mijnstreek, on all indicators of excellence. Excellence according to the teacher is more prevalent in Westelijke-Mijnstreek than in Parkstad, but on the top 5, 10, and 20 percent excellence indicators for CITO and IQ, the differences between these two regions are very small, and mostly insignificant.

Data

The data are collected in a cooperative project between schools, schools boards, municipalities and Maastricht University to analyse the performance of schools in order to foster educational improvement . A unique feature of this program is the participation of almost all schools in the region, implying almost full coverage of children (about 98 percent of the regular elementary schools participate in the program and about 90 percent of the regular high schools in the region). The few non-participating schools are in most cases special education schools or schools using alternative pedagogical approaches (e.g. Montesori, Jenaplan, Steiner). For about 200 primary schools, we have results from a large number of standardized tests that the children made, in various domains such as math/calculating, reading and language, including a high stakes achievement test at age 12 ("Eindtoets Basisonderwijs"). In addition, we have teacher assessments and the results of an intelligence test at the age of 12.

Indicators of excellence [3]

A first indicator in the data is the teacher assessment of whether a child is gifted. In 6th grade the teacher is asked to indicate for every child in the classroom whether or not the child is regarded as gifted. This indicator is available for the years 2011-2015. On average, the teachers assess that 2.6 percent of 6th grade children in South-Limburg are gifted.

A second indicator of excellence is whether the children reach a top score on a high-stakes test in 6th grade ("Eindtoets Basisonderwijs"). In 6th grade, children take a three-day standardized achievement test, which is used to determine which track children enrol in in secondary education. Therefore, this test is high-stakes for the children. The score on this test ranges from 500 to 550. We defined top-5, top-10 and top-20 groups of children, based on the score on the test, using cutoff points 550, 548-550 and 545-550.

A third and final indicator of excellence is whether the children reach a top score on a short IQ-test. As part of the 6th grade survey among children, an IQ-test is taken. The test consists of 43 puzzles, composed of geometric shapes and patterns. We defined top-5, top-10 and top-20 groups of children, based on the score on the test, using cutoff points 39-43, 38-43 and 36-43.

Parental education

As part of the survey, parents are asked to give the highest completed level of education for both parents of the child. Table 1 shows that for about a third of the children (35.3%) we do not know the educational background. Among the two-thirds for whom we do observe education of parents, most children (37.2%) live in families in which the highest educated parent obtained an upper secondary or lower vocational degree (havo/vwo/mbo). For an additional third of the children for whom parental education is known, the highest educated parent

obtained a higher vocational degree (hbo). The last thirty percent are roughly equally divided in the lowest and highest educational groups: 13.3 percent with parents who completed only primary or lower secondary education (basis/vmbo/mavo), and 16.5 percent with at least one parent with a university degree (wo).

Gender
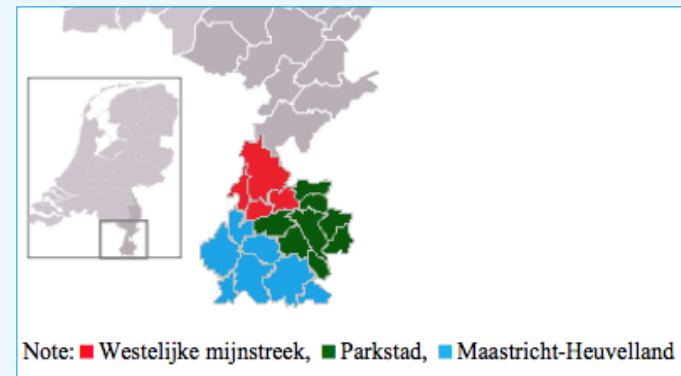The sample is about equally divided into boys and girls.

Region
From the school administration system, we obtained the postal codes for where the children live. The region of South-Limburg is divided into three large regions (see Figure 1): (1) Maastricht-Heuvelland, (2) Parkstad, and (3) Westelijke Mijnstreek. Table 1 shows that about 40 percent of the children live in Parkstad, about 30 percent in Maastricht-Heuvelland and 26 percent in Westelijke Mijnstreek. A small number of children live in Middle-Limburg (other), but go to school in South-Limburg.

Figure 1: Regions in South-Limburg

Note: ■ Westelijke mijnstreek, ■ Parkstad, ■ Maastricht-Heuvelland

Results

Parental education
Table 2 depicts the mean rates of excellence in relation to the parental education of the children for all indicators of excellence. Across all educational categories, 2.6% of children are rated as gifted by their teacher. For low-educated parents, (i.e. if the highest educated parent only followed primary education or lower secondary education, primary school or vmbo/mavo), this share is the lowest, with only 0.4% of the children being indicated as gifted. For children with higher educated parents, with at least one parent with a higher vocational (hbo) or university degree (wo), these shares are significantly higher, at 3.1% and 7.5%, respectively. The same pattern exists for the top 5, 10, and 20 percent excellence indicators for CITO and IQ, although the extent of the differences is less extreme. From low parental education to high parental education, the shares of children indicated as excellent significantly increases step by step, regardless of which indicator of excellence is used.

Table 1: Descriptive statistics on background characteristics (%)

	% including missings	% excluding missings
Parental education level		
1 primary school	2,5	3,9
2 lower secondary (vmbo/mavo)	6,1	9,4
3 upper secondary/lower vocational (havo/vwo/mbo)	24,0	37,2
4 higher vocational (hbo)	21,4	33,0
5 academic (wo)	10,7	16,5
Unknown/missing	35,3	
Gender		
Boys	49,2	49,2
Girls	50,7	50,8
Unknown/missing	0,1	
Region		
Maastricht-Heuvelland	30,8	31,4
Parkstad	39,2	39,9
Westelijke-Mijnstreek	26,4	26,9
Other	1,7	1,8
Unknown/missing	1,8	

Table 2: Indicators of excellence and students' parental education

	Gifted	Cito 5	Cito 10	Cito 20	IQ 5	IQ 10	IQ 20
Overall mean	**2.6%**	**5.1%**	**10.7%**	**21.2%**	**5.2%**	**9.8%**	**24.4%**
(1) primary school	0.004	0.014	0.037	0.094	0.043	0.069	0.191
(2) vmbo/mavo	0.005	0.013	0.033	0.087	0.027	0.054	0.172
(3) havo/vwo/mbo	0.013	0.031	0.073	0.164	0.043	0.089	0.225
(6) hbo	0.031	0.072	0.144	0.271	0.059	0.112	0.284
(7) wo	0.075	0.123	0.237	0.419	0.089	0.159	0.366
Observations	13,691	16,832	16,832	16,832	16,569	16,569	16,569
Difference between subgroups[1]							
p(1=2)	0.709	0.937	0.670	0.640	0.076	0.193	0.291
p(2=3)	**0.001**	**0.000**	**0.000**	**0.000**	**0.001**	**0.000**	**0.000**
p(3=6)	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
p(6=7)	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
p(1=3)	**0.001**	**0.001**	**0.000**	**0.000**	0.946	**0.059**	**0.038**
p(2=6)	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
p(3=7)	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

[1] The bottom panel of the table shows the statistical significance of the comparison of excellence in two categories of parental education. For example: p(1=2) shows whether the percentage of excellent children with parents that only have primary school is different from the percentage of excellent children with parents that have vmbo/mavo education. p-value <0.10 shows significance on a 10%-level, p-value <0.05 shows significance on a 5%-level and p-value <0.01 shows significance on a 1%-level.

Gender

Table 3 shows the the rates of excellence for boys and girls, for all excellence indicators. Boys are more likely to be indicated as being excellent, yet it depends on which measure of excellence we use as to how large the difference is. According to teachers, boys are twice as likely to be gifted as girls (3.6% vs 1.7%, p<0.001). Using the CITO and IQ indicators of excellence, the differences are rather small, and often not significant. Boys are slightly more likely to perform better on the CITO measures of excellence, but the difference is not statistically significant for the top 5% indicator, which means obtaining the maximum score of 550 (5.3% vs 5.0%, p=0.209). For the IQ test cut-off points, only the top 5% indicator gives a significant difference gives a significant difference in favour of boys. The gender differentials for scoring in the top 10 or top 20 percent on the IQ test are not significant.

Table 3: Indicators of excellence and students' gender

	Gifted	Cito 5	Cito 10	Cito 20	IQ 5	IQ 10	IQ 20
Overall mean	**2.6%**	**5.1%**	**10.7%**	**21.2%**	**5.2%**	**9.8%**	**24.4%**
Girl (0)	0.017	0.050	0.103	0.206	0.048	0.097	0.247
Boy (1)	0.036	0.053	0.111	0.218	0.055	0.099	0.241
Observations	18,877	25,582	25,582	25,582	22,501	22,501	22,501
Difference between boys and girls[1]:							
p(0=1)	**0.000**	0.209	**0.040**	**0.016**	**0.026**	0.599	0.272

[1] The bottom line of the table shows the statistical significance of the comparison of excellence rates between boys and girls. p-value <0.10 shows significance on a 10%-level, p-value <0.05 shows significance on a 5%-level and p-value <0.01 shows significance on a 1%-level.

Region

The top panel of Table 4 depicts the mean rates of excellence across all four regions for all indicators of excellence. The bottom panel further distinguishes between the main city and the periphery within these regions of South-Limburg. There are significant differences between the regions when it comes to the prevalence of excellence. Excellence is more prevalent in Maastricht-Heuvelland than in Parkstad or Westelijke-Mijnstreek, on all indicators of excellence. Excellence according to the teacher is more prevalent in Westelijke-Mijnstreek than in Parkstad, but on the top 5, 10, and 20 percent excellence indicators for CITO and IQ, the differences between these two regions are very small, and mostly insignificant. When comparing the three major cities in South-Limburg, similar results are found as when comparing their respective regions. Heerlen (Parkstad) has the lowest rates of excellence, and Maastricht (Maastricht-Heuvelland) the highest, on all indicators. When comparing the central cities in the regions to their surrounding municipalities, there are also some interesting significant differences. Within Maastricht-Heuvelland, the city of Maastricht, when compared to its surrounding municipalities, shows higher rates of excellence according to teachers (6.1% vs 2.4%, p<0.001). Interestingly, the differences on the CITO and IQ excellence indicators are very small, and insignificant. For Westelijke-Mijnstreek, the same pattern is observed for the city of Sittard-Geleen, in comparison to its surrounding municipalities.

Table 4: Indicators of excellence and the region where children live

	Gifted	Cito 5	Cito 10	Cito 20	IQ 5	IQ 10	IQ 20
Overall mean	**2.6%**	**5.1%**	**10.7%**	**21.2%**	**5.2%**	**9.8%**	**24.4%**
Maastricht-Heuvelland	0.042	0.060	0.122	0.230	0.061	0.111	0.270
Parkstad	0.013	0.048	0.097	0.196	0.047	0.093	0.229
Westelijke-Mijnstreek	0.024	0.048	0.105	0.215	0.047	0.091	0.238
Difference between regions1:							
p(MH=PS)	**0.000**	**0.001**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
p(PS=WM)	**0.000**	0.981	**0.067**	**0.002**	0.925	0.656	0.200
p(MH=WM)	**0.000**	**0.002**	**0.001**	**0.037**	**0.000**	**0.000**	**0.000**
Maastricht (10)	0.061	0.058	0.123	0.221	0.061	0.116	0.269
MH Overig (11)	0.024	0.061	0.122	0.238	0.062	0.106	0.271
Heerlen (20)	0.014	0.042	0.090	0.181	0.042	0.083	0.224
PS Overig (21)	0.013	0.051	0.100	0.203	0.050	0.098	0.232
Sittard-Geleen (30)	0.030	0.047	0.107	0.220	0.048	0.090	0.232
WM Overig (31)	0.017	0.049	0.103	0.208	0.045	0.091	0.246
Difference between regions1:							
p(10=11)	**0.000**	0.652	0.821	**0.081**	0.908	0.195	0.877
p(20=21)	0.560	**0.031**	0.129	**0.008**	**0.099**	**0.016**	0.395
p(30=31)	**0.001**	0.721	0.551	0.224	0.661	0.925	0.200
p(10=20)	**0.000**	**0.001**	**0.000**	**0.000**	**0.001**	**0.000**	**0.000**
p(20=30)	**0.000**	0.253	0.016	0.000	0.265	0.275	0.432
p(10=30)	**0.000**	**0.025**	**0.023**	0.901	**0.016**	**0.000**	**0.000**
p(11=21)	**0.001**	**0.040**	**0.001**	**0.000**	**0.018**	0.207	**0.000**
p(21=31)	0.220	0.675	0.683	0.601	0.390	0.316	0.151
p(11=31)	**0.061**	**0.037**	**0.014**	**0.004**	**0.006**	**0.051**	**0.031**
Observations	18,375	24,822	24,822	24,822	21,920	21,920	21,920

1 The bottom panel of the table shows the statistical significance of the comparison of excellence in the various regions. For example: p(MH=OM) shows whether the percentage of excellent children in Maastricht-Heuvelland is different from the percentage of excellent children in Parkstad. p-value <0.10 shows significance on a 10%-level, p-value <0.05 shows significance on a 5%-level and p-value <0.01 shows significance on a 1%-level.

Predictive value of background

Given that there are significant correlations between various background characteristics, we next combine the background measures in logistic regression models to predict our indicators of excellence. For example, in Maastricht, it is much more likely to see parents with a university degree than in Heerlen (26% vs 12%). Hence, part of the gap between Maastricht (Maastricht-Heuvelland) and Heerlen (Parkstad) can be explained by the differences in education level of these two cities (regions). For each excellence indicator we ran several models, first including the different background characteristics separately and second including them all together. Table 5 shows the results. The coefficients are odds ratios, and give the odds of being gifted in comparison to the baseline rate of excellence reported under the constant. An odds ratio larger than 1 means a higher probability in comparison with the baseline rate, an odds ratio smaller than 1 means a lower probability. The baseline parental education level is upper secondary or lower vocational education (havo/vwo/mbo)), the baseline region is Westelijke-Mijnstreek, and for gender, girls are the baseline group.

For all excellence indicators, the first three models confirm the descriptive relations denoted earlier. Children with higher educated parents, children in Maastricht-Heuvelland and boys are more likely to be indicated as gifted by the teacher. Model 4 shows that when including all variables together, there is not much difference. The odds ratio's for the education dummies are quantitatively and qualitatively similar to the model with only parental education. The strongest explanatory background factor for all our excellence indicators is parental education, accounting for as much as 5.4% of variation in teacher-rated excellence, and 4.3% of variation in the top 5, top 10, and top 20 CITO indicators of excellence. The IQ-test indicators of excellence are very poorly explained by parental education (Pseudo R-squared roughly 1.2%). Although our indicators of excellence do differ significantly across region and gender, using either of these two factors as single explanatory factor in logistic regressions of our excellence indicators accounts for less than 1% of the variation in the indicators (Pseudo R-squared <0.01). One exception for the predictive value of region is for teacher-rated excellence. Apparently there are significant variations across regions when it comes to the view of teachers on the excellence of their children (Pseudo R-squared of 2.7%). This regional effect also seems to be independent of parental education, since the odds ratio's for the regional dummies remain sizeable and significant in model [4], where parental background is also a factor in the model.

Table 5: Results of logistic regressions for relation between excellence indicators and background characteristics

	Teacher assessment of excellence				Excellence based on CITO-test (top 5%)				Excellence based on IQ-test (top 5%)			
	Model [1]	Model [2]	Model [3]	Model [4]	Model [1]	Model [2]	Model [3]	Model [4]	Model [1]	Model [2]	Model [3]	Model [4]
SES (base=(3) havo/vwo/mbo)												
(1) primary/vmbo/mavo	0.33***			0.36***	0.42***			0.43***	0.72**			0.74**
	(-2.98)			(-2.72)	(-4.35)			(-4.29)	(-2.40)			(-2.24)
(4) hbo	2.42***			2.30***	2.38***			2.41***	1.39***			1.40***
	(5.88)			(5.43)	(9.72)			(9.78)	(3.85)			(3.91)
(5) wo	6.14***			5.47***	4.34***			4.34***	2.14***			2.06***
	(12.35)			(11.27)	(15.85)			(15.62)	(8.27)			(7.70)
Region (base=(3) Westelijke-Mijnstreek)												
(1) Maastricht-Heuvelland		1.74***		1.56***		1.26***		1.17***		1.33***		1.27***
		(4.94)		(3.91)		(3.10)		(2.10)		(3.58)		(3.05)
(2) Parkstad		0.54***		0.60***		0.99		1.12		1.01		1.07
		(-4.58)		(-3.77)		(-0.02)		(1.54)		(0.09)		(0.87)
Gender (0=girl, 1=boy)												
(1) Boy			2.14***	2.19***			1.07	1.06			1.14**	1.14**
			(7.88)	(7.88)			(1.26)	(0.97)			(2.23)	(2.13)
Constant (odds base group)	0.013	0.025	0.017	0.008	0.032	0.050	0.052	0.029	0.045	0.049	0.051	0.038
	(-35.15)	(-41.25)	(-51.54)	(-29.82)	(-47.27)	(-52.72)	(-73.11)	(-38.20)	(-49.44)	(-49.41)	(-68.50)	(-36.96)
Observations	18,888	18,595	18,877	18,595	25,582	25,188	25,582	25,188	22,527	22,144	22,501	22,144
Pseudo R-sq	0.054	0.027	0.015	0.088	0.042	0.002	0.000	0.043	0.012	0.002	0.001	0.013

Note: In all models we controlled for cohort by including year dummies. Those students with missing parental education level are included, but odds ratios are not reported here for this group.

Conclusion

The aim of this study is to investigate to what extent the prevalence of excellence differs between certain groups of children. We look at three background characteristics: parental education, gender, and region of residence. While there are significant differences across parental education, gender, and region, the extent of the differences is dependent on what indicator of excellence is used.

For all indicators of excellence we find a higher share of excellent children among those with higher educated parents. Parental education is also the most predictive of the three background characteristics. What is most interesting is that the difference in the prevelance of excellence between children with high and low educated parents is largest for the teacher assessment of excellence. In addition, the teacher assessment of excellence also shows a higher share of excellence among boys than among girls. For the other indicators - top scores on an achievement or intelligence test - this gender difference is not systematically observed.

A question worth investigating is why a teacher's evaluation of excellence is more strongly related to background characteristics than is the case for the – perhaps less subjective – achievement and intelligence test indicators of excellence. Are teachers biased in their assessment of children because of expectations? Is there a belief that children of higher educated parents, but who are bored, act out, or are creative are gifted. And that children from lower educated parents with similar adjustment issues are rather misbehaving? When it comes to gender differences, are girls simply expected to do well in school, and are boys who do similarly well more easily labelled as gifted?

There are also significant regional differences in the prevalence of excellence. Excellence is more prevalent in the South-Limburg region Maastricht-Heuvelland than in the regions Parkstad or Westelijke-Mijnstreek, on all indicators of excellence. In addition, it is interesting that excellence according to the teacher is more prevalent in Westelijke-Mijnstreek than in Parkstad, but this is not observed for excellence according to the achievement or intelligence test. The region of Maastricht-Heuvelland is a region with higher education and higher income levels, which might be valid criteria for observing higher rates of excellence among 6th grade students. Given that teacher ratings of excellence show a similar pattern to the more objective indicators of excellence based on top performance on an achievement or an intelligence test, the composition of the population in the region seems be the cause of the regio-

nal differences. Regarding the differences between Westelijke-Mijnstreek and Parkstad, there may again be differences in expectations, seeing that the regions only differ in prevalence of excellence when using the – perhaps more subjective – teacher rated indicator of excellence.

All in all, the results demonstrate that background characteristics have a large impact on whether or not a child is indicated as excellent in 6th grade. However, the differences in the prevalence of excellence is also highly dependent on which indicator for excellence is used. More objective indicators of excellence seem to be associated with lower differentials across background characteristics. If educational policy or funding to stimulate development of excellent students is to be independent of background, as to give all students equal opportunity, one should take these first indications into consideration when choosing which indicator of excellence to use.

Appendix

Using data from 2011 through 2015, we have five cohorts of children in 6th grade. If the population and/or the items underlying the indicators of excellence change over time, estimates for the shares of excellent pupils may also fluctuate from year to year. The sample is about evenly split among the five different cohorts in the study. Percentages are a little bit lower in the last two years (19,3 and 18,8 percent).

Table A1 shows shares of excellence over the years, for all our indicators. The question in the teacher questionnaire regarding excellence did not change over the years. Nevertheless, the prevalence of excellence is higher in recent years. The rate increased from 2.16% in 2011-2012, to an average of 2.92% for the years 2013-2015.

The CITO test consists of many questions, related to math, language, and study skills. For the years 2011-2014, the composition of the test was the same, with 200 questions in total. There were 100 items for language, 60 for math, and 40 for study skills. In 2015, the number of questions increased to 220, and Study skills was no longer a separate dimension. We do not know to what extent the items that were previously part of study skills were simply integrated within the domains of language and math, but there is no significant difference in the CITO excellence indicators between 2014 and 2015. There is however an increasing trend visible for all three CITO indicators, with higher shares of children scoring above the respective cut-off points on the test.

Whereas in 2011, only 3.6% of children obtained the maximum standardized score of 550, this share has increased to 6.6% by 2015.
Despite the fact that the IQ test items remained the same over the years, there are significant year-to-year differences in the share of children scoring above the respective cut-off points on the test. This brings into question whether or not our short IQ-test is a suitable measure to use when comparing year-to-year results.

Table A1: Indicators of excellence and cohort

	Gifted	Cito 5	Cito 10	Cito 20	IQ 5	IQ 10	IQ 20
Overall mean	**2.6%**	**5.1%**	**10.7%**	**21.2%**	**5.2%**	**9.8%**	**24.4%**
Year							
2011	0.021	0.036	0.090	0.204	0.081	0.139	0.306
2012	0.022	0.038	0.093	0.200	0.052	0.101	0.253
2013	0.031	0.056	0.115	0.209	0.040	0.081	0.222
2014	0.030	0.064	0.116	0.219	0.038	0.074	0.206
2015	0.027	0.066	0.123	0.228	0.044	0.089	0.223
Observations	18,888	25,582	25,582	25,582	22,527	22,527	22,527
p 2011=2012	0.870	0.651	0.626	0.556	**0.000**	**0.000**	**0.000**
p 2012=2013	**0.021**	**0.000**	**0.000**	0.222	**0.008**	**0.001**	**0.000**
p 2013=2014	0.901	**0.068**	0.924	0.251	0.544	0.201	**0.071**
p 2014=2015	0.449	0.703	0.312	0.280	0.116	**0.011**	**0.055**
p 2011=2013	**0.012**	**0.000**	**0.000**	0.532	**0.000**	**0.000**	**0.000**
p 2012=2014	**0.026**	**0.000**	**0.000**	**0.019**	**0.001**	**0.000**	**0.000**
p 2013=2015	0.385	0.027	0.262	**0.025**	0.325	0.191	0.883

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