Moderators of Treatment Effects in a Child Maltreatment Prevention Programme in South Africa

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Background. Previous research has found mixed results on whether the most disadvantaged families benefit as much as less disadvantaged families from parenting interventions designed to reduce child maltreatment, and little in known in low-income settings.

Objective. In this study, we test the effects of child, caregiver, household, and community characteristics as treatment moderators of intervention outcomes – child maltreatment and parenting practices. We test characteristics previously examined elsewhere as well as factors relevant to the South African context.

Participants and Setting. This analysis includes adolescents (ages 10-18) and their caregivers (*N*=552 pairs) who participated in a randomised trial of a parenting programme in the Eastern Cape Province of South Africa.

Methods. Data from the caregiver and adolescent standardised questionnaires collected at baseline, post-test (1-month post-intervention), and follow-up (5-9 months) were analysed using longitudinal multilevel analyses. We tested seven hypothesised moderators for each of the primary outcomes through interactions of treatment effect with baseline moderators.

Results. No moderator effects were statistically significant after correcting for multiple comparisons testing. Hence, in line with several recent studies examining moderation effects in parenting programmes, our study suggests that parenting interventions aiming to reduce child maltreatment and promote parenting skills in low- and middle-income countries may be similarly effective for families facing various levels of economic, social, and health risk factors.

Conclusions. It may be useful to explicitly power trials for testing moderator effects, study different types of moderators and use person-centred analyses to further understand variations in treatment effects.

Child maltreatment has profound life-long effects on young people's health and wellbeing. Parenting interventions are a promising approach to improving parenting skills and reducing child maltreatment by caregivers (Barlow, Smailagic, Huband, Roloff, & Bennett, 2014; Mikton & Butchart, 2009; Vlahovicova, Melendez-Torres, Leijten, Knerr, & Gardner, 2017). Parenting interventions can also target a range of other outcomes, such as child conduct problems and parental mental health (Chen & Chan, 2016). Although most evaluations have been conducted in high-income countries (HICs), there are multiple rigorous evaluations of parenting interventions that have been implemented in low- and middle-income countries (LMICs) that suggest positive effects (Gardner, Montgomery, & Knerr, 2015; Knerr, Gardner, & Cluver, 2013). International agencies, such as the World Health Organization, have recommended the use of parenting interventions worldwide as a means towards reduction in violence against children (Butchard & Mikton, 2014).

Variation in Treatment Effects in Parenting Programmes

Most research examining variation in the effects of parenting programmes has focused on programmes addressing child behaviour problems. Only a few studies have examined treatment moderators in relation to maltreatment or harsh parenting (e.g., Puffer et al., 2015). However, there are crucial similarities between programmes focusing primarily on changing child behaviour and preventing child maltreatment. Both tend to draw on social learning theory to teach skills that reduce child and parent aggression, and strengthen caregiver-child relationships (Knerr et al., 2013). Therefore, research on moderators from programmes targeting child behaviour is highly relevant to maltreatment reduction.

While, on average, many parenting programmes are effective for a number of outcomes, they are not equally effective for everyone (Webster-Stratton, Reid, & Hammond, 2004). It is important to examine whether participating families who are most at risk in relation to the intervention outcomes can benefit from the growing number of parenting

interventions in LMICs. For example, the most disadvantaged families may not be able to attend, or engage in, sessions due to pressing demands on their time and attention, such as providing key material necessities for their children. At the same time, primary studies of risk factors suggest that children living in households facing challenges such as exposure to violence, poverty, and illness may be most at risk regarding child maltreatment (Meinck, Cluver, Boyes, & Mhlongo, 2015; Stith et al., 2009).

Even if disadvantaged families can participate equally in an intervention and receive high-quality programming, it may still be more difficult for these families to implement changes in the household due to diminished health, less stable home environment, or conflicts with other caregivers (Eckenrode et al., 2000; Furlong & McGilloway, 2012). Alternatively, higher-risk families can benefit equally or more than lower-risk participants, as the former may perceive a stronger need for change and have greater room for improvement (Pelham, Dishion, Tein, Shaw, & Wilson, 2017). Researchers have termed these compensatory effects (more beneficial for high-risk groups) and leveraging effects (more beneficial for low-risk groups) (Spoth, Shin, Guyll, Redmond, & Azevedo, 2006).

Treatment moderation can be defined as an interaction between treatment and baseline characteristics of the participants or settings (Kraemer & Wilson, 2013). A 2014 review by Shelleby and Shaw (2014) summarised a number of such within-study moderator analyses examining interventions that target child conduct problems from ages 1 through 10, looking at both child behaviour and parenting outcomes. Several earlier reviews had examined heterogeneity of effects in parenting interventions through meta-analytic moderation analyses, comparing intervention results between groups of studies. In such reviews, authors have categorised parenting intervention evaluations based on their samples, such as high or low socio-economic status, comparing intervention effects across subgroups of studies. However, comparing results between studies has several limitations, such as

potential confounding (Bloch, 2014). For example, interventions conducted in research settings may also include more affluent parents, making it difficult to disentangle the two effects to understand what might be driving different treatment effects between samples (Gardner et al., 2017). Therefore, in reviewing previous literature we focus on studies and reviews that examine moderators as interactions of baseline characteristics and treatment.

Moderators identified in studies in HICs may not have the same effects in LMICs, for instance because of differences in common family structures or greater prevalence of some risk factors, such as absolute poverty (Murray et al., 2018). Alongside programme evaluations, there is an emerging body of evidence on moderators of family interventions in LMICs (Puffer, Annan, Sim, Salhi, & Betancourt, 2017; Puffer et al., 2015).

Caregiver factors. Previous research has examined a range of risk factors to assess whether families that face more challenges are able to benefit equally from interventions. A common concern is that caregiver psychosocial risks may prevent behaviour change. For example, mothers' exposure to intimate partner violence (IPV) predicted a decreased effect on reduction of child maltreatment in a study of the Nurse-Family Partnership, a home visitation programme in the United States (US) (Eckenrode et al., 2000). Shelleby and Shaw (2014) review found an equal effectiveness across levels of parental characteristics, such as maternal mental health, history of maltreatment as a child, education, and others, suggesting that variation in parental risk factors did not substantially affect intervention effectiveness.

Several studies that evaluated group-based Incredible Years programme found that the families of caregivers experiencing issues such as marital discord and higher levels of depression benefitted more than other participants from the intervention in respect to child behaviour problem reduction (Beauchaine, Webster-Stratton, & Reid, 2005; Gardner, Hutchings, Bywater, & Whitaker, 2010). The pooled data from 14 RCTs of Incredible Years in Europe did not reveal differences in programme effects on disruptive child behaviour based on

family socioeconomic or ethnic minority status, or baseline parenting practices (Gardner et al., 2017). The findings also suggested some compensatory effects, as the intervention effects were greatest for children with more depressed parents.

Caregiver HIV status, while not previously studied to our knowledge in regard to parenting intervention effects, is an important predictor of parenting and maltreatment outcomes within the South African context (Meinck et al., 2017) and may influence the effects of a child maltreatment programme.

Child factors. Given the bidirectional relationship between child and caregiver behaviours, externalising child behaviour is an important correlate of harsh parenting and child maltreatment (Meinck, Cluver, Boyes, & Ndhlovu, 2015; Stith et al., 2009) and a commonly studied moderator of treatment effects in parenting programmes. Shelleby and Shaw (2014) review found that higher levels of child problem behaviour at baseline was, in some studies, associated with greater benefits, while in other studies, there was no association. None of the studies included in the review found a negative effect of higher baseline problems on treatment outcomes. Similarly, studies of Incredible Years in a number of European countries found that children with more severe baseline behaviour problems on average benefitted more (Leijten et al., 2017, 2018).

Household factors. Families facing greater economic disadvantage may benefit less from parenting interventions, as they often experience multiple chronic stressors. However, previous research suggests mixed results on the role of economic disadvantage on programme effectiveness (Leijten et al., 2018). Although some reviews comparing study-level results suggested diminished results for economically disadvantaged families (e.g. Lundahl, Risser, & Lovejoy, 2006), several studies have found equal effectiveness (McTaggart & Sanders, 2007; Weeland et al., 2017). Poverty is also a key risk factor for child maltreatment identified in research in Africa (Meinck, Cluver, Boyes, & Ndhlovu, 2015).

Community factors. As interventions are delivered in multiple contexts, there is a growing interest in examining community-level characteristics that may affect violence prevention interventions, such as levels of income and violence against children in the community (Morris et al., 2017).

Given the above evidence, the current study explores if the characteristics of participating families and communities affected the intervention effects of Sinovuyo Teen on child maltreatment and parenting behaviours within an RCT in South Africa. This study presents an opportunity to examine moderators studied in HICs, such as poverty, in a LMIC context, as well as explore the markers of disadvantage that have not been examined extensively but are relevant to Southern Africa, such as HIV. The selection of moderators was based on existing literature on treatment moderators, risk factors for maltreatment, and the study setting. Our selection of potential intervention effect moderators was also pre-specified in the trial protocol (Cluver, Meinck, Shenderovich, et al., 2016). In addition to the moderators pre-specified in the protocol, we tested the moderation effects of adolescent externalising behaviour, as well as rural versus peri-urban residence. In South Africa, rural areas tend to have lower levels of public services and income in comparison to peri-urban or urban locations (Coovadia et al. 2009), and therefore location is an important community characteristic. Thus, the moderators examined in this paper include factors at the level of the caregiver (caregiver HIV, history of maltreatment, and exposure to IPV), adolescent (problem behaviour), family (poverty) and household (rural/urban).

Methods

Participants and Procedures

Study setting. This study was a cluster-randomised two-arm trial conducted in the Eastern Cape, South Africa. A comprehensive description of the trial can be found in the study protocol (Cluver, Meinck, Shenderovich, et al., 2016). In brief, the treatment arm

received the Sinovuyo Teen, an evidence-informed group-based parenting programme that focused on reducing physical and emotional maltreatment against adolescent children and promoting positive parenting. The control arm received a one-day hygiene information intervention. The trial enrolled 552 families in 32 rural and 8 peri-urban study clusters and took place during April 2015 – August 2016 in disadvantaged isiXhosa-speaking communities with high rates of poverty, unemployment, and HIV. The study clusters were randomised within the urban and rural strata (1:1).

Screening and recruitment of participants. In each participating family, the study enrolled one adolescent aged 10 to 18 and their primary caregiver (defined as the person mainly responsible for the adolescent and residing in the same household at least four nights a week). The participants were recruited into the study through local community members, schools, social workers, as well as door-to-door recruitment, focusing on families that experience family conflict and high stress. To be enrolled into the study, both adolescent and caregiver had to complete the baseline assessment. All responses were kept confidential, except in cases of participants requesting assistance, or at risk of significant harm, such as adolescents with recent suicide attempts. Families did not receive monetary incentives for participation, but were given packs with snacks, stationery and toiletries to thank them for participating. Key descriptive statistics of the sample are provided in Table 1.

Table 1. *Sample Baseline Characteristics (N=552)*

Sample characteristic	Mean	*SD*	Observed range	Possible range
Adolescent age	13.7	2.3	10-18	
Adolescent girls, *n* (%)	228 (41%)			
Caregiver age	49	15.2	18-92	
Female caregivers, *n* (%)	524 (95%)			
Moderator variables (baseline)				
Adolescent externalising	18.46	11.68	0-56	0-70
Caregiver childhood maltreatment	0.97	1.38	0-7	0-7
Caregiver IPV	0.40	1.14	0-6	0-6
Household necessities	3.83	2.21	0-8	0-8
Caregiver HIV-positive, *n* (%)	148 (27%)			

Intervention. Sinovuyo Teen is group-based manualised programme based on social learning theory. The programme consists of a series of 14 weekly meetings of 1.5-2 hours each. In addition, when a participant was not able to attend a session, for instance due to illness, the programme included facilitators visiting them at home with a brief recap. It was developed drawing on parent training principles emphasized in existing research, such as modelling positive behaviour and collaborative problem solving (Cluver, Lachman, et al., 2016). During the initial programme development and two pilot studies (Cluver, Lachman, et al., 2016; Cluver, Meinck, Yakubovich, et al., 2016), the intervention was designed to suit the South African context. This study, part of the Parenting for Lifelong Health initiative launched in 2012, is a collaboration between academic researchers and collaborators from the WHO, UNICEF and non-governmental organisations (NGOs) to develop and test, in

randomised trials, a suite of non-commercialised parenting programmes for low-resource settings.

The intervention was delivered by Clowns Without Borders South Africa, a South African non-governmental organisation that focuses on the psychosocial wellbeing of children and communities. Facilitators with various backgrounds, such as childcare, social work, and a range of other diverse backgrounds, delivered the group sessions after receiving a week of training as well as on-going supervision throughout the programme delivery.

Facilitator fidelity to the programme at the group sessions was recorded by a team of trained Research Assistants (RAs) at 99% of all delivered sessions (32% were double-rated). The RAs used an observation tool measuring how well the facilitators implemented the core activities in a session, such as guiding and discussing role plays. Average 83% fidelity was recorded. Overall, caregivers attended on average 50% of group sessions and adolescents, 64%. Together with home-based visits, in total the intervention families received 91% of the sessions either via group sessions or home visits (for more details on intervention delivery, see Shenderovich et al., 2018, 2019).

Data collection. Primary caregivers and adolescents completed self-report measures at pre-test, one month post-intervention (92% retention from baseline), and 5-9 months post-intervention (97% retention from baseline). Furthermore, due to the high migration in the area, 52 adolescents were no longer living with their original caregivers at follow-up. Only reports regarding original caregivers were included in the current analysis. Details on sample characteristics as well as the CONSORT diagram are available in other reports (Cluver et al., 2018).

Informed consent. Ethical approval for the study was obtained from the Research Ethics Committees at [Blinded University Names], and from the South African Departments

of Social Development and Department of Basic Education. Both adolescents and caregivers needed to complete written informed consent for the dyad to participate.

Study Measures

Outcome measures. As previous research on moderators in parenting interventions has sometimes found effects in opposing directions, it has been recommended to examine multiple measures of risk and outcomes (Shelleby & Shaw 2014). Therefore, we examine moderation effects for all intervention primary outcomes, described below. As a pragmatic trial (Porzsolt et al., 2015), the study included two clusters of primary outcomes, one related to maltreatment and one to parenting, comprising a total of 14 constructs, described below.

Adolescent emotional and physical maltreatment, and neglect by caregivers within the past month were measured using a culturally-adapted version of the ISPCAN Child Abuse Screening Tool, ICAST-C (Meinck et al., 2018); see Supplementary Materials for examples of all measures. At baseline, in this sample, Cronbach's alpha for caregiver-reported physical and emotional maltreatment scale was .78 (14 items), and for adolescent-reported maltreatment – .86 (12 items). For neglect, the alphas were .63 (3 items) in caregiver report, and .78 (6 items) in adolescent report.

Relevant dimensions of *parenting* (poor parental monitoring and supervision, inconsistent discipline, corporal punishment, positive parenting, and involved parenting) in the past month were measured using the Alabama Parenting Questionnaire (parent and child versions), widely used internationally and previously used in South Africa (Frick, 1991; Lachman, Cluver, Boyes, Kuo, & Casale, 2014). In the caregiver report, Cronbach's alphas were .77 for positive parenting (6 items); .77 for involved parenting (10 items); .75 for poor monitoring (10 items); .70 for corporal punishment (3 items); and .58 for inconsistent discipline (6 items). In the adolescent report, Cronbach's alphas were .87 for positive

parenting (6 items), .87 for involved parenting (10 items), .75 for poor monitoring (10 items), .67 for corporal punishment (3 items) and .67 for inconsistent discipline (6 items).

Possible treatment moderators. Drawing on the longitudinal trial design, we examined whether the *baseline values of parenting and maltreatment behaviours* moderated the intervention effects on these measures. That is, we evaluated whether the rate of change due to the intervention was related to the initial level of the outcome measures at baseline.

Caregiver IPV exposure in the past month (psychological aggression and physical assault by intimate partners) was measured using modified items from the revised Conflict Tactics Scale (Straus, Hamby, Boney-McCoy, & Sugarman, 1996). Cronbach's alpha was .90 (6 items). A summary variable was created to indicate whether the participant experienced different forms of IPV in the past month.

Caregiver history of childhood maltreatment was assessed using an adapted version of the ISPCAN Child Abuse Screening Tool-Retrospective (ICAST-R) (Dunne et al., 2009), measuring the occurrence of abusive physical, sexual and emotional victimisation events before the age of 18. Cronbach's alpha was .71 (7 items).

Caregiver HIV was identified using a list of signs and symptoms, developed for areas with over 20% HIV-prevalence (Hosegood, Vanneste, & Timaeus, 2004; Lopman et al., 2006). We considered participants HIV-positive if they self-reported as HIV positive or reported three or more AIDS-related symptoms.

Adolescent behaviour problems were measured using a composite score of the rule-breaking and aggression sub-scales from the Child Behaviour Checklist (caregiver report) (Rescorla et al., 2012). Cronbach's alpha was .90 (35 items).

Economic disadvantage (household necessities) was measured based on caregiver report on access to eight necessities for children, such as three meals a day and school uniform, in the past month. These commodities were perceived as top necessities by over

80% of South African population in a nationally-representative survey (Pillay, Roberts, & Rule, 2006). Cronbach's alpha was .71 (8 items).

Rural/peri-urban residence was recorded at cluster level to reflect if the participant lived in a rural village or a peri-urban township.

Intervention Treatment Effects

Trial outcomes on primary and secondary measures are reported in detail elsewhere (Cluver et al., 2018). In brief, the randomised trial found improvements across a range of parenting and family outcomes. Among the primary outcomes, caregivers reported reduced physical and emotional maltreatment, reduced use of corporal punishment and poor monitoring, as well as an increase in positive and involved parenting. Adolescents reported an increase in involved parenting and a decrease in inconsistent discipline. Overall, adolescents reported fewer programme effects than the caregivers. Chance baseline differences between arms were observed on three outcomes and were accounted for by the difference-in-difference approach used for all analyses.

Moderator Analysis Strategy

To be a moderator of treatment, the variable must be a baseline characteristic, uncorrelated with treatment allocation, and have an interactive effect with treatment on the outcome (Kraemer & Wilson, 2013). Given that the trial included repeated measures, we adopt a longitudinal data analysis approach (Moerbeek & Teerenstra, 2016). Therefore, moderator effects were tested through interactions (Hall & Sammons, 2013), using the following model:

$$
\begin{aligned}
Parenting_{ti} = {} & \beta_{00} + \beta_1(Treatment_i) + \beta_2(Moderator_i) + \beta_3(PT_{ti}) + \beta_4(FU_{ti}) \\
& + \beta_5(Treatment_i * PT_{ti}) + \beta_6(Treatment_i * FU_{ti}) \\
& + \beta_7(Treatment_i * Moderator_i) + \beta_8(PT_{ti} * Moderator_i) + \beta_9(FU_{ti} \\
& * Moderator_i) + \beta_{10}(Moderator_i * Treatment_i * PT_{ti}) + \beta_{11}(Moderator_i \\
& * Treatment_i * FU_{ti}) + \alpha_1(Stratification_i) + u_{0i} + \varepsilon_{ti}, (1)
\end{aligned}
$$

where Level 1 = occasion (*t*), Level 2 = individual(*i*), PT_{ti} is the dummy variable that encodes the contrast between baseline and immediate post-test, and FU_{ti} is the dummy variable that encodes the contrast between baseline and follow-up. $Parenting_{ti}$ is the estimated value for parenting at time *t* for person *i*, $Treatment_i$ is the treatment allocation received by individuals in study clusters, $Moderator_i$ is the candidate moderator that is a baseline characteristic of the individual *i*, β_{00} is the grand intercept, and β_1 accounts for the mean differences between treatment and control groups at baseline. The three-way cross-level interactions β_{10} and β_{11} are the key parameters of interest used to assess moderation effects. These interactions compare the effect of the predictors in the intervention group to the effect in the control group, assessing whether the moderator affects the difference in the slopes between the two trial arms. The last two terms represent the time- and person-level residuals. All moderator variables were grand-mean centred. We used a negative binomial link function for maltreatment outcomes to account for their skewed distribution and a linear function for parenting outcomes. The outputs of the negative binomial models are presented as incidence rate ratios (IRR).

Random slopes for individual trajectories over time did not improve model fit and thus, were not included in the final model (Barr, 2013). The models were estimated using maximum likelihood estimation, drawing on all available data. Although this was a cluster randomised trial, due to low ICC at cluster level (under 5%) and a design effect under 2.0, we did not include a separate level for clusters in the moderator analyses (Peugh, 2010). We used robust clustered standard errors to account for any cluster level correlations. Given the large number of comparisons, we used the Benjamini-Hochberg procedure to account for multiple hypothesis testing (Benjamini & Hochberg, 1995), treating all tests as one family. For each outcome, we report the unadjusted *p*-values and the corrected *q*-values.

Preliminary power calculations suggested that the minimum detectable effect size difference for moderation was approximately d = 0.23 for continuous moderators, and d =

0.50 for binary moderators at participant level, with power of .80, two-tailed test with alpha of .05, non-randomly varying slopes, and intra-class correlation coefficient (ICC) of .07 (Dong & Maynard, 2013). Therefore, the study would not have sufficient statistical power to detect smaller difference in effects due to moderators. Furthermore, these power calculations did not account for the use of non-linear link function and the multiple testing procedures, which further reduce the ability to detect effects (Porter, 2017).

Results

On average, in the intervention arm the incidents of physical and emotional maltreatment reported by caregivers reduced from M=8.40 (SD=9.81) incidents at baseline to M=3.82 (SD=6.17) at 5-9 months follow-up within the past month. Adolescents in the intervention group reported maltreatment scores of M=8.99 (SD=12.56) at baseline and M=4.84 (SD=8.52) at follow-up. Within that, there was considerable variation in changes over time reported by intervention participants: the changes in maltreatment behaviours towards adolescents reported by caregivers in the intervention condition from baseline to follow-up varied from a decrease of 56 to an increase of 37 in the maltreatment score. Similarly, intervention adolescents reported a wide range of changes following the intervention, from a decrease of 83 points to an increase of 47. Analysis of average trial outcomes is available in other publications (Cluver et al., 2018).

Moderation by Baseline Characteristics

Results of the moderator analyses are provided in Tables 2 and 3. These results showed that, at both post-test and follow-up, there was not a consistent trend of any of the candidate moderators affecting the treatment effect across the primary outcomes. Although there was no overall consistent pattern of individual characteristics moderating treatment effects, there were several statistically significant moderation effects. In particular, there was an effect of adolescent externalising behaviours on treatment effects for adolescent-reported

involved parenting, indicating that families with higher externalising problems at baseline reported a stronger improvement on caregiver involved parenting at follow-up. There was also a steeper improvement for caregiver-reported parental monitoring at follow-up among caregivers who experienced maltreatment as children. Furthermore, among caregivers who have experienced IPV, these analyses suggested a larger improvement on positive parenting (at post-test in caregiver report) and on parental monitoring (at post-test in adolescent report and at follow-up in caregiver report). Finally, HIV-positive caregivers reported a smaller decline in corporal punishment of their adolescents at follow-up.

We also examined the role of one cluster-level predictor: rural and peri-urban location, finding that participants in rural areas reported greater intervention effects on some outcomes at follow-up. In particular, we found that both adolescents and caregivers in rural clusters reported a larger improvement in positive parenting than their counterparts in peri-urban townships at follow-up. Caregivers in villages also reported a higher level of growth in involved parenting and a stronger decrease in physical and emotional maltreatment at follow-up. Adolescents in rural areas reported a larger decrease in caregiver neglect at follow-up.

Moderation by Baseline Outcome Levels

Generally, programme effects did not vary according to the baseline reports of primary outcomes. However, we did observe that caregiver reports of parental monitoring at baseline appear to have an impact on programme effectiveness on monitoring. In particular, the caregivers who, at baseline, reported the least parental monitoring benefitted from the intervention more in comparison to those who reported better monitoring at baseline. On the other hand, levels of neglect reported by adolescents decreased less for those who reported higher neglect at baseline. Finally, due to low prevalence, it was not possible to estimate the effect of baseline severity on caregiver-reported neglect. Consistent with the results from baseline participant characteristics, analysis of baseline levels of primary outcomes suggested

that participants were able to benefit from the intervention at similar levels regardless of these risks.

Overall, out of the thirteen statically significant moderation effects, eleven were in the direction of greater disadvantage predicting stronger effects. However, after the adjustment for multiple testing, none of the relations between treatment effects and baseline moderators remained significant. Thus, the evidence did not suggest differential impacts based on the risk factors studied.

Table 2. *Moderation at Immediate Post-Test*

Outcome \ Moderator	Caregiver intimate partner violence	Caregiver childhood maltreatment	Caregiver HIV-positive	Baseline outcome level	Adolescent externalising	Household necessities	Rural area
	Coef. [95% CI]						
Child maltreatment (adolescent report) [a]	IRR: 1.02 [0.86; 1.21]	IRR: 1.06 [0.87; 1.30]	IRR: 1.31 [0.61; 2.82]	IRR: 1.00 [0.96; 1.03]	IRR: 0.99 [0.97; 1.01]	IRR: 0.97 [0.87; 1.07]	IRR: 0.57 [0.28; 1.15]
p-value	0.815	0.557	0.484	0.879	0.357	0.542	0.116
Adjusted p-value	0.954	0.875	0.875	0.961	0.875	0.875	0.700
Child maltreatment (caregiver report) [a]	IRR: 0.90 [0.71; 1.14]	IRR: 1.16 [0.89; 1.51]	IRR: 0.81 [0.40; 1.67]	IRR: 1.00 [0.96; 1.03]	IRR: 0.99 [0.96; 1.03]	IRR: 1.05 [0.88; 1.24]	IRR: 0.80 [0.32; 2.02]
p-value	0.364	0.281	0.574	0.920	0.732	0.595	0.639
Adjusted p-value	0.867	0.875	0.875	0.974	0.914	0.875	0.892
Positive parenting	0.23	0.08	-1.43	-0.05	0.00	0.15	3.00

Outcome \ Moderator	Caregiver intimate partner violence	Caregiver childhood maltreatment	Caregiver HIV-positive	Baseline outcome level	Adolescent externalising	Household necessities	Rural area
(adolescent report)	[-0.98; 1.45]	[-0.65; 0.81]	[-4.07; 1.21]	[-0.22; 0.12]	[-0.09; 0.09]	[-0.45; 0.74]	[-1.14; 6.96]
p-value	0.708	0.832	0.290	0.589	0.993	0.630	0.160
Adjusted p-value	0.910	0.953	0.875	0.875	0.993	0.892	0.790
Positive parenting	0.81*	0.10	-1.13	-0.01	0.02	-0.02	0.27
(caregiver report)	[0.15; 1.47]	[-0.64; 0.83]	[-3.27; 1.02]	[-0.17; 0.14]	[-0.08; 0.11]	[-0.54; 0.50]	[-2.76; 3.31]
p-value	0.016	0.794	0.303	0.865	0.719	0.942	0.861
Adjusted p-value	0.541	0.942	0.875	0.953	0.914	0.974	0.953
Involved parenting	0.61	0.01	-1.05	-0.04	0.05	0.49	4.01
(adolescent report)	[-0.91; 2.14]	[-1.10; 1.12]	[-5.37; 3.27]	[-0.19; 0.11]	[-0.05; 0.15]	[-0.22; 1.19]	[2.84; 10.85]
p-value	0.431	0.983	0.633	0.601	0.335	0.179	0.251
Adjusted p-value	0.867	0.989	0.892	0.875	0.875	0.830	0.875
Involved parenting	0.29	-0.90	-0.15	-0.06	0.02	0.24	3.48
(caregiver report)	[-1.04; 1.62]	[-2.34; 0.53]	[-3.91; 3.60]	[-0.22; 0.11]	[-0.12; 0.16]	[-0.46; 0.95]	[0.62; 7.57]

Outcome / Moderator	Caregiver intimate partner violence	Caregiver childhood maltreatment	Caregiver HIV-positive	Baseline outcome level	Adolescent externalising	Household necessities	Rural area
p-value	0.668	0.218	0.936	0.496	0.778	0.501	0.096
Adjusted p-value	0.889	0.874	0.974	0.875	0.934	0.875	0.700
Poor parental monitoring (adolescent report)	-1.81*	0.41	-2.48	-0.01	-0.03	0.49	-0.28
	[-2.94; -0.70]	[-0.3; 1.44]	[-5.47; 0.51]	[-0.16; 0.15]	[-0.15; 0.08]	[-0.45; 1.43]	[-6.36; 5.79]
p-value	0.002	0.440	0.104	0.923	0.606	0.311	0.927
Adjusted p-value	0.153	0.875	0.700	0.974	0.875	0.875	0.974
Poor parental monitoring (caregiver report)	-0.80	-0.50	-1.06	-0.13	0.02	0.30	2.43
	[-1.97; 0.36]	[-1.68; 0.68]	[-4.07; 1.94]	[-0.27; 0.00]	[-0.13; 0.16]	[-0.48; 1.07]	[3.01; 7.87]
p-value	0.177	0.407	0.488	0.057	0.807	0.454	0.382
Adjusted p-value	0.856	0.875	0.875	0.581	0.950	0.875	0.875

Note. [a] – negative binomial models, results presented as incidence rate ratios. Maltreatment includes physical and emotional violence.

*p<0.05 for *p*-values before the correction for multiple comparisons

Table 3. *Moderation at Follow-Up*

Outcome \ Moderator	Caregiver intimate partner violence	Caregiver childhood maltreatment	Caregiver HIV-positive	Baseline outcome level	Adolescent externalising	Household necessities	Rural area
	Coef. [95% CI]						
Child maltreatment (adolescent report) [a]	IRR: 0.92 [0.72; 1.18]	IRR: 0.95 [0.77; 1.16]	IRR: 1.13 [0.56; 2.30]	IRR: 1.03 [0.99; 1.07]	IRR: 0.98 [0.95; 1.00]	IRR: 0.97 [0.87; 1.07]	IRR: 0.47 [0.19; 1.17]
p-value	0.500	0.603	0.728	0.189	0.067	0.866	0.104
Adjusted *p-value*	0.867	0.875	0.914	0.851	0.641	0.953	0.700
Child maltreatment (caregiver report) [a]	IRR: 0.83 [0.64; 1.06]	IRR: 0.94 [0.77; 1.15]	IRR: 1.53 [0.86; 2.73]	IRR: 1.00 [0.96; 1.03]	IRR: 0.99 [0.98; 1.05]	IRR: 1.07 [0.92; 1.25]	IRR: 0.52* [0.30; 0.90]
p-value	0.132	0.562	0.146	0.840	0.445	0.393	0.019
Adjusted *p-value*	0.777	0.875	0.790	0.953	0.875	0.875	0.541
Neglect	IRR : 0.84	IRR : 0.71	IRR : 1.55	IRR: 1.13*	IRR: 0.99	IRR: 1.26	IRR: 0.25*

Moderator / Outcome	Caregiver intimate partner violence	Caregiver childhood maltreatment	Caregiver HIV-positive	Baseline outcome level	Adolescent externalising	Household necessities	Rural area
(adolescent report) [a]	[0.49; 1.45]	[0.47; 1.07]	[0.46; 5.22]	[1.01 ; 1.27]	[0.95; 1.04]	[0.94; 1.68]	[0.07; 0.97]
p-value	0.531	0.101	0.476	0.041	0.817	0.119	0.045
Adjusted p-value	0.867	0.700	0.875	0.541	0.953	0.700	0.541
Neglect (caregiver report) [a]	IRR: 1.49 [0.74 ; 2.98]	IRR: 1.44 [0.67; 3.09]	IRR: 0.31 [0.03; 2.87]	N/A	IRR: 1.04 [0.94; 1.16]	IRR: 0.86 [0.54; 1.38]	IRR : 0.19 [0.01; 2.63]
p-value	0.266	0.349	0.300		0.463	0.536	0.214
Adjusted p-value	0.867	0.875	0.875		0.875	0.875	0.875
Corporal punishment (adolescent report) [a]	IRR: 0.88 0.73 ; 1.07	IRR: 0.94 [0.77 ; 1.15]	IRR: 1.04 [0.56 ; 1.92]	IRR: 1.05 [0.90 ; 1.22]	IRR: 0.98 [0.95; 1.00]	IRR: 1.08 [0.95 ; 1.23]	IRR: 0.71 [0.44 ; 1.14]
p-value	0.194	0.561	0.901	0.574	0.102	0.248	0.155
Adjusted p-value	0.857	0.875	0.971	0.875	0.700	0.875	0.790

Moderator / Outcome	Caregiver intimate partner violence	Caregiver childhood maltreatment	Caregiver HIV-positive	Baseline outcome level	Adolescent externalising	Household necessities	Rural area
Corporal punishment (caregiver report) [a]	IRR: 1.01 [0.80 ; 1.29]	IRR: 0.91 [0.75; 1.10]	IRR: 2.25* [1.01 ; 4.99]	IRR: 1.00 [0.90 ; 1.12]	IRR: 0.99 [0.96 ; 1.02]	IRR: 1.04 [-0.91 ; 1.19]	IRR: 1.20 [0.62 ; 2.32]
p-value	0.905	0.328	0.046	0.950	0.565	0.545	0.578
Adjusted *p-value*	0.974	0.875	0.541	0.976	0.875	0.875	0.875
Positive parenting (adolescent report)	-0.57 [-1.75; 0.62]	0.41 [-0.42; 1.25]	-1.03 [-3.32; 1.26]	-0.06 [-0.21; 0.10]	0.02 [-0.08; 0.12]	0.01 [-0.43; 0.45]	3.00* [0.17; 5.83]
p-value	0.348	0.326	0.377	0.480	0.735	0.965	0.038
Adjusted *p-value*	0.867	0.875	0.875	0.875	0.914	0.984	0.541
Positive parenting (caregiver report)	0.56 [-0.40; 1.51]	0.20 [-0.54; 0.95]	1.09 [-0.83; 3.02]	-0.13 [-0.29; 0.03]	0.06 [-0.04; 0.16]	-0.24 [-0.77; 0.30]	3.42* [0.27; 6.58]
p-value	0.253	0.593	0.266	0.113	0.227	0.389	0.033
Adjusted *p-value*	0.867	0.875	0.875	0.700	0.875	0.875	0.541

Outcome \ Moderator	Caregiver intimate partner violence	Caregiver childhood maltreatment	Caregiver HIV-positive	Baseline outcome level	Adolescent externalising	Household necessities	Rural area
Involved parenting (adolescent report)	0.64 [-0.81; 2.08]	0.75 [-0.83; 2.32]	-1.55 [-5.24; 2.14]	0.03 [-0.12; 0.19]	0.14* [0.01; 0.27]	0.12 [-0.68; 0.93]	1.18 [-4.37; 6.72]
p-value	0.387	0.352	0.410	0.679	0.032	0.767	0.677
Adjusted *p-value*	0.867	0.875	0.875	0.903	0.541	0.931	0.903
Involved parenting (caregiver report)	1.18 [-0.61; 2.98]	-1.14 [-2.27; 0.00]	1.65 [-1.35; 4.65]	-0.11 [-0.30; 0.08]	0.08 [-0.09; 0.25]	0.08 [-0.83; 1.00]	3.45* [0.21; 6.70]
p-value	0.196	0.050	0.281	0.274	0.371	0.858	0.037
Adjusted *p-value*	0.857	0.546	0.875	0.875	0.875	0.953	0.541
Poor parental monitoring (adolescent report)	-0.41 [-1.61; 0.79]	-0.54 [-1.49; 0.41]	0.85 [-2.30; 4.01]	-0.11 [-0.30; 0.09]	-0.07 [-0.19; 0.05]	0.08 [-0.78; 0.94]	-0.99 [-5.97; 3.98]
p-value	0.501	0.266	0.596	0.280	0.250	0.857	0.696
Adjusted *p-value*	0.867	0.875	0.875	0.875	0.875	0.953	0.914

Moderator / Outcome	Caregiver intimate partner violence	Caregiver childhood maltreatment	Caregiver HIV-positive	Baseline outcome level	Adolescent externalising	Household necessities	Rural area
Poor parental monitoring (caregiver report)	-1.41*	-0.91*	1.46	-0.22*	0.01	0.20	0.63
	[-2.60; -0.22]	[-1.79; -0.02]	[-2.06; 4.98]	[-0.35; -0.09]	[-0.13; 0.15]	[-0.50; 0.91]	[-2.03; 3.30]
p-value	0.021	0.044	0.415	0.001	0.898	0.580	0.641
Adjusted *p-value*	0.541	0.541	0.875	0.153	0.971	0.875	0.892
Inconsistent discipline (adolescent report)	0.10	-0.16	0.55	0.06	0.00	0.24	-1.32
	[-0.70 ; 0.89]	[-0.84 ; 0.53]	[-2.06; 3.17]	[-0.06 ; 0.19]	[-0.10; 0.10]	[-0.25; 0.73]	[-5.18 ; 2.53]
p-value	0.806	0.652	0.678	0.309	0.938	0.334	0.500
Adjusted *p-value*	0.954	0.899	0.903	0.875	0.974	0.875	0.875
Inconsistent discipline (caregiver report)	-0.19	-0.33	0.35	0.08	0.06	0.32	0.02
	[-1.08; 0.70]	[-1.17 ; 0.51]	[-1.87 ; 2.56]	[-0.10 ; 0.29]	[-0.02; 0.14]	[-0.03 ; 0.68]	[1.85; 1.89]

Moderator Outcome	Caregiver intimate partner violence	Caregiver childhood maltreatment	Caregiver HIV-positive	Baseline outcome level	Adolescent externalising	Household necessities	Rural area
p-value	0.680	0.442	0.758	0.333	0.157	0.072	0.981
Adjusted *p-value*	0.889	0.875	0.928	0.875	0.790	0.648	0.989

Note. [a] – negative binomial models, results presented as incidence rate ratios

*p<0.05 for p-values before the correction for multiple comparisons

Sensitivity Analyses

As suggested by previous research, it is important to examine the cumulative effect of moderators (Weeland et al., 2017). Therefore, we also examine the pattern of results in models with all moderators included at once, finding a similar pattern of results.

Discussion

Our research set out to examine if the most vulnerable families within an at-risk sample benefitted in a similar way as less vulnerable families from a parenting intervention in the Eastern Cape Province of South Africa in a multi-informant pragmatic randomised evaluation including over 500 families. Prior to the correction for multiple testing, there were several statistically significant treatment moderation effects, suggesting that there may be greater benefits for families who report higher levels of disadvantage for some of the outcomes examined, such as caregiver experience of childhood maltreatment, exposure to IPV, and rural residence. There were, however, two exceptions to this, including smaller intervention effects observed for caregiver-reported corporal punishment among HIV-positive caregivers, and for adolescent-reported neglect for families with higher baseline neglect. However, after adjusting for the testing of multiple hypotheses, none of the baseline risk factors had a statistically significant impact on treatment effects. On balance, therefore, our results suggest that there were no clear detectable differences in the impact of the intervention based on the examined moderator variables, such as baseline household poverty and location, adolescent problem behaviour, caregiver exposure to IPV, their HIV status, and childhood maltreatment.

As parenting research has primarily focused on young children, only a few other studies have explored whether family characteristics influence the treatment effects for adolescents and their caregivers. Our findings within this RCT of a child maltreatment prevention programme align with recent studies and reviews of parenting programmes that

target the reduction of child behavioural problems among families with younger children (Gardner et al., 2015; Pelham et al., 2017; Weeland et al., 2017), as well as programmes addressing parenting and harsh punishment (Annan, Sim, Puffer, Salhi, & Betancourt, 2017; Puffer et al., 2015). Notably, these recent studies differ from some of the earlier findings suggesting reduced parenting programme benefits for disadvantaged families and caregivers (e.g., Eckenrode et al., 2000; Lundahl et al., 2006), whereas the more recent studies have either suggested no reduced benefits for disadvantaged families.

There are many potential reasons for the variations in findings, such as different analytical approaches (Coffman, Edelman, & Woolson, 2016). For example, correction for multiple hypotheses testing has been used in some of the recent moderation studies, which can considerably impact results and conclusions, reducing the number of identified moderators (Shelleby & Shaw, 2014). Variation in analytical approaches may help explain some of the differences in findings, together with the variety of interventions, samples, outcomes, and risk measures used. Researchers have also argued for a more nuanced approach, where variation in families' responses to specific techniques or programme components rather than to the programme overall is examined (Leijten et al., 2018).

The reporting of randomised trials increasingly follows standard guidelines, such as CONSORT. Given the importance of understanding variation in treatment effects, it will be useful for guidelines to also be used for moderator analyses (for example, Van Hoorn et al., 2017). While some literature emphasizes the importance of pre-planning analyses, others also highlight the benefits of exploratory moderator analyses (Kraemer, Frank, & Kupfer, 2006). This is especially relevant for outcomes where risk factors are not well established and it may be beneficial to explicitly modify analyses plans, for instance, based on the hypotheses emerging during data collection (Jamal et al., 2015). Furthermore, in a trial with multiple outcomes, it is not immediately clear how many statistically significant moderation results

constitute a pattern. Researchers could address this by adopting pre-planned decision rules regarding moderators in study protocols (Porter, 2017). It may also be useful to define a minimal effect size for a moderator to be clinically meaningful, and the type of effect – for instance, whether the average effect includes benefits to some and harm to other groups, or just differential effectiveness.

There might also be important effects resulting from a combination of risk factors. Person-centred analyses, such as latent class analysis (Pelham et al., 2017), would be better suited to examining combinations of risk factors. Machine-learning inference can help identify groups that benefit most and least from an intervention using a large number of observed characteristics and their combinations that are not captured via simple interactions (Chernozhukov, Demirer, Duflo, & Fernandez-Val, 2018).

Our study design has allowed us to examine the role of pre-intervention family characteristics in the variation in intervention effects. Having examined all pre-specified primary outcomes, this study did not find consistent evidence of treatment effects moderation by baseline characteristics, adding to a growing body of literature suggesting limited explanatory power of baseline sociodemographic moderators.

The limited variation in treatment effects across families with various levels of risk in our study may be related to the design of the intervention and its implementation which may have helped participants at various risk levels to engage and benefit. For example, intervention families were provided with free meals and transportation, as well as home visits for those who missed group sessions. Like Incredible Years and other similar interventions, this programme has a collaborative working style which can help accommodate the needs of different families (Gardner et al., 2017). The intervention was delivered within a pragmatic randomised trial by lay workers following only a week of training, with ongoing weekly training and supervision. Process data suggest that the intervention quality was comparable to

what was intended (e.g. overall fidelity of 83%). Thus, the programme design, fidelity, and high coverage of group sessions combined with home visits may have helped overcome barriers for some families who might struggle to engage if, for example, a lengthy trip had been required to engage with the programme (Whittaker & Cowley, 2012). However, evaluations of family engagement strategies are still limited (Gonzalez, Morawska, & Haslam, 2018), and further research is crucial to establish which support strategies in fact impact family engagement and outcomes (Lachman et al., 2019). Implementation and programme supports should also be examined in routine settings (Alonge et al., 2019), so we can compare delivery in routine implementation to delivery in research studies, as we might expect that similar implementation is required to achieve comparable effects.

The current study targeted families in a high poverty area, focusing specifically on families with existing challenges around family conflict and high stress. Since targeting individual families or participants has a cost in terms of resources for screening as well as a potential to create stigma, it needs to be managed carefully, and delivering the programme on a more generalised basis can be considered. Further research should examine the effects and costs of universal community-wide programme delivery to all families, for instance in similar high-poverty areas as the area of the current study. Moreover, in ongoing service provision, parenting programmes are often rolled out as part of a package of services, which have broader selection criteria not specifically informed by the parenting component. For example, the current intervention is being delivered in some settings within the USAID-PEFPAR DREAMS intervention package, which includes a parenting component, as part of a range of other strategies to support adolescent girls and young women and reduce the rate of new HIV infections in this group (Gourlay et al., 2019).

Among limitations of the current study, it is important to note that the effects of moderators may have been smaller than could be detected in this trial. Future trials interested

in moderation ideally need to be powered for detecting moderation effects of a specific magnitude, in addition to the main intervention effects (Shieh, 2009). It may also be harder to detect moderation effects within a high-risk sample, such as the current study, where there may be range restriction on some of the relevant moderating characteristics.

Another set of limitations is regarding measurement. Some of the constructs used in our evaluation, in particular inconsistent parenting, had relatively low alpha coefficients. Previous studies using Alabama Parenting Questionnaire in South Africa and other contexts (e.g., Boyes, Cluver, Meinck, Casale, & Newnham, 2019; Dadds, Maujean, & Fraser, 2003; Lachman, Cluver, Boyes, Kuo, & Casale, 2014; Topçuoğlu, Eisner, & Ribeaud, 2015) reported alpha coefficients in the range of 0.6-0.9. This is perhaps due to a small number of items and a broad range of parenting behaviours covered by the subscales, resulting in a content validity-reliability trade-off. As using observational measures with adolescents is challenging, particularly in a low-resource setting, we relied on the parent and child reports of parenting practices, which may be subject to social desirability and recall biases.

As long as there is variation in treatment effects among participants, it remains a question whether there are any other risk factors, or combinations of risk factors, that could explain this variation. Understanding the mechanisms behind heterogeneity of treatment effects can be used for targeting and refining interventions as parenting interventions are rolled out to new settings.

Supplementary Table 1. *Overview of measures used in the questionnaires*

Construct	Measure	Sample items (adolescent report)	Sample items (caregiver report)	Response codes
Child maltreatment	ISPCAN Child Abuse Screening Tool for use in trials (ICAST-Trial) - physical and emotional maltreatment	- "In the past month, how often did an adult in your house say that they wished you were dead or had never been born?" (emotional) - "In the past month, how often did an adult in your house push, grab, or kick you?" (physical)	- "In the past month, how often did you tell your teen that you wished he had never been born?" (emotional) - "In the past month, how often did you push, grab or kick your teen?" (physical)	0- zero 1- one 2- two 3- three 4- four 5- five 6- six
	- neglect	- "In the past month, were you not taken care of when you were sick- for example not taken to see a doctor when you were hurt or not given the medicines you needed?"	- "In the past month, how many times did you not get medical care for an injury or illness that your teen needed at the time even though there was money to pay for it?"	7- seven 8- eight or more
Parenting	Alabama Parenting Questionnaire	- "In the past month, how often does your caregiver tell you that he/she	- "In the past month, how often do you tell your teen that you	0 – Never

Construct	Measure	Sample items (adolescent report)	Sample items (caregiver report)	Response codes
	- positive parenting	likes it when you help around the house?"	like it when he/she helps around the house?"	1 – Almost never
	- involved parenting	- "… you play games or do other fun things with your caregiver?"	- "…you play games or do other fun things with your teen?"	2 – Sometimes 3 – Often 4 – Always
	- poor monitoring	- "… you stay out in the evening past the time you are supposed to be home"	- "… your teen stays out in the evening past the time your teen is supposed to be home"	
	- corporal punishment	- "… your teen is not punished when your teen has done something wrong"	- "… your teen talks you out of being punished after your teen has done something wrong"	
	- inconsistent discipline	- "… your caregiver slaps you when you have done something wrong."	- "… you slap your teen when your teen has done something wrong."	
Household necessities	South African Social Attitudes survey	Not used in the current analysis	"Please tick if you could afford 3 meals a day in the past month"	0 – No 1 – Yes

Construct	Measure	Sample items (adolescent report)	Sample items (caregiver report)	Response codes
Adolescent behaviour problems	Child Behaviour Checklist - rule-breaking and aggression	Not used in the current analysis	"Your teen drinks alcohol or uses drugs without your approval"	0- Not True 1- Sometimes True 2 -Very True
Caregiver IPV exposure	Conflict Tactics Scale	N/A	"In the past month, my partner twisted my arm, my hair or threw something at me that could hurt."	0- Never 1- Once or twice 2- 3-5 times 3- More than 5 times
Caregiver history of maltreatment	ISPCAN Child Abuse Screening Tool-Retrospective	N/A	"When you were growing up (before you were 18 years old) did anyone ever hit, punch, kick, beat or shake you very hard so that it hurt you?"	0 – No 1 – Yes
Caregiver HIV	Self-report as HIV positive or reported three			

Construct	Measure	Sample items (adolescent report)	Sample items (caregiver report)	Response codes
	or more AIDS-related symptoms			
Rural/peri-urban residence	Determined by the research team based on participant's residence			

Supplementary Table 2. *Intra-class Correlation Coefficients for Study Outcomes*

Primary study outcomes	ICC at person level	ICC at cluster level
Physical and emotional maltreatment (adolescent report)	29%	0.35%
Physical and emotional maltreatment (caregiver report)	15%	2%
Neglect (adolescent report)	22%	0%
Neglect (caregiver report)	3%	3%
Corporal punishment (adolescent report)	7%	0%
Corporal punishment (caregiver report)	10%	0%
Positive parenting (adolescent report)	25%	1%
Positive parenting (caregiver report)	22%	5%
Involved parenting (adolescent report)	27%	3%
Involved parenting (caregiver report)	25%	4%
Poor monitoring (adolescent report)	22%	3%
Poor monitoring (caregiver report)	22%	5%
Inconsistent discipline (adolescent report)	1%	1%
Inconsistent discipline (caregiver report)	8%	1%

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Conflict of Interest

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