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DISCUSSION PAPER SERIES

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ISSN: 2365-9793

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ABSTRACT

The Effects of Home Visiting on Mother-Child Interactions: Evidence from a Randomised Trial Using Dynamic Micro-Level Data

Background: Home visiting programs constitute an important policy to support vulnerable families with young children. They mainly aim to improve infant-parent relationships, however evidence on their effectiveness based on observational measures is relatively scarce. The present study provides the rare opportunity to directly examine the effects of a home visiting program, the Pro Kind, on mother-child interactions in a randomized controlled trial (RCT). **Methods:** A sample of 109 mother-child dyads was videotaped during a 3-min typical play situation at the participants' homes when the child was aged 25 months. We use a novel micro-coding system which allows us to examine how the intervention affected the dynamic feedback responses of both mothers and children in three key measures of behavior: orientation, positive contingency, and negative/lack of contingency. The study is registered in the German Clinical Trial Register (trial ID: DRKS00007554, date of registration: 11 June 2015). **Results:** The intervention significantly improved the interactions between girls and their mothers, both in strongly stable and partly unstable situations. Mixed impacts were detected for boys. **Conclusions:** These results have important implications for the analysis of mother-child interactions data and the design of home visiting programs.

JEL Classification: I14, J13, J24

Keywords: home visiting, mother-child interactions, randomized controlled trial

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Introduction

Early experiences can have a lasting impact on lifecourse wellbeing. Children born in vulnerable families risk failing to reach their developmental potential, in part because they are exposed to unstable, unsafe and non-stimulating environments (e.g., Bradley, et al., 2001). In many countries home visiting programs constitute an important strategy to support vulnerable families with young children, and several studies show their effectiveness at promoting child development (for reviews see Sweet & Appelbaum, 2004; Avellar & Supplee, 2013; Olds et al., 2007).

Almost all home visiting programs aim to support infant-parent relationships, as well as sensitive parenting (Berlin et al., 2017; Harding, et al., 2007; Olds, 2006). It is hypothesized that parents who respond to signals from their children and address their physical, emotional, and behavioral needs in a warm and sensitive manner establish a basis for a secure attachment relationship (Ainsworth, et al., 2015; Berger, et al., 2007). The degree to which children form a secure attachment relationship with a caring, responsive, and sensitive adult then influences their trust in the world, which in turn positively affects children's self-representation, cognition, and psychological development (Sroufe, 1979; Bachmann et al., 2019).

The present study provides the rare opportunity to directly examine the effects of a home visiting program, the *Pro Kind*, on sensitive and empathic maternal care and mother-child relationships in a randomized controlled trial (RCT). *Pro Kind* is the German adaptation of the Nurse-Family Partnership (NFP), an evidence-based home visiting program for disadvantaged first-time mothers, which starts during pregnancy and continues until the second birthday of the child (Olds, 2006). Our measures for maternal care and mother-child relationships rely on in-home observations of the mother and child's interaction sequences during typical play situations, which were videotaped and coded in 5-second intervals; we innovate on previous work by modelling them allowing for dynamic feedback responses between the two members of the dyad.

Some previous randomised evaluations of home visiting programs, including Healthy Families New York (HFNY) (Rodriguez et al., 2010), Early Head Start (EHS) (Love et al., 2005), and NFP (Olds et al., 2004), have indeed used measures based on video recordings to analyse impacts on mother-child interactions; however, they have either (NFP and EHS) given a single score to one entire video session (known as “global coding system”), or (HFNY) simply counted the frequencies of certain behaviors; and in all cases they have only focused on mothers. Instead, it has been shown since Markman & Notarius (1987) and Floyd (1989) in the context of couple relationships that only micro-coding systems considering dynamic reactions of *both* members of a dyad can reveal complex patterns of interactions. For example, Bardack et al. (2017) show that micro-coded measures of mother-child interactions independently predict fewer externalizing and inattentive/impulsive behaviors in school, whereas global-coded measures do not. Furthermore, global coding systems may be susceptible to rater bias, as they require the coder to make complex judgments to produce ratings that summarize behaviors across lengthy periods; instead, micro-coding schemes divide behaviors into small units, leaving little room for subjective judgments (Alexander et al., 1995; Markman & Notarius, 1987).

The present study measures mother-child interactions within an objective micro-coded system, which considers actions and responses in 5-second coding intervals. Therefore, we innovate on previous home visiting trials, which only used global measures of mother-child interactions, or static micro measures that simply counted frequencies and only focused on mothers. Additionally, we conduct our analysis separately for boys and girls, since previous evaluations of early interventions have found significant differences by gender, often uncovering greater impacts for girls. For example, Eckenrode et al. (2010) find greater treatment effects for girls than for boys (especially for reductions in crime) in the NFP Elmira trial; Sidora-Arcoleo et al. (2010) show that the NFP Memphis trial reduced the prevalence of physical aggression at age 2 only in girls; and Lorber et al. (2019) find that the NFP Denver trial moved girls from high to moderate externalising behavior, with no impact on boys. For the *Pro Kind*, Sandner & Jungmann (2017), Sierau et al. (2016), Sandner et al. (2018), and Sandner (2017) found positive effects of *Pro Kind* on child cognitive development and maternal investments – both concentrated in girls – and on maternal mental health, employment, fertility and well-being.

Intervention and Participants

The *Pro Kind* is an adaptation of the well-known NFP program. The intervention starts between the 12th and 28th week of pregnancy, and continues until the child's second birthday. The frequency of the home visits varies between weekly, biweekly, and monthly according to the NFP model, for an overall maximum of 52 home visits with an average duration of 90 minutes each. Teaching materials and visit-by-visit guidelines, adapted from NFP, structure the aim and content of each home visit. Similarly, as in the NFP, the theoretical concept of the *Pro Kind* intervention is based on human attachment theory (Bowlby, 1969), human ecology theory (Bronfenbrenner, 1979) and self-efficacy (Bandura, 1982). Sierau et al. (2016) and Olds (2006) present more information about the *Pro Kind* project and NFP, respectively.

The *Pro Kind* trial enrolled 755 expectant women in three federal states of Germany (Lower Saxony, Bremen and Saxony); all of them were financially and socially disadvantaged with at least a basic understanding of the German language. The baseline randomization was successfully conducted by a computer routine based on Efron's biased coin approach (Efron, 1971) stratified by municipality, maternal age (< 18 vs. > 18 years old), and maternal nationality (German vs. non-German).

At 24 months after birth, 346 of the mothers participated in a follow-up interview (see CONSORT flow diagram in figure 1). At this follow-up, videotapes were recorded in Lower Saxony and Bremen for 150 randomly chosen mother-child pairs (it was not possible to record them for the full sample for budgetary reasons); of these, 41 videos were not coded because they were shorter than three minutes, leaving an analysis sample of 109 mother-child pairs with coded videos. Table 1 in Supplement 1 shows that the video subsample is balanced, with no differences in observed baseline characteristics significant at 5% level between the treated and the control group (Columns 1-3), as well as between girls and boys (Columns 4-6). The women in our video subsample are also not significantly different from those in the full sample, with the exception of having higher income (Columns 7-9). In additional analyses (results not reported), we have been able to reproduce the key results by Sandner and Jungmann (2017), namely that the intervention reduced the prevalence of developmental delays at 12 months in girls only. Similarly to the full sample, the mothers in our video subsample received 46.79 (SD=8.92, range: 13-63) home visits on average, while the control group received none.

Measures

To measure interactions, the mothers were asked to play for three minutes with the children in their homes, without performing any specific task. Video recording was done by female research assistants (studying psychology or special needs education) who received standardized training and ongoing supervision in interviewing techniques and developmental testing from the research staff.

Two persons independently coded the videotaped play situations, following an adaptation of the *Mannheim rating scale for the analysis of mother-child interactions in toddlers* (MRS-MCI-T; Dinter-Jörg et al., 1997). The two coders were intensively trained in using the MRS-MCI-T for rating and reached high rater-trainer reliability after the training (Kappa .86-.87). The software *Interact*, a computer-based video analysis tool, was used for all video ratings. Both the research assistants and the coders were blinded to the treatment condition.

Scales

For our analysis of mother child-interactions, we focused on the MRS-MCI-T scales

Orientation and *Contingency*, which have been related to the quality of attachment, especially in Germany (Grossman et al., 1985; Scher, 2001). The coders rated the scales one after another separately for mother and child, for all the 109 videos, following the recommended order of the MRS-MCI-T guidelines. Coder A rated 78 videos and coder B rated 31 videos.

The coding interval for *Orientation* is 5 seconds, in which the main attention focus of the subject was observed by considering three aspects: direction, verbal expression, and hand and body motion. For our analysis, we generated a binary variable coded as 1 if the orientation was on the play situation and the partner (a positive behavior), and as 0 if it was on neither one of the two. The coding interval for *Contingency* – whose aim is to measure the reciprocity of the interaction - is also 5 seconds, in which all direct and distinct reactions (positive, negative, initiation of interaction and also lack of reaction) to the partner's behavior were observed. We generated two binary variables. The first takes value 1 if the child or the mother showed *Positive Contingency* (e.g. if the child smiled at the mother), including initiation of interaction, and 0 if otherwise; the second takes value 1 if the child or the mother showed *Negative or Lack of Contingency (*e.g. if the child reacts crying to an action of the mother or if the mother does not react to an action of the child), and 0 if otherwise. The residual intervals are those in which neither the mother nor the child showed any interaction (e.g. both are playing with the toy but they are not interacting).

Table 2 in the Supplement shows that our interactions measures have meaningful correlations with important risk factors: child and mother *Orientation* and *Positive(Negative) Contingency* correlate negatively(positively) with low birth weight and depression, respectively.

Interaction scenarios

To test the dynamic interdependency of mother-child actions, we focus on four scenarios in which we investigate how one partner reacts to the corresponding behavior (*Orientation,* *Positive Contingency, Negative or Lack of Contingency*) of the other in the previous period. The first scenario (*"Both"*) represents a strongly stable situation, in which we examine how the child or the mother reacts if *both* partners showed *positive* behavior in the previous period. The second scenario (*"None"*) represents a strongly unstable situation, in which we investigate how the child or the mother reacts if *both* partners showed *negative* behavior in the previous period. The third and fourth scenarios (*"Child"* and "*Mother"*) represent a partly unstable situation, in which we investigate how the child or the mother reacts if *one* of the partners showed *positive* and the other *negative* behavior in the previous period. Table 1 gives an overview of the scenarios: here the columns show the behaviors *(Orientation, Positive Contingency, Negative or Lack of Contingency)* and the rows the four scenarios.

The first scenario is interesting because, when both partners start with positive behavior, if one partner shows negative behavior in the next period this might be a strong indicator of unpredictable and dysfunctional mother-child interaction. The second scenario studies whether the intervention is able to induce positive behavior in a stressful situation, where both partners show negative behavior. The last two scenarios investigate whether the partner with the negative behavior or the partner with the positive behavior has a more dominant effect on the behavior of the dyad in the next period: for example, whether the mother (who showed positive behavior in the previous period) is able to bring her child (who showed negative behavior in the previous period) back to positive behavior.

Statistical Analysis

We perform a novel *dynamic interaction analysis,* in which we simultaneously model two equations with correlated errors - one for the mother and one for the child - for each of the three behaviors *(Orientation*, *Positive Contingency*, *Negative or Lack of Contingency*), as function of the behavior of both members of the dyad in the previous period, by means of cross-lagged panel probit models. More precisely, we include as covariates in each equation: the first lag of the mother's and the child's outcome, a binary variable for treatment status and its interactions with the two lags (to allow for the effect of the intervention to vary with the behavior of the partner in the previous period). Full equations are in Supplement 2.

Results

The predicted probabilities are presented in Tables 2-4, one table for each outcome. In each Table, there are four panels, one for each scenario. In each panel, the first and second columns show the predicted probabilities for the control and the treatment groups, respectively; the third column shows a Wald test on their difference. In the rows, the effects of the scenarios are displayed for girls and boys, separately for children and mothers.

The Average Marginal Effects for all the estimated coefficients are presented in Tables 3-5 in Supplement 1. These tables also report, for each model, the parameter rho, which is an estimate of the correlation between the error terms of the mother and child equations. A large (small) value of rho is indicative of strong (weak) dependence between the two outcomes, whereas in case rho is zero they are independent and there is no efficiency improvement by the joint estimation. We see that rho is almost always significant, which justifies our modelling choice.

Table 2 shows the results for the models for *Orientation* (on the task and the partner). Looking at the most positive scenario, "Both" (the one where both the child and the mother were oriented towards the task and the partner in the previous interval), the girls in the control group have a 67% probability to be oriented towards the task and the mother in the current interval, whereas the girls in the treatment group have a significantly higher 76% probability. For their mothers, the probabilities are also significantly different: 95% and 92% for the treatment and control, respectively. For the scenarios "None" and "Child", there are no significant differences. Instead, in the "Mother" scenario, the control girls have 34% probability and the treated girls a significantly higher 48% probability to be oriented towards the task and the partner when the mother showed positive behavior (and the child herself negative behavior) in the previous period. In contrast, there are no positive impacts for the treated boys and their mothers.

Table 3 presents the results for *Positive Contingency*. Under the scenario “Both”, girls in the control group have 65% probability of showing positive contingency in the present period, whereas girls in the treatment group have a significantly higher probability of 73%; for mothers we detect no significant differences. In contrast, the treatment has a significantly negative impact on the boys and their mothers. There are no significant differences in the scenarios “None” and “Mother”. Instead, in the “Child” scenario, control girls have 59% probability and treated girls a significantly higher 71% probability to display positive contingency – even with their mothers showing negative behavior in the previous period.

Table 4 presents the results on *Negative (or Lack of) Contingency.* We see significant intervention effects in the scenario “Both”, with the control group having a 5% probability and the treatment group having a 2% probability to show negative (or lack of) contingency in the present period. No significant differences are detected for the boys and their mothers. For the “None” scenario, there is a significant difference for both girls’ and boys’ mothers, with 13% and 10% probabilities to remain in negative (or lack of) contingency for those in the control group, and 47% and 57% probabilities for those in the treatment group, respectively. In the “Child” scenario, no significant difference is detected for any of the groups. In the “Mother” scenario (mother showed no negative (or lack of) contingency in the previous period), there is a significant difference for girls, with the control group having 15% probability and the treatment group having only 6% probability of showing negative or lack of contingency in the current interval; a marginally significant difference in favor of the treated is also found for the boys, but not for their mothers.

Discussion

The present study uses a sequential micro-coding system to study mother-child interactions in a randomized experiment of a home visiting program. The program focused on disadvantaged first-time mothers, started during pregnancy, and continued until the second birthday of the child. We performed a novel dynamic analysis, considering behavioral actions and reactions of both mother and child, by means of cross-lagged panel probit models. We focused on three key behaviors of interest for each partner: *Orientation, Positive Contingency*, and *Negative or Lack of Contingency*.

Several important findings emerge from the dynamic analysis. We report them by scenario ("Both", "None", "Mother" and "Child") and by gender (girls and boys). First, for all three behaviors of interest *(Orientation, Positive Contingency,* and *Negative or Lack of Contingency)* the intervention has a positive impact on the girls in the scenario "Both". These findings indicate higher stability in girls' interactions with their mothers, in the presence of positive initial behaviors, as an outcome of the program. In line with the improvements seen for the treated girls in stable situations, we also find improvements for the mothers in the "Both" scenario for *Orientation.*

Second, the intervention did not have positive impacts in the "None" scenario. Additionally, we find that mothers of girls in the treatment group more often persist in *Negative or Lack of Contingency* in this scenario, i.e. if both themselves and their daughters showed this behavior in the previous period. However, this negative effect of the intervention for mothers of girls is limited to this scenario ("None") and behavior (*Negative or Lack of Contingency*).

Third, in the scenario "Child", girls in the treatment group were more likely to show *Positive Contingency,* despite the mother not showing it in the previous period. This suggests that the treated girls are more stable and continue to display positive behavior, even if their mothers are not acting positively. There is no significant effect in the "Child" scenario for the other behaviors.

Fourth, in the scenario "Mother" (mother showed positive behavior in previous period) the treated girls are more likely than the control girls to switch from negative to positive behavior, and to show more *Orientation* and less *Lack of Contingency*. These results suggest that the girls in the treatment group are more likely to respond to the positive behavior of their mother than the girls in the control group. This finding may indicate a greater sensitivity of the mothers in the intervention group who are better able to react if their daughters show negative behavior.

While the intervention clearly improved the behaviors of the daughters, the results for the son dyads are mixed. First, for the scenario "Both", both sons (for *Positive Contingency*) and their mothers (for *Orientation* and *Positive Contigency*) exhibit less stable behaviors. Second, as seen for daughters, we find that boys' mothers in the treatment group more often persist in *Negative or Lack of Contigency* in the "None" scenario, i.e. if themselves and their sons showed this behavior in the previous period. Third, in the "Mother" scenario, we find mixed impacts for *Negative or Lack of Contigency* with positive effects for the sons (who switch to a more positive behavior) and negative effects for their mothers (who switch to less stable behavior), in the presence of positive maternal behavior in the previous period. All the other effects are not significantly different. Therefore, it appears that the treatment had mixed effects on the interactions between boys and their mothers.

Overall, the dynamic analysis substantially improves our understanding of the situations in which the treatment improved mother-child interactions. First, treated girls always display improved behavior in strongly stable situations (i.e. in the scenario "Both", where both the mother and the child displayed positive behavior in the previous period), in comparison to control girls. This shows that home visiting prevents unpredictable behavior changes and fosters stability in dyadic interactions. Second, treated girls also show improved behavior in less stable situations. In particular, they show greater stability of *Positive Contingency*, even in the absence of a positive behavior of the mother in the previous period (scenario "Child"), and display greater ability to switch to more *Orientation* and less *Negative Contingency* when their mothers show positive behavior in the previous period (i.e. even in the absence of their own positive behavior in the previous period, in the "Mother" scenario). This finding could be interpreted as showing that the intervention promotes resilience in face of adversity, and helps avoiding negative behavior.

The value of our dynamic analysis is even more evident if we contrast it against the results of a static analysis, reported in Table 6 of Supplement 1. This analysis only shows that the intervention led to a higher (lower) probability of orientation (negative/lack of contingency) for girls, with no qualification of the circumstances under which these improvements occurred.

Another main finding of our analysis is that the intervention appear to benefit more the interactions between mothers and daughters than those between mothers and sons. This is consistent with the early interventions literature cited previously - including previous evidence based on the *Pro Kind* – which shows greater treatment impacts for girls. While we cannot provide a definite explanation for these gender differences, critical factors which might contribute to the emergence of impacts more favourable to girls in the *Pro Kind* trial include the absence of a father and the availability of limited resources, which have been associated with increased investment in girls (Gibson, 2008; Godoy et al., 2006).

Conclusions, Limitations and Implications

Our study is the first to examine the effects of a home visiting program on parent-child interactions using micro-social measures and dynamic modelling. Most previous studies have applied static models to global-coded measures, which do not fully capture the dynamics and the feedback effects of the repeated interactions between mother and child. We have shown that it is important to account for these to better understand the situations in which home visiting can improve the mother-child relationship.

Despite its strength and novelty, the present study has some limitations. First, we have video recordings of only three minutes duration. Longer (or repeated) recordings could reveal more nuanced patterns of interactions, in particular for behaviors that occur less frequently.

Second, videos were only recorded when the child was 2 years of age. Videos at different ages would have allowed to analyse intervention impacts on mother-child interactions at different stages of child development (as for example in Meins et al., 2018). Third, the videos recorded only mother-child interactions. Therefore, we cannot say whether father-child interactions were improved by the home visits.

Our analysis has important implications. First, our findings and methodology might foster further research on behavioral interactions between two partners, not only in mother-child relationships, but also in other settings. Additionally, our findings might also influence the design and delivery of home visiting programs, to the extent that they suggest that more attention has to be devoted to the interactions between boys and their mothers.

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Figure 1. CONSORT flow chart of the participants' progress

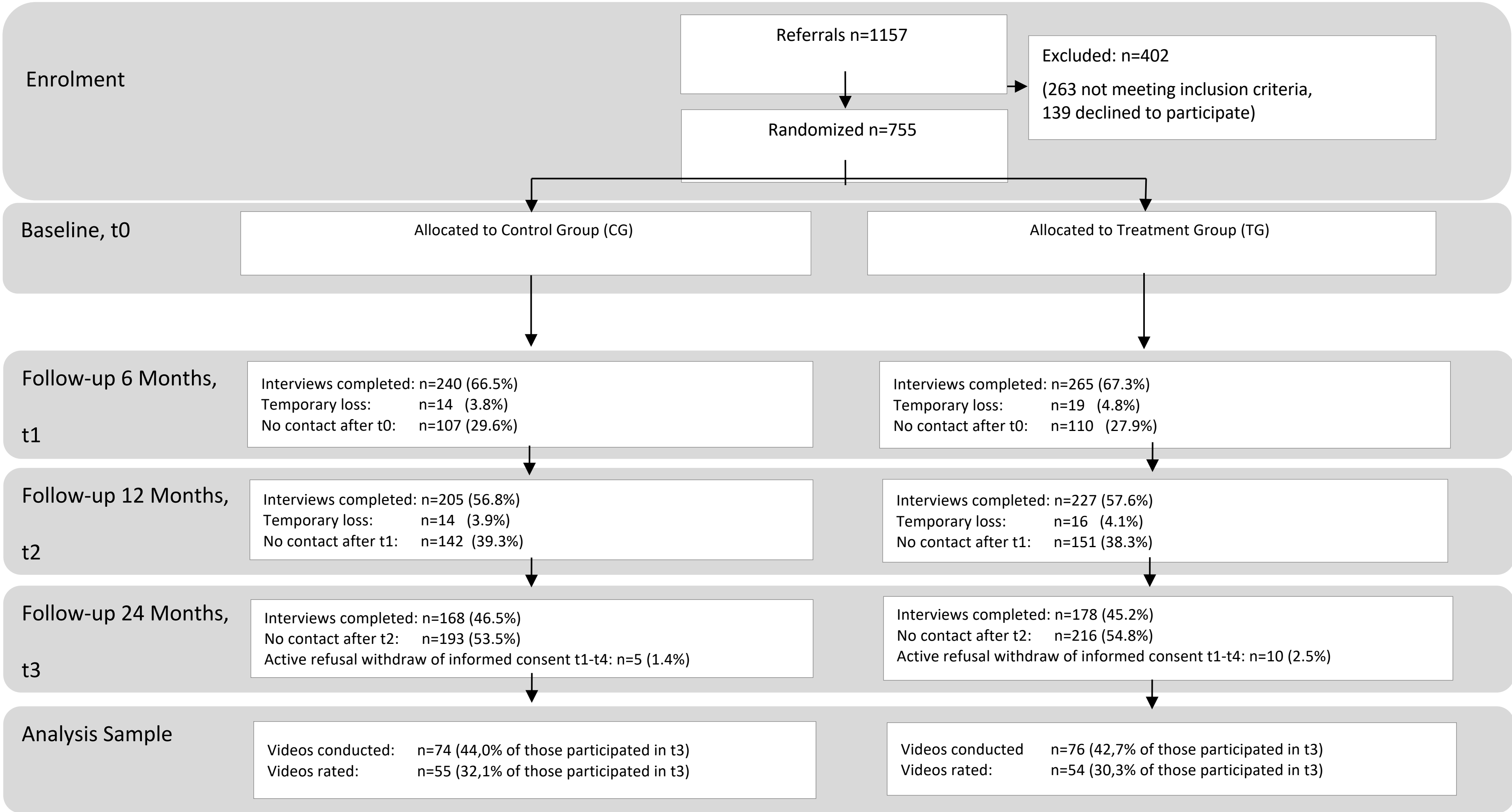

Table 1: Description of Scenarios for Treatment Effects Analysis

		Behavior in current period:		
		(1) Orientation on Partner and Play Situation	(2) Contingency Positive	(3) Contingency Negative / Lack
Scenario Name				
Both	Child	1	1	0
	Mother	1	1	0
None	Child	0	0	1
	Mother	0	0	1
Child	Child	1	1	0
	Mother	0	0	1
Mother	Child	0	0	1
	Mother	1	1	0

Note: The name of the scenario is based on the behavior of the mother and the child in the ***previous*** *period. For example, in the scenario "Both" in column 1, both mother and child show "Orientation on Partner and Play Situation" (indicated by 1) in the* ***previous*** *period. In the scenario "None" in column 2, neither mother nor child show "Contingency Positive" (indicated by 0) in the previous period.*

Table 2: Predicted Probabilities - Different Scenarios – Orientation

Scenario		Both			None		
		C	T	Wald Test	C	T	Wald Test
Girls	Child	0.67	0.76	4.07**	0.24	0.32	2.11
(N=2,100)		(0.04)	(0.02)	*p* = .044	(0.04)	(0.04)	*p* = .147
	Mother	0.92	0.95	2.93*	0.47	0.40	1.17
		(0.01)	(0.01)	*p* = .087	(0.04)	(0.05)	*p* = .280
Boys	Child	0.74	0.67	1.19	0.19	0.19	0.00
(N=1,715)		(0.03)	(0.05)	*p* = .276	(0.05)	(0.04)	*p* = .993
	Mother	0.94	0.87	3.68*	0.40	0.40	0.00
		(0.02)	(0.03)	*p* = .055	(0.06)	(0.04)	*p* = .976
Scenario		**Child**			**Mother**		
		C	T	Wald Test	C	T	Wald Test
Girls	Child	0.56	0.61	0.59	0.34	0.48	9.83***
(N=2,100)		(0.06)	(0.04)	*p* = .441	(0.03)	(0.04)	*p* = .002
	Mother	0.59	0.59	0.00	0.87	0.88	0.27
		(0.06)	(0.06)	*p* = .992	(0.02)	(0.02)	*p* = .602
Boys	Child	0.55	0.52	0.10	0.36	0.31	0.84
(N=1,715)		(0.07)	(0.07)	*p* = .750	(0.03)	(0.04)	*p* = .359
	Mother	0.60	0.53	0.49	0.84	0.79	1.26
		(0.08)	(0.07)	*p* = .483	(0.03)	(0.04)	*p* = .261

*Notes: The coefficients show the probability of orientation on the play situation for each partner in each of the different scenarios described in Table 2. C = Control Group, T = Treatment Group; *** p<0.01, ** p<0.05, * p<0.1.*

Table 3: Predicted Probabilities - Different Scenarios - Contingency Positive

Scenario		Both			None		
		C	T	Wald Test	C	T	Wald Test
Girls	Child	0.65	0.73	5.47**	0.48	0.48	0.00
(N=2,100)		(0.03)	(0.02)	*p* = .019	(0.04)	(0.05)	*p* = .974
	Mother	0.74	0.77	0.40	0.53	0.53	0.00
		(0.03)	(0.02)	*p* = .528	(0.04)	(0.04)	*p* = .982
Boys	Child	0.71	0.59	4.66**	0.36	0.40	0.31
(N=1,715)		(0.03)	(0.04)	*p* = .031	(0.05)	(0.04)	*p* = .576
	Mother	0.78	0.65	6.00**	0.43	0.47	0.58
		(0.04)	(0.04)	*p* = .014	(0.05)	(0.04)	*p* = .447
Scenario		Child			Mother		
		C	T	Wald Test	C	T	Wald Test
Girls	Child	0.59	0.71	4.63**	0.54	0.50	0.66
(N=2,100)		(0.04)	(0.04)	*p* = .032	(0.03)	(0.03)	*p* = .417
	Mother	0.63	0.57	1.13	0.66	0.74	2.37
		(0.04)	(0.04)	*p* = .287	(0.04)	(0.04)	*p* = .124
Boys	Child	0.64	0.57	1.68	0.43	0.42	0.03
(N=1,715)		(0.04)	(0.05)	*p* = .195	(0.05)	(0.04)	*p* = .852
	Mother	0.57	0.51	0.82	0.66	0.61	0.51
		(0.06)	(0.04)	*p* = .364	(0.05)	(0.03)	*p* = .473

*Notes: The coefficients show the probability of positive contingency for each partner in each of the different scenarios described in Table 2. C = Control Group, T = Treatment Group; *** p<0.01, ** p<0.05, * p<0.1.*

Table 4: Predicted Probabilities - Different Scenarios - Contingency Negative-Lack

Scenario		Both			None		
		C	T	Wald Test	C	T	Wald Test
Girls	Child	0.05	0.02	5.74**	0.17	0.14	0.12
(N=2,100)		(0.01)	(0.01)	*p* = .017	(0.06)	(0.07)	*p* = .733
	Mother	0.05	0.04	0.09	0.13	0.47	8.33***
		(0.01)	(0.01)	*p* = .760	(0.08)	(0.08)	*p* = .004
Boys	Child	0.07	0.04	2.22	0.27	0.31	0.13
(N=1,715)		(0.02)	(0.01)	*p* = .136	(0.10)	(0.06)	*p* = .717
	Mother	0.04	0.03	0.34	0.10	0.57	3.17*
		(0.01)	(0.01)	*p* = .562	(0.10)	(0.25)	*p* = .075
Scenario		Child			Mother		
		C	T	Wald Test	C	T	Wald Test
Girls	Child	0.06	0.07	0.02	0.15	0.06	3.93**
(N=2,100)		(0.03)	(0.03)	*p* = .892	(0.04)	(0.03)	*p* = .047
	Mother	0.15	0.29	2.16	0.03	0.10	1.94
		(0.05)	(0.08)	*p* = .141	(0.02)	(0.04)	*p* = .164
Boys	Child	0.06	0.11	0.61	0.27	0.15	3.82*
(N=1,715)		(0.03)	(0.04)	*p* = .435	(0.03)	(0.06)	*p* = .051
	Mother	0.27	0.38	0.27	0.01	0.09	3.05*
		(0.11)	(0.18)	*p* = .607	(0.01)	(0.04)	*p* = .081

*Notes: The coefficients show the probability of negative contingency or lack of contingency for each partner in each of the different scenarios described in Table 2. C = Control Group, T = Treatment Group; *** p<0.01, ** p<0.05, * p<0.1*

Supplement 1

Table 1: Sample characteristics at baseline

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variable	**Categories**	**C**	**T**	***p* val.**	**Female**	**Male**	***p* val.**	**Full sample**	**Video sample**	***p* val.**
Group	Control				31	24	.780	306	55	.550
	Treatment				29	25		340	54	
Child's Gender	Female	31	29	.780				266	60	.696
	Male	24	25					236	49	
Mother's birthplace	Germany	44	49	.113	50	43	.516	562	93	.633
	Other	11	5		10	6		84	16	
State	Bremen	25	29	.389	30	25	.916	165	54	.000
	Lower Saxony	30	25		30	24		231	55	
Partner	Present	40	36	.491	39	37	.235	442	76	.702
	Not Present	15	18		21	12		184	33	
Additional persons in Household	0	13	10	.578	14	9	.416	145	23	.922
	1	19	24		19	24		243	43	
	2+	17	15		17	15		192	32	
School/ Qualification	Degree	41	40	.955	42	39	.254	496	81	
	No Degree	14	14		18	10		144	28	.464
Occupational level	Unemployed	50	42	.059	51	41	.849	540	92	.966
	Employed	5	12		9	8		101	17	
Mother's Age (mean)		21.70	21.65	.480	21.55	21.83	.746	21.35	21.68	.466
Household income in € per Month (mean)		933.35	1,123.83	.093	976,99	1.079,57	.369	910.54	1,025.58	.052

Notes: Columns (3), (6) and (9) report p-values of tests for the equality of means of selected baseline characteristics between treated and controls in the video sample, between males and females in the video sample, and between the full baseline and the video sample, respectively. C = Control group, T = Treatment Group

Table 2: Correlation with Observable characteristics

	Overall	Girls	Boys	Wald Test	
	Child Orientation				
Low Birth Weight	-27.76*	-40.88***	14.11	1.81	*p* = .182
	(14.83)	(13.90)	(43.30)		
Cognitive Development 24m	0.62*	0.22	0.95*	1.36	*p* = .246
	(0.31)	(0.39)	(0.50)		
	Child Contingency Positive				
Low Birth Weight	9.49	0.76	30.11	0.76	*p* = .384
	(12.16)	(11.98)	(34.13)		
Cognitive Development 24m	-0.08	-0.27	-0.04	0.17	*p* = .683
	(0.27)	(0.34)	(0.44)		
	Child Contingency Negative-Lack				
Low Birth Weight	8.93*	7.00	29.00*	2.67	*p* = .106
	(4.89)	(4.46)	(14.52)		
Cognitive Development 24m	-0.25**	-0.20	-0.25	0.05	*p* = .827
	(0.11)	(0.12)	(0.20)		
	Mother Orientation				
Risk Depression	-25.88***	9.65	-32.68**	3.91	*p* = .051
	(9.41)	(16.45)	(12.27)		
	Mother Contingency Positive				
Risk Depression	-17.75*	11.05	-22.47**	2.47	*p* = .119
	(9.30)	(18.13)	(11.08)		
	Mother Contingency Negative-Lack				
Risk Depression	6.90	7.72	7.18	0.09	*p* = .769
	(5.52)	(9.11)	(7.95)		

*Notes: Risk Depression is a binary variable which is 1 if the mother shows symptoms of depression at the baseline, measured by the Depression Anxiety Stress Scale (DASS). Cognitive Development is measured by the Bayley Scales of Infant Development II (BSID-II). Low Birth Weight is a binary variable which takes value 1 if the birth weight was < 2500g. Wald Test t-statistics and p-values are for the equality of coefficients between male and female samples. *** p<0.01, ** p<0.05, * p<0.1.*

Table 3: Cross-Lagged Panel Probit Average Marginal Effects, Orientation

	Girls	Boys	Wald	p-value
		Child Equation		
Treat	0.087	0.001	0.78	0.378
	(0.061)	(0.077)		
Lag Child Orientation	0.327***	0.380***	0.76	0.383
	(0.046)	(0.042)		
Treat * Lag Child Orientation	-0.035	-0.026	0.01	0.920
	(0.059)	(0.069)		
Lag Mother Orientation	0.108**	0.177***	0.88	0.349
	(0.047)	(0.058)		
Treat * Lag Mother Orientation	0.043	-0.042	0.90	0.344
	(0.056)	(0.072)		
		Mother Equation		
Treat	-0.034	0.001	0.39	0.532
	(0.032)	(0.047)		
Lag Child Orientation	0.062**	0.135***	2.19	0.139
	(0.025)	(0.043)		
Treat * Lag Child Orientation	0.033	-0.049	1.71	0.191
	(0.027)	(0.058)		
Lag Mother Orientation	0.345***	0.417***	0.79	0.375
	(0.049)	(0.065)		
Treat * Lag Mother Orientation	0.049	-0.054	2.01	0.156
	(0.039)	(0.061)		
Rho	0.484***	0.574***	1.58	0.209
	(0.047)	(0.054)		
Observations	2,100	1,715		

Clustered Standard Errors in parentheses. Wald Test t-statistics and p-values are for the equality of coefficients between male and female samples. *** p<0.01, ** p<0.05, * p<0.1

Table 4: Cross-Lagged Panel Probit Average Marginal Effects, Contingency Positive

	Girls	Boys	Wald	p-value
		Child Equation		
Treat	0.002	0.037	0.17	0.679
	(0.054)	(0.066)		
Lag Child Contingency Positive	0.107***	0.282***	9.60	0.002
	(0.038)	(0.043)		
Treat * Lag Child Contingency Positive	0.123**	-0.110*	9.79	0.002
	(0.048)	(0.057)		
Lag Mother Contingency Positive	0.054*	0.071	0.09	0.768
	(0.030)	(0.047)		
Treat * Lag Mother Contingency Positive	-0.034	-0.049	0.03	0.855
	(0.046)	(0.067)		
		Mother Equation		
Treat	-0.001	0.043	0.17	0.679
	(0.053)	(0.057)		
Lag Child Contingency Positive	0.083***	0.135***	9.60	0.002
	(0.023)	(0.040)		
Treat * Lag Child Contingency Positive	-0.052	-0.101**	9.79	0.002
	(0.036)	(0.051)		
Lag Mother Contingency Positive	0.119***	0.222***	0.09	0.768
	(0.045)	(0.060)		
Treat * Lag Mother Contingency Positive	0.079	-0.085	0.03	0.855
	(0.056)	(0.072)		
Rho	0.256***	0.221***	0.26	0.612
	(0.039)	(0.057)		
Observations	2,100	1,715		

Clustered Standard Errors in parentheses. Wald Test t-statistics and p-values are for the equality of coefficients between male and female samples. *** p<0.01, ** p<0.05, * p<0.1

Table 5: Cross-Lagged Panel Probit Average Marginal Effects, Contingency Negative-Lack

	Girls	**Boys**	**Wald**	**p-value**
		Child Equation		
Treat	-0.032**	-0.035	0.01	0.936
	(0.013)	(0.023)		
Lag Child Contingency Negative-lack	0.080***	0.179***	4.35	0.037
	(0.030)	(0.038)		
Treat * Lag Child Contingency Negative-lack	-0.013	-0.016	0.01	0.938
	(0.020)	(0.029)		
Lag Mother Contingency Negative-lack	0.009	-0.002	0.07	0.794
	(0.021)	(0.036)		
Treat * Lag Mother Contingency Negative-lack	0.051	0.097	0.20	0.659
	(0.050)	(0.089)		
		Mother Equation		
Treat	-0.006	-0.012	0.05	0.832
	(0.019)	(0.021)		
Lag Child Contingency Negative-lack	-0.011	-0.040***	1.61	0.205
	(0.022)	(0.009)		
Treat * Lag Child Contingency Negative-lack	0.089	0.225**	1.41	0.236
	(0.068)	(0.096)		
Lag Mother Contingency Negative-lack	0.107**	0.208**	0.95	0.329
	(0.050)	(0.092)		
Treat Lag Mother Contingency Negative-lack	0.080	0.057	0.05	0.831
	(0.067)	(0.092)		
Rho	0.174	0.266***	0.35	0.555
	(0.132)	(0.083)		
Observations	2,100	1,715		

Clustered Standard Errors in parentheses. Wald Test t-statistics and p-values are for the equality of coefficients between male and female samples. *** p<0.01, ** p<0.05, * p<0.1

Table 6: Treatment Effects on Outcomes (Probit Average Marginal Effects)

	All	**Girls**	**Boys**	**Wald**
	Child Orientation			
Treat	0.04	0.15***	-0.09	9.47***
	(0.04)	(0.04)	(0.06)	*p* = .002
R^2				
C. Mean	0.49	0.48	0.52	
	Child Contingency Positive			
Treat	0.00	0.06	-0.07	3.63*
	(0.03)	(0.04)	(0.05)	*p* = .057
R^2				
C. Mean	0.57	0.58	0.56	
	Child Contingency Negative-Lack			
Treat	-0.04***	-0.034**	-0.04	0.075
	(0.01)	(0.02)	(0.02)	*p* = .785
R^2				
C. Mean	0.07	0.06	0.08	
	Mother Orientation			
Treat	-0.02	0.04	-0.09	3.10*
	(0.04)	(0.04)	(0.06)	*p* = .079
R^2				
C. Mean	0.81	0.82	0.80	
	Mother Contingency Positive			
Treat	-0.02	0.02	-0.07	1.58
	(0.03)	(0.04)	(0.05)	*p* = .209
R^2				
C. Mean	0.66	0.67	0.64	
	Mother Contingency Negative-Lack			
Treat	0.01	0.01	0.01	0.00
	(0.02)	(0.02)	(0.04)	*p* = .975
R^2				
C. Mean	0.05	0.05	0.05	
Obs.	3,924	2,160	1,764	

Supplement 2: Methods - Estimating Equations

Supplement 2: Methods - Estimating Equations

For the static analysis, we use the Probit model. Thus, we have for each mother-child pair i at each time point t, outcome y_{it} in raw format (binary), taking value 1 if a certain behavior is present in that interval. Thus, for the following 6 outcomes: Orientation, Contingency Positive and Contingency Negative-Lack (for child and mother separately) we use the following Probit model using clustered Standard Errors to account for the multiple observations over time:

$$\Pr(y_{i,t} \ = 1 | Treat_i) = \Phi(\beta_0 + \beta_1 Treat_i)$$

As the estimated coefficients in the Probit models are hard to interpret, we report the Average Marginal Effects which, since variable $Treat$ is binary, has the simple form:

$$\frac{1}{n}\sum_{i=1}^{n}\{\Phi(\hat{y}_i | Treat_i = 1) - \Phi(\hat{y}_i | Treat_i = 0)\}.$$

For the dynamic analysis, we model the following outcomes $y_{i,t}$: Orientation, Contingency Positive and Contingency Negative-Lack, observed for mother-child pair i at time point t, using the following cross-lagged panel Probit models:

$$\Pr(y_{i,t}^{C}) = \Phi\big(\beta_0^C + \beta_1^C Treat_i + \beta_2^C y_{i,t-1}^{C} + \beta_3^C Treat_i * y_{i,t-1}^{C} + \beta_4^C y_{i,t-1}^{M} + \beta_5^C Treat_i * y_{i,t-1}^{M}\big)$$

$$\Pr(y_{i,t}^{M}) = \Phi\big(\beta_0^M + \beta_1^M Treat_i + \beta_2^M y_{i,t-1}^{M} + \beta_3^M Treat_i * y_{i,t-1}^{M} + \beta_4^M y_{i,t-1}^{C} + \beta_5^M Treat_i * y_{i,t-1}^{C}\big)$$

Where $y_{i,t}^{C}$ is the outcome for the child and $y_{i,t}^{M}$ is the outcome for the mother, and similarly all the other covariates in the model with the superscripts C and M. These two equations are modelled together, and this is achieved in the estimation process by assuming jointly normal error terms across the two equations, such as:

$$\left(\begin{matrix}\epsilon_t^C \\ \epsilon_t^M\end{matrix}\middle| X^C, X^M\right) \sim N\left(\begin{matrix}0 \\ 0\end{matrix}, \begin{bmatrix}1 & \rho \\ \rho & 1\end{bmatrix}\right)$$

with the parameter ρ being estimated jointly with the rest of the coefficients. The Marginal Effects are calculated in the same way as before (for the static case), with the values for conditional variables being assigned according to Table 2 in the main text describing the different scenarios. In Tables 3-5 of supplement 1 we report the average marginal effects for every variable included in the model.

The gender Wald tests for all parts of the analysis in this study were performed on the fully saturated models and for the coefficient vector (β_M, β_F) and $Var(\beta_M, \beta_F)$, are:

$$W = (\beta_M, \beta_F)'[Var(\beta_M) + Var(\beta_F) - Cov(\beta_M, \beta_F)^2](\beta_M, \beta_F) \xrightarrow{D} \chi_1^2.$$