Maternal Regulation of Child Affect in Externalizing and Typically-Developing Children

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Abstract

Temporal contingencies between children's affect and maternal behavior play a role in the development of children's externalizing problems. The goal of the current study was to use a microsocial approach to compare dyads with externalizing dysregulation ($N = 191$) to healthy controls ($N = 54$) on maternal supportive regulation of children's negative and positive affect. Children were between the ages of 8 and 12 years. Mother-child dyads participated in conflict and positive discussions, and child affect and maternal supportive affect regulation were coded in real time. First, no group differences on overall levels of mother supportive regulation or child affect were found. Second, three event history analyses in a two-level Cox hazard regression framework were used to predict the hazard rate of (1) maternal supportiveness, and of children's transitions (2) out of negative affect and (3) into positive affect. The hazard rate of maternal supportiveness, regardless of child affect, was not different between groups. However, as expected, the likelihood of mothers' supportive responses to children's negative affect was lower in externalizing than comparison dyads. In addition, children with externalizing problems were significantly less likely than typically-developing children to transition out of negative affect in response to maternal supportiveness. The likelihood of both typically-developing children and children with externalizing problems transitioning into positive affect were not related to specific occurrences of maternal supportiveness. Results of the current study show the importance of temporal dynamics in mother-child interactions in the emergence of children's externalizing problems.

Keywords: parent-child interactions, externalizing problems, event history analysis, co-regulation

Maternal Regulation of Child Affect in Externalizing and Typically-Developing Children

Children with externalizing problems, such as aggression, oppositional behavior, and attention deficits/hyperactivity, have difficulties managing affect (Patterson, 1982; Rothbaum & Weisz, 1994). Affect regulation—also referred to as emotion regulation—is the process of modulating, initiating, or inhibiting the occurrence, intensity, or form of emotions, and is the basis of socioemotional functioning (e.g., managing negative affect, maintaining relationships) across the lifespan (Cole, Martin, & Dennis, 2004; Thompson, 1994). Children who have affect regulation difficulties, such as externalizing problems, are at risk for negative outcomes in adulthood such as poor-quality relationships, substance use, and unemployment (Capaldi & Stoolmiller, 1999). A primary, proximal factor in the emergence of children's externalizing problems is the parent-child relationship, and indeed, problematic aspects of this relationship are often the targets of interventions (Connell et al., 2008; Dadds, Barrett, Rapee, & Ryan, 1996; Dishion, Shaw, Connell, Wilson, & Gardner, 2008; Granic & Patterson, 2006; Rothbaum & Weisz, 1994).

Parents socialize children about the appropriate expression and regulation of affect in day-to-day interactions (Kopp, 1989; Morris, Silk, Steinberg, Myers, & Robinson, 2007). Parents scaffold children's affect regulation both by indirectly modeling affect regulation and by directly facilitating children's resolution of affect (Morris et al., 2007). Indeed, much of affect regulation occurs in interpersonal contexts, and interpersonal affect regulation with parents is one way through which children internalize their own self-regulation abilities (Campos, Walle, Dahl, & Main, 2011; Kopp, 1989). Parents' supportive regulation of children's affect—the use of strategies such as validation, reappraisal, and positive emotional directives to help children resolve negative affect and to maintain or enhance positive affect—facilitates children's learning

about affect self-regulation and children's social competence (Eisenberg, Fabes & Murphy,

1996; Fabes, Leonard, Kupanoff, & Martin, 2001; Gottman, Katz, & Hooven, 1996). Thus,

children's affect regulation emerges through day-to-day patterns of bi-directional affect

exchanges with parents, and the nature of parents' regulation of their children's affect is

associated with children's affective competence (Kopp, 1989). For example, dysregulated

parent-child interactions in which negative affect escalates but is not resolved are related to

children's affect dysregulation such as externalizing problems (Patterson, 1982). The aims of

current study were to compare mother-child dyads with children with externalizing problems to

dyads with typically-developing children on: (1) mothers' responses to children's negative and

positive affect with supportive regulation, and (2) children's affective responses (e.g., resolving

negative affect, eliciting positive affect) to maternal supportive regulation.

Parent-Child Interactions in Children with Externalizing Problems

Much of the research on parent-child interactions in children with externalizing problems

has taken a social learning theory approach, which involves examining aspects of interactions

that increase or decrease the likelihood of specific behaviors (Patterson, 1982). Research from

the social learning approach has focused on the contingency between parental disciplinary

practices and children's behavior, and on parental affective reactions to children's affect (e.g.,

Patterson, 1982; Schrepferman & Snyder, 2002; Snyder, Stoolmiller, Wilson, & Yamamoto,

2003). Parent-child interactions in dyads with children with externalizing problems have several

characteristics that differentiate them from dyads with typically-developing children. One

characteristic is a coercive interaction pattern, in which children refuse to comply with parental

demands until parents capitulate (Granic & Patterson, 2006). Such interactions, repeated over

time, both increase the likelihood of children's aversive behavior and decrease parents' ability to

help their children manage such behaviors. In terms of affective processes, mothers of children

with externalizing problems tend to show neutral or positive affect in response to their child's

negative affect, indicating maternal permissiveness (Granic & Lamey, 2002). Thus, from a social

learning theory perspective, parents' responses to their children reinforce children's negative

affect without resolving it, thereby perpetuating children's affect dysregulation (i.e., decreasing

the likelihood that children will be able to resolve negative affect; Granic & Lamey, 2002). In

addition, parents of children with externalizing problems tend to respond in harsh, yet

inconsistent ways to their children's affect, which makes it difficult for children to correctly

anticipate appropriate affective responses and therefore also to effectively self-regulate (Denham

et al., 2000; Eisenberg et al., 1999; Granic & Patterson, 2006; Patterson, 1982; Shipman et al.,

2007; Snyder et al., 2003).

　　　　While the vast majority of research on parent-child interactions in dyads with children

with externalizing problems has focused on coercive and harsh parenting processes, another

dimension of parenting—warmth and support—plays a role in children's externalizing problems

(McFayden-Ketchum, Bates, Dodge, & Pettit, 1996). Supportive processes scaffold children's

affect regulation by facilitating children's resolution of negative affect, and promoting and

maintaining positive affect (Gottman et al., 1996). Parents of children with externalizing

problems tend to show less warmth, affection, and support to their children than parents of

typically-developing children (Dadds et al., 1996; Lunkenheimer et al., 2007; McFayden-

Ketchum et al., 1996). However, past research that has examined supportive aspects of parent-

child interactions in dyads with children with externalizing problems have used either general

measures such as global ratings of interactions and questionnaires (e.g., Lunkenheimer et al.,

2007; McFayden-Ketchum et al., 1996) or have aggregated real-time observational codes into

total scores (e.g., Dadds et al., 1996). While it is important to understand general characteristics

of parent-child interactions in clinical populations, real-time processes are what give rise to

enduring patterns of psychosocial behavior, including externalizing dysregulation (Granic,

2005). Currently, parental supportive regulation of children's affect, as it occurs in the moment,

is not well understood in relation to children's externalizing problems. In addition, no studies to

date have examined the effect of parents' real-time regulation on changes in children's affect in

children with externalizing problems. The present study was designed to examine moment-to-

moment, bi-directional relationships between maternal supportive regulation and child affect in

the context of children's affect dysregulation (i.e., externalizing problems).

The Current Study

The current study extends previous research on parent-child interactions and

externalizing problems in three ways. First, the current study extends the social learning theory

approach to examine direct maternal supportive regulation of children's negative and positive

affect. Specifically, we examined if cycles of maternal supportive regulation and children's

affect resolution differentiates dyads with children with externalizing problems from those with

typically-developing children. Mothers of children with externalizing problems may tend not to

scaffold their children's affect with support, if such attempts tend to be unsuccessful. Second,

while much of the research on parent-child interactions and children's externalizing problems

has focused on global characteristics, the timing of maternal regulation and child affect was

incorporated in the current study to examine the real-time processes by which mothers facilitate

the resolution of their children's affect. Third, because research to date on the temporal dynamics

of parent-child interactions with children with externalizing problems has focused on parental

non-supportive (e.g., aversive, hostile) responses to children's affect (e.g., Snyder et al., 2003;

Stoolmiller & Snyder, 2004), mothers' supportive regulation of children's affect was the focus of the current study.

The objectives of the current study were to examine differences between dyads with typically-developing children and dyads with children with externalizing problems on the extent to which maternal supportive regulation and children's negative and positive affect are linked in time. Our first research question was whether there were differences in the temporal contingencies between maternal supportive regulation and children's affect between externalizing and typically-developing dyads. Parent-child interactions in dyads with children with externalizing problems are generally characterized by negative behaviors and affect (e.g., anger reactivity and hostility; Dadds et al., 1992; Snyder et al., 2003). Thus, it was hypothesized that mothers of children with externalizing problems would be less likely to respond supportively to children's negative and positive affect than mothers of typically-developing children.

Our second research question was whether there were differences in children's affective responses to maternal supportive regulation between externalizing and typically-developing mother-child dyads. That is, we wanted to know whether mothers' regulation attempts were successful. Dyads with children with externalizing problems tend to show less responsiveness and mutual problem solving than typically-developing children and difficulties resolving negative affect (Sanders, Dadds, Johnston, & Cash, 1992). Thus, it was hypothesized that children with externalizing problems would be less likely to respond to maternal supportive regulation by transitioning out of negative affect and into positive affect than typically-developing children.

The research questions were tested by event history analysis (EHA), a statistical method that estimates the likelihood of an event within a certain time frame and time-varying influences

on those events (Mills, 2011; Stoolmiller & Snyder, 2006). EHA was used in a multilevel

framework to examine differences between dyads with externalizing and typically-developing

children on the likelihood that: (1) mothers transitioned into supportive regulation states in

response to children's expressions of negative and positive affect, (2) children transitioned out of

negative affect in response to mothers' supportive regulation, and (3) children transitioned into

positive affect in response to mothers' supportive regulation. In the first EHA model, group

differences (externalizing versus typically developing) on the likelihood of mothers showing

supportive regulation were estimated from children's real-time expressions of negative and

positive affect. A greater likelihood of mothers' transitions into supportive regulation indicated

mothers' contingent, supportive scaffolding of children's affect. In the second and third EHA

models, the likelihood of children's transitions out of negative and into positive affective states,

respectively, was estimated from mothers' real-time supportive regulation. A greater likelihood

of children's transitions either out of negative affect or into positive affect indicated successful

maternal supportive regulation of children's affect and children's responsiveness to maternal

regulation.

Method

Participants

The current study used extant data from a larger study that examined the effects of an

aggression reduction program (see Granic, Meusel, Lamm, Woltering, & Lewis, 2012; Granic,

O'Hara, Pepler, & Lewis, 2007; Lichtwarck-Aschoff, Hasselman, Cox, Pepler, & Granic, 2012).

The current study consisted only of data collected prior to the start of the treatment program.

In the current study, the initial sample consisted of 304 parent-child dyads, with children

between the ages of 7 and 18 years ($M = 10.06$, $SD = 2.11$). However, as the majority of children

(85%) were between the ages of 8 and 12 years, we decided to maximize generalizability to pre-adolescence and minimize emotional maturation effects from confounding results by only including children between the ages of 8 and 12 in the analyses. Thus, 44 dyads were excluded based on child age. The sample consisted of children with externalizing problems who were referred to an aggression reduction program by mental health professionals, teachers, and parents ($N = 196$, 81% male) and a typically-developing comparison control group ($N = 64$, 65% male). Membership in the Externalizing group was determined by scores on the Externalizing subscale of the Childhood Behavior Checklist (CBCL; Achenbach, 1991a) and Teacher Report Form (TRF; Achenbach, 1991b). There were 3 child participants in the Externalizing group with sub-clinical levels of externalizing problems (T-score between 54 and 59 on the Externalizing subscale of the CBCL and TRF) and 2 participants with missing data on both the CBCL and TRF who were excluded from analyses. Participants in the Comparison group were recruited through newspaper advertisements. Of the 64 participants in the Comparison group, 10 child participants scored highly on either the CBCL or TRF (T-score of 60 or greater) and were excluded from analyses. Thus, the overall sample consisted of 245 parent-child dyads with children aged 8 to 12 years ($M = 9.55$, $SD = 1.20$, 77% male), the final Externalizing group consisted of 191 participants (81% male), and the final Comparison group consisted of 54 participants (59% male).

Participants identified ethnicities as European (69%), African/Caribbean-Canadian (15%), Asian-Canadian (3%), Latin American-Canadian (3%), Native-Canadian (2%), South Asian-Canadian (2%), and Other (6%). Children lived with their mother only (38%), with both biological parents (36%), their mother and a step-parent (12%), adoptive parents (4%), both parents with joint custody (2%), their father and a step-parent (1%), or with another legal

guardian (e.g., grandparents, foster parents, extended family members), (7%). Approximately

17% of families had an annual income less than $20,000 per year, 22% had an annual income

between $20,000 and $39,000, 21% had an annual income between $40,000 and $59,000, and

40% had an annual income greater than $60,000. A Chi square analysis showed that participants

in the Comparison group differed significantly from participants in the Clinical groups on race,

X^2 (6) = 60.17, p < .001. Approximately 77% of participants in the Clinical group identified

ethnicity as European versus 41% in the Comparison group. The Comparison and Clinical

groups did not differ on family income, X^2 (7) = 10.87, p = .14. An independent-samples t-test

showed that groups differed significantly on age, t(243) = -2.13, p =.03. The Control group (M =

9.85, SD = 1.39) was significantly older than the Externalizing group (M = 9.46, SD = 1.13).

There were more males in the Externalizing group than the Comparison group, X^2(1, N = 245) =

11.17, p = .00. Informed consent was obtained from caregivers prior to participation in the study,

and families received $10 for participating.

Procedure

      Laboratory procedure. Prior to beginning the lab procedure, mothers provided informed

consent and children provided assent to participate. All procedures were reviewed and approved

by the institutional Office of Research Ethics. Mother-child dyads participated in videotaped

observational sessions that consisted of three different problem-solving discussions (positive

topics and topics of interpersonal conflicts). The first and last discussions were of a positive

topic. The first positive topic was designed to be a warm-up task, and thus only the conflict and

final positive discussion were the focus of the current study. The conflict discussion was on an

area of conflict that was identified by the parents and children to be currently distressing.

Conflict discussions lasted for 6 minutes. For the positive discussion, dyads were instructed to

brainstorm a fun hypothetical activity such as planning a party, which lasted for 4 minutes.

Observational sessions were conducted in the participants' own homes, usually with dyad

members seated at a kitchen table beside each other, or in a laboratory, with participants facing

each other. There were no significant differences on key variables based on location.

Measures

Issues Checklist. A modified version of the Issues Checklist (Robin & Weiss, 1980) was

filled out by both members of the dyad prior to the discussion tasks in order to determine the

conflict discussion topic. The Issues Checklist lists 18 items that are common issues between

children and parents, such as cleaning, lying, and fighting with siblings. Both dyad members

identified whether they had argued about each item, and if so, rated how upset they currently felt

about it on a 5-point scale. The conflict discussion was chosen from the dyad's three most

upsetting issues.

Child Behavior Checklist. The CBCL (Achenbach, 1991a) is a parent-report measure of

children's emotional and behavioral problems. The CBCL contains 113 items that are scored on

a 3-point scale (0 = *not true* to 2 = *often true*). Scores on subscales for total problems,

externalizing problems, and internalizing problems yield standardized *T*-scores. The 33-item

externalizing subscale, used in the current study, assesses symptoms such as aggressiveness,

hyperactivity, and noncompliance. Children in the Externalizing group had a mean score of

71.99 (*SD* = 6.43) and children in the Comparison group had a mean score of 47.87 (*SD* = 7.49)

on the CBCL.

Teacher Report Form. The TRF (Achenbach, 1991b) is a parallel form to the CBCL

that is completed by teachers rather than primary caregivers. As with the CBCL, it yields scores

on subscales for total problems, externalizing problems, and internalizing problems as

standardized *T*-scores. The externalizing subscale, used in the current study for children in the Externalizing group only, assesses symptoms such as aggressiveness, hyperactivity, and noncompliance. Children in the Externalizing group had a mean score of 66.42 (*SD* = 10.29) on the TRF.

Child affect. All videos were previously coded for affect with a 10-code version of Specific Affect Code (SPAFF; Gottman, McCoy, Coan, & Collier, 1996), an observational coding system that captures expressed positive and negative affect in real time. The 10 SPAFF codes were Contempt, Anger, Whine, Sad, Fear, Neutral, Joy, Interest, Humor, and Affection. SPAFF coding was completed by a team of four undergraduate research assistants using Noldus Observer 5.0. The onset and offset times for all codes were applied to children and were recorded continuously in real time. The reliability of SPAFF coding was good, with the average percent agreement for frequency-sequence-based analyses of 83% and κ = .76, and an average percent agreement for duration-sequence-based analyses of 90%. As children's externalizing problems are often accompanied by internalizing symptoms, which influence expressions of both externalizing (Contempt, Anger) and internalizing affect (Whine, Sad, Fear; Angold et al., 1999; Dadds et al., 1996), SPAFF codes Contempt, Anger, Whine, Sad, and Fear were collapsed into Child Negative Affect. SPAFF codes Joy, Interest, Humor, and Affection were collapsed into Child Positive Affect. These negative and positive categories, derived from previous uses of the SPAFF in the literature (e.g., Hollenstein & Lewis, 2006) were used to identify episodes of children's negative affect (NA) and positive affect (PA), children's transitions out of NA, and children's transitions into PA (see Derivation of Measures).

Mother supportive regulation. Mother-child interactions were coded by a team of four undergraduate research assistants using the Co-Regulation (CORE) observational coding system

(Lougheed & Hollenstein, 2011) which is based on verbal content and accompanying verbal tone

and body language and is used to capture regulation behaviors directed at interaction partners in

real time. The 11 mutually-exclusive code categories are: Negative Emotional Directive, Positive

Emotional Directive, Invalidation, Validation, Avoidance, Reappraisal, Negative Emotion Talk,

Positive Emotion Talk, Problem Definition, Solution-Focused Problem Solving, and No Co-

Regulation. The CORE coding scheme was applied using Noldus Observer 5.0. The onset and

offset times for all codes were applied to parents and were recorded continuously in real time,

but only the supportive regulation codes were of interest in the current study. Overall, reliability

was good with frequency-sequence-based percent agreement of 81% and $\kappa = .77$, and duration-

sequence-based percent agreement of 84%. Positive Emotional Directive (e.g., reassurances that

directly target affect, "You should feel proud of yourself"), Validation (e.g., expressions of

support, empathy, or approval), and Reappraisal (e.g., attempts to modify the appraised

significance of an issue to be more positive) were aggregated for Mother Supportive Regulation

because of their functional equivalence, as these three behaviors all involve providing

acknowledgement, support, and active involvement in helping children to resolve negative affect

or maintain positive affect (Eisenberg et al., 1996; Fabes et al., 2001; Gottman et al, 1996;

Lunkenheimer, Shields, & Cortina, 2007; Morris et al., 2007; Morris et al., 2011).

   Derivation of measures. After child affect and mother supportive regulation were coded

in real time, quantitative variables for preliminary analyses and EHA were derived using

GridWare (Lamey, Hollenstein, Lewis, & Granic, 2004), a computer program that derives

quantitative measures from categorical time series data. First, affect and regulation coding files

from Observer 5.0 (odfs) for each dyad were separately converted by the GridWare File

Converter into tab-delimited text files with one column of onset times and separate columns for

each coding variable (trajectory files). Next, these separate affect and regulation trajectory files were merged together into time-synchronized trajectory files for each dyad with three columns of data containing: (1) onset times for each coded behavior, where each row represents a new regulation/affect combination, (2) mother regulation behavior events, and (3) child affect events. The column of onset times was used to derive both the frequency and duration of each new combination of child affect and mother regulation, as each new event row indicates both the onset of a new behavior and the offset (i.e., transition out of) the previous behavior.

For preliminary analyses, the frequency and duration of combined Child Negative and Positive Affect codes, and Mother Supportive Regulation codes were exported from GridWare (Lamey et al., 2004) for preliminary group comparisons. The frequency was derived for each dyad from the total number of child affect and mother regulation events. Therefore, the frequency reflects the number of transitions for each variable. The duration was derived from the total length of time of child affect and mother regulation events. The text trajectory files used for GridWare were further transformed for EHA; onset and offset times of child affect and mother regulation categorical time series data were used to define time-varying covariates and dependent variable transitions (Mills, 2011; Stoolmiller & Snyder, 2006) using a Visual Basic macro developed by and available from the corresponding author. After appending all the files into one, long data file, binary data were calculated from the columns for child negative and positive affect and mother regulation for each row, with 1 indicating the occurrence of child affect or mother regulation events and 0 indicating their non-occurrence in a given row. Then, from the binary-recoded data, EHA variables were computed in the following manner: for dependent variables (mothers' transitions into Supportive Regulation, children's transitions out of NA, and children's transitions into PA), 1s were used to indicate the transition point into each event of interest, 0s to

indicate any other state, and a missing value indicator to act as a place holder during the duration of the event. For time-varying covariates, the macro calculated the occurrences of the covariate for each row, with 1s indicating the occurrences of the covariate in a given row and 0s indicating the occurrence of any other state in a given row. A Time to Event variable was calculated from each row of data to indicate the time until dependent variables and covariates transitioned into a dependent or covariate state, respectively. The Time to Event variable (e.g., time until mother supportive regulation) was used to estimate hazard rates in the EHA, as detailed further below.

Results

Descriptive Statistics and Preliminary Analyses

Table 1 shows the descriptive statistics for the frequency and duration of Mother Supportive Regulation, Child NA, and Child PA, indicating the average number of transitions per group per variable and the average amount of time observed within the 10-minute observation for each variable, respectively. Because distributions were skewed with some outliers, preliminary analyses were run with bootstrapping. Bootstrapping is a non-parametric approach that approximates sampling distributions by resampling from the data with replacement, rather than relying on assumptions based on the normality of the theoretical sampling distribution (Efron, 1979; Mooney & Duval, 1993). Bootstrapping was performed with IBM SPSS version 20, and was used to test group differences on Mother Supportive Regulation, Child NA, and Child PA with analyses of variance (ANOVAs).

Six one-way ANOVAs were used to test group differences on (1) the frequency of Mother Supportive Regulation, Child NA, and Child PA, and (2) the total duration of Mother Supportive Regulation, Child NA, and Child PA. No significant group differences were found on the frequency of Mother Supportive Regulation, Child NA, and Child PA. Significant group

differences were also not found on the total duration of Mother Supportive Regulation, Child

NA, and Child PA.

Event History Analysis

EHA is a Cox hazard regression model that estimates the likelihood of the occurrence of

repeating events by estimating the hazard rate (Mills, 2011; Stoolmiller & Snyder, 2006). The

hazard rate is the conditional probability that an event occurs within a given time interval (Mills,

2011; Stoolmiller & Snyder, 2006). In the current study, three multilevel EHA models were run

to test hypotheses. The first model tested the probability that mothers transitioned into

Supportive Regulation given Child NA and Child PA. The second model tested the probability

that children transitioned *out of* NA given Mother Supportive Regulation, and the third model

tested the probability that children transitioned *into* PA given Mother Supportive Regulation.

Thus, the events of interest (i.e., dependent variables) were (1) mothers' transitions into

Supportive Regulation, (2) children's transitions out of NA, and (3) children's transitions into

PA. EHA makes it possible to study the impact of time-varying covariates, which vary across the

observation period, on the event occurrences (Stoolmiller & Snyder, 2006). Child NA and Child

PA were included simultaneously as time-varying covariates in Model 1 to test the hazard rate of

Mother Supportive Regulation in relation to occurrences of Child NA and Child PA. Mother

Supportive Regulation was included as a time-varying covariate in Models 2 and 3 to test

whether there were group differences on the influence of mothers' supportiveness on children's

transitions out of NA and into PA. Time-invariant covariates, which do not vary across the

observation period, can also be included in EHA (Stoolmiller & Snyder, 2006). Age and sex

were included as time-invariant covariates in all models to control for group differences. For all

models, at the within level, the hazard rate of the dependent variables on time-varying covariates

were estimated as a slope for each dyad. Then, at the between level, group differences on these slopes, and effects of time-invariant covariates, were included. All EHA models were tested initially on the conflict and positive discussion separately. However, as no differences in the direction of effects were found on the different tasks, the final EHA models reported were run on the tasks included together, as done in previous studies (e.g., Snyder et al., 2003) to increase power.

EHA was modeled in a two-level Cox hazard regression framework using Mplus version 7 (Muthén & Muthén, 2012). The primary statistic for interpretation in the Cox model is the *hazard ratio*, which is defined as the exponentiated hazard rate estimated by the model (Mills, 2011). The hazard ratio is the multiplicative increase in the hazard rate of the dependent variable per unit increase in time-varying covariates (Snyder et al., 2003). A value greater than 1 indicates that the parameter is associated with an increased hazard of the event, a value of 1 indicates no association between the parameter and the hazard, and a value less than 1 indicates that the parameter is associated with a decreased hazard of the event (Mills, 2011). A percent change in the hazard ratio can be calculated by subtracting 1 from the hazard ratio and multiplying the outcome by 100 (Mills, 2011). The percent change in hazard is useful for interpretation and indicates the percentage by which the rate of the dependent variable changes per occurrence of the time-varying covariate (Mills, 2011).

Mother supportive regulation of child NA and PA. Table 2 shows the parameters for the model of the overall hazard rate and contingent hazard rate of Mother Supportive Regulation on Child NA and PA. The intercepts for Child NA and PA were non-significant, indicating that overall, Child NA and PA did not predict Mother Supportive Regulation in the full sample. Consistent with the preliminary analyses, the rate at which mothers displayed Supportive

Regulation did not differ between groups, as shown by the non-significant coefficient for group predicting the overall hazard rate ($b = -.05$, $p = .60$). However, as expected, when tested in relation to occurrences of Child NA, the Externalizing group showed a significantly lower hazard rate of Mother Supportive Regulation than the Comparison group, indicating that mothers in the Externalizing group had a lower probability of transitioning into Supportive Regulation during their child's expression of NA than the Comparison group ($b = -.56$, $p = .05$). The percent change in the hazard for the Externalizing group indicated that they had almost half (42%) the hazard for transitioning into Mother Supportive Regulation after occurrences of Child NA than the Comparison group. There was no significant group difference for mothers' probability of transitioning to Supportive Regulation following Child PA ($b = .44$, $p = .10$).

Children's transitions out of NA in response to mother supportive regulation. Table 3 shows the parameters for the model of the overall hazard rate and contingent hazard rate of children's transitions out of NA in response to Mother Supportive Regulation. The intercept of children's transitions out of NA was not significant, indicating that Mother Supportive Regulation did not predict children's transitions out of NA in the full sample. Contrary to expectations, the overall rate at which children transitioned out of NA did not differ between groups ($b = -.05$, $p = .23$). However, in line with expectations, groups did differ on the likelihood of children's transitions out of NA in relation to occurrences of Mother Supportive Regulation ($b = -1.43$, $p = .03$). Children in the Externalizing group were 76% less likely than the Comparison group to transition out of NA in response to Mother Supportive Regulation.

Children's transitions into PA in response to mother supportive regulation. Table 4 shows the parameters for the model of the overall hazard rate and contingent hazard rate of children's transitions into PA in response to Mother Supportive Regulation. The intercept of

children's transitions into PA was significant, indicating that Mother Supportive Regulation was

negatively associated with children's transitions into PA in the full sample. Contrary to

expectations, there were no differences between groups on either the rate at which children

transitioned into PA overall ($b = -.06$, $p = .60$) or in response to Mother Supportive Regulation ($b = .23$, $p = .69$), but males were less likely than females to transition into PA ($b = -.25$, $p = .01$).

There were no group or sex differences on the likelihood of children's transitions into PA in

relation to occurrences of Mother Supportive Regulation.

Discussion

The goal of the current study was to examine real-time, bi-directional temporal dynamics

between mothers' supportive affect regulation and children's negative and positive affect in the

context of children's externalizing problems. Externalizing and typically-developing groups did

not differ on overall levels of mother supportive regulation, and child negative and positive

affect. Rather, groups differed when mothers' specific regulatory attempts were examined in

relation to children's expressions of affect in real time, with mothers of children with

externalizing problems being less likely to respond with support to children's negative affect

than mothers of typically-developing children. In addition, children with externalizing problems

were less likely than typically-developing children to transition out of (resolve) negative affect in

response to mothers' supportive regulation. Maternal supportiveness was not associated with

children's up-regulation of positive affect in either group, but regardless of maternal regulation,

males were less likely than females to transition into positive affect.

Mothers' Supportive Regulation of Children's Affect

Mothers of children with externalizing problems only differed from mothers of typically-

developing children on supportiveness when faced with children's negative affect, and not on the

overall use of supportiveness. Thus, the effectiveness of supportive regulation may depend less

on its general use and more on its contingent use in response to children's specific affect

expressions (Granic, 2005; Westphal, Seivert, & Bonanno, 2010). This result is a direct test of,

and supports, the social learning theory idea that a lack of consistent parental responding is one

mechanism involved in children's externalizing problems (Granic & Patterson, 2006). Recent

research suggests another possible reason for this finding is related to maternal self-regulation

(Bridgett, Burt, Laake, & Oddi, 2013). Mothers of children with externalizing problems have

more difficulty with self-regulation than mothers of typically-developing children, which may

make it less likely for mothers to respond with supportive regulation to their children's affect.

Children's Affect Transitions in Response to Mother Supportive Regulation

In line with expectations, children with externalizing problems were less likely than

typically-developing children to transition out of negative affect in response to maternal

supportive regulation. That is, for children with externalizing problems, mothers' attempts to

supportively regulate their child's negative affect were less successful than regulation attempts of

mothers of typically-developing children. By mid-childhood, children with externalizing

problems might not respond to supportive regulation if their negative affect typically has not

been regulated this way in their family environment. Finally, groups did not differ on children's

transitions into positive affect in response to maternal supportive regulation. Children's

externalizing problems might have more to do with negative affect dysregulation than positive

affect dysregulation (Kim, Walden, Harris, Karrass, & Catron, 2007).

The finding that groups did not differ on overall levels of mother supportive regulation

and child affect should be interpreted with caution, as this is inconsistent with substantial

previous research (e.g., Dadds et al., 1996; Patterson, 1982; Verhoeven, Junger, van Aken,

Deković, & van Aken, 2010). However, previous studies have assessed mother supportive

regulation and child affect through interviews, self-report measures, or global ratings of

observational data, methods through which higher frequencies and lower variability are obtained.

It is possible that there are meaningful differences between groups on these variables but they

were not manifest in our sample given our microsocial approach and relatively short observation

period. It is also possible that group differences were not manifest given the relatively low

occurrence of mother supportive regulation and child affect—the discussion task might not have

been evocative enough to elicit sufficient levels of these behaviors.

Implications for Theory and Intervention

One strength of the current study is the use of a real-time statistical approach to mother-

child interactions. In accordance with social learning theory, this approach allowed us to directly

test interpersonal dynamics involved in children's externalizing problems. From the social

learning theory perspective, moment-to-moment patterns of parent-child interactions that recur

over time eventually stabilize into enduring characteristics such as externalizing problems, which

in turn contribute to behavior in interpersonal interactions (Granic & Patterson, 2006). The result

is a dyadic feedback system in which it becomes increasingly difficult to change behavior

patterns (Granic & Patterson, 2006). Mothers of children with externalizing problems could be

less likely to supportively regulate their children's negative affect if they have learned over time

that these strategies do not tend to result in changes in their children's negative affect, and

children might not respond to supportiveness if it is uncommon in their household. According to

social learning theory, this mother-child interaction pattern will continue to become more stable

over time, indicating the importance of early intervention in children's externalizing problems.

Taken together, the results of the current study point to specific maternal behaviors, as they occur in the moment, as an important focus for clinical intervention for children's externalizing problems. Specifically, educating parents of children with externalizing problems with respect to *when*, and not just *how*, to be supportive of their children's affect may ameliorate children's externalizing problems. In addition, treatments that target children's externalizing problems such as Parent Management Training (e.g., Kazdin, 2005) often focus on children's behaviors. The current results suggest that refocusing interventions to also include children's affect may also be successful.

Limitations and Future Directions

There are several important limitations of the current study to note. First, children's affect displays were aggregated into valence (negative or positive), which prevented examination of mothers' differential regulatory responses to children's discrete affect (e.g., anger versus sadness). Parents of children with externalizing problems differ from parents of typically developing children in their differentiated responses to children's diverse emotions (Rydell et al., 2003; Snyder, Brockman, & Stoolmiller, 2012). However, due to the relatively short observation period and the relatively low base rates of observed maternal and child behaviors in the current study, we could not assess the temporal relationships between maternal supportive regulation and children's specific affect. Future research should use longer observational periods to examine real-time relationships between parental supportive regulation and children's specific affect.

In addition, only children's expressed affect, and not their subjective experience, was captured. Children could have felt positive and negative affect without expressing it (Smith, Hubbard, & Laurenceau, 2011), and indeed, experienced affect is likely more salient for social learning. In addition, the observational coding did not capture the intensity of affect, nor were

transitions between affect of similar valence (e.g., anger and sadness) examined. In the current study, children's transitions between affective states represented changes in affect along a continuum from more negative to more positive. Thus, affect regulation in the current study should be regarded as a general indicator of affect changes, and future research should incorporate more nuanced indicators of affect regulation including affect intensity, experienced affect, and changes between affect of the same valence.

Another limitation concerns sex differences. One issue is that the sample consisted only of mothers, but interactions with other relationship partners play a role in the development of children's affective competence (Gottman et al., 1996). As mothers typically provide more support and caregiving and fathers provide more instrumental care and play (Trautmann-Villalba, Gschwendt, Schmidt, & Laucht, 2006), fathers may have particular difficulty with helping children to resolve negative affect, and therefore contribute to the real-time dynamics associated with children's externalizing problems. Another issue is that our sample included a relatively small number of female children, meaning that we could not fully assess whether or not the real-time parent-child processes we examined vary by gender. As previous research has identified gender differences on externalizing problems (Broidy et al., 2003), it will be important for future research to more thoroughly examine the role of gender in the temporal aspects of parent-child interactions that are associated with children's externalizing problems.

It is also important to examine the role of parent-child interactions in the heterogeneity of externalizing developmental trajectories. Some children show externalizing problems from childhood, whereas others a sudden onset at adolescence (Moffitt, Caspi, Harrington, & Milne, 2002). Future studies could prospectively examine temporal dynamics in parent-child interactions to identify early indicators of early- versus late-onset externalizing problems.

Longitudinal designs could also identify whether there are periods during child development in which the dynamics of parent-child interactions have an increased likelihood of taking on patterns associated with the development of externalizing problems. For example, parent socialization of children's affect in toddlerhood is one factor that influences older children's affect regulation (Verhoeven et al., 2010), and it would be valuable to learn what parent-child interaction patterns in toddlerhood lead to the bidirectional associations observed in the current study. Research employing both microsocial and longitudinal approaches would inform treatment research by identifying sensitive developmental periods for intervention, as well as specific, real-time aspects of parental responses to children's affect that increase or decrease the likelihood of children's externalizing problems.

Conclusion

The temporal dynamics of mother-child interactions during day-to-day interactions shape children's affective competence over time. The current study showed that maternal difficulties using supportive regulation strategies contingently and in optimal affect contexts may be related to their lack of effectiveness (i.e., children do not respond to supportive efforts by transitioning out of negative affect), and that this bidirectional relationship may be one factor related to children's externalizing dysregulation. Continued investigations of the temporal dynamics of parent-child interactions will clarify the specific processes by which externalizing problems emerge and are maintained.

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Table 1

Means and Standard Deviations of the Frequency and Total

Duration (seconds) of Mother Supportive Regulation, Child NA,

and Child PA

	Externalizing	Comparison
Frequency		
Mother Supportive Regulation	9.02 (5.40)	9.28 (6.70)
Child NA	3.34 (4.13)	3.30 (3.58)
Child PA	4.99 (3.70)	5.83 (4.01)
Duration		
Mother Supportive Regulation	24.62 (19.70)	24.33 (22.68)
Child NA	26.00 (53.76)	12.17 (18.99)
Child PA	20.53 (17.22)	22.79 (21.21)

Note. Standard deviations in parentheses. NA = Negative affect,

PA = Positive affect.

Table 2

Hazard Rate Estimates for Mother Supportive Regulation of Child NA and PA

(Model 1)

	Estimate	Standard Error	Estimate/ Standard Error	*p*	Hazard Ratio	95% Confidence Interval Lower	Upper
Child NA Intercept	.33	.24	1.38	.17	1.39	.87	2.23
Child PA Intercept	-.37	.26	-1.45	.15	.69	.41	1.15
Overall Hazard Rate							
Age	-.01	.03	-.18	.86	.99	.93	1.05
Sex	.00	.08	-.02	.99	1.00	.85	1.17
Group	-.05	.09	.52	.60	.95	.80	1.13
Effect of Child NA on Hazard Rate							
Group	-.56	.28	-1.99	.05	.57	.33	.99
Effect of Child PA on Hazard Rate							
Group	.44	.27	1.64	.10	1.55	.91	2.64

Note. Comparison group = 0, Externalizing group = 1. Female = 0, Male = 1. NA = negative affect,

PA = positive affect. Effects of Child NA and PA estimated simultaneously.

Table 3

Hazard Rate Estimates for Children's Transitions out of NA in Response to Mother

Supportive Regulation (Model 2)

	Estimate	Standard Error	Estimate/ Standard Error	*p*	Hazard Ratio	95% Confidence Interval	
						Lower	Upper
Intercept	-.53	.78	1.05	.50	.59	.13	2.72
Overall Hazard Rate							
Age	.11	.08	1.38	.17	1.11	.95	1.31
Sex	-.24	.21	-1.16	.25	.79	.52	1.19
Group	-.05	.21	-.23	.23	.95	.63	1.44
Effect of Mother Supportive Regulation on Hazard Rate							
Group	-1.43	.68	-2.12	.03	.24	.06	.91

Note. Comparison group = 0, Externalizing group = 1. Female = 0, Male = 1. NA = Negative

Affect.

Table 4

Hazard Rate Estimates for Children's Transitions into PA in Response to Mother Supportive

Regulation (Model 3)

	Estimate	Standard Error	Estimate/ Standard Error	*p*	Hazard Ratio	95% Confidence Interval Lower	Upper
Intercept	-1.10	.53	-2.08	.04	.33	.12	.94
Overall Hazard Rate							
Age	.03	.04	.71	.48	1.03	.95	1.11
Sex	-.25	.10	-2.49	.01	.78	.64	.95
Group	-.06	.12	-.53	.60	.94	.74	1.19
Effect of Mother Supportive Regulation on Hazard Rate							
Group	.23	.56	.41	.69	1.26	.42	3.77

Note. Comparison group = 0, Externalizing group = 1. Female = 0, Male = 1.