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Post-Natal Effects of Maternal Cigarette Smoking and Family Dynamics on Child Behaviours

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Abstract

This study examined the relationship between maternal smoking (smoking during pregnancy) and child behavior problems, while considering other possible contributors to child behavior, namely parenting stress, family stability, life stress, family income, and parental education. In order to determine how smoking and non-smoking families may vary, this study also investigated differences between smoking and non-smoking families with respect to various descriptive and demographic characteristics, including environmental tobacco smoke exposure (ETS) throughout development. Participants included mothers with children ages four to six years who either smoked during pregnancy, or did not.

Results revealed a significant dose dependent relationship between smoking during pregnancy (maternal smoking) along with post-natal ETS exposure, and behavioral problems in children. No significant differentiation was found between the families of smoking and non-smoking mothers and their parenting stress, family stability, parental education or family income. However, results did indicate that families of mothers who smoked during pregnancy experienced more life stressors in the past year than families of non-smoking mothers. Overall maternal smoking and non-smoking families were similar on most of the descriptive and demographic variables with the exception of divorce rates, which were significantly higher in smoking mother families. Although parenting stress, family stability, parental education and family income were found to significantly contribute to child behavioral problems, smoking and non-smoking families were not distinguishable on these variables. Maternal smoking status, however, emerged as a significant unique predictor of post-natal behavioral problems.

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Post-Natal Effects of Maternal Cigarette Smoking and Family Dynamics on Child Behaviours

Tobacco smoke contains over 4000 chemical compounds, of which few have been tested for adverse effects on child development (Naeye, 1992). Yet, despite evidence of the teratogenic effects of maternal smoking (smoking during pregnancy) and the subsequent warnings placed on cigarette packaging, it has been reported that approximately one third of women of reproductive age smoke on a regular basis in Canada (Gilmore, 2000). Findings also indicate that 57% of the women who smoke do so heavily, as compared to only 31% of men (Statistics Canada, 1988). This statistic is all the more concerning because cigarette use during pregnancy has been shown to have a dose-dependent relationship to detrimental outcomes (Naeye & Peters, 1984). It has been postulated that while many smokers have switched to cigarettes with lower tar and nicotine levels, they nevertheless tend to smoke more cigarettes (Fried, 1992). Research has shown that the negative outcomes of maternal smoking may be due in part to the fetus's exposure to carbon monoxide (Slotkin, 1992). Thus, regardless of whether pregnant women are smoking low tar and nicotine cigarettes, the fact they are smoking more cigarettes will increase the amount of carbon monoxide the fetus is exposed to and increase the risk of hypoxia (Naeye, 1992).

Research in this controversial field has only just begun to uncover some of the deleterious effects maternal smoking may have on children. Initially, research focused on the physiological effects of maternal cigarette smoking with respect to growth retardation (Picone, Allen, Olsen, & Ferris, 1982; Jacobson, Fein, Jacobson, Schwartz, Dowler, 1984), stillbirth (Risch, Weiss, Clarke & Miller, 1988), and perinatal death (Cnattingius, Hagland, & Meirik, 1988). However, it has only been in the last few decades that

researchers have begun to focus their efforts on understanding the possible neuro-developmental and behavioral outcomes. The relationship between lowered cognitive skills, increased behavioral problems and smoking during pregnancy has been systematic and consistent (Rush and Callahan, 1989). Although the impairments linked with maternal smoking during pregnancy are wide spanning and statistically significant, the strength of the association is small.

The issue of establishing causality among a myriad of factors is one which plagues this field of research. In a review of the criteria of causation for the adverse effects of prenatal exposure to cigarettes on pregnancy outcomes, Walsh (1994), established the following parameters: is there evidence of a consistent, strong association; is there evidence from true experiments in humans; and is there a dose-response gradient? Each of these criteria will be discussed and utilized to elucidate the nature of the relationship between prenatal cigarette exposure and child development.

Evidence for a Consistent Association and the Strength of Effect

Maternal cigarette smoking has been consistently linked to a number of adverse pregnancy outcomes, however, researchers are cautious in positing a causal relationship due to numerous complex variables which also affect child development (Fried, 1992). Among the major limitations and criticisms related to these studies is that there are numerous confounding factors that may also account for the outcomes observed. Variables that have been partialled out in studies as confounding factors include: other drug use, family income and education, nutrition, maternal age, parity, race, sex of the child, mother's marital status, passive smoking and home environment (Fried &

Watkinson, 1988; Makin, Fried, & Watkinson, 1991; Naeye & Peters, 1984). Recent research has attempted to control for such factors and has still found consistent support for the teratogenic effects of cigarette smoking (Fried, 1992).

Confounding Factors which Affect the Strength and Consistency of an Association

Effects of the Home Environment on Child Development. One prominent confounding factor that has emerged from several studies is that women who smoke cigarettes during their pregnancy tend to differ from non-smokers on a number of variables that may potentially influence subsequent child development (Rush and Callahn, 1989). Women who smoke reportedly drink more alcohol and coffee, have higher anxiety scores, divorce more often, and change jobs more frequently than non-smokers (Naeye and Peters, 1984; Yerushalmy, 1971). Relative to non-smoking mothers, women who smoked during pregnancy that participated in research conducted through the Ottawa Prenatal Prospective study were younger in age, had less formal education, lower maternal and paternal occupational status, and lower family income (Fried, 1992).

Research by Rantakallio (1983) examined the long-term effects of smoking during pregnancy on children up to the age of 14 and found that smoking mothers differed from non-smoking mothers matched on the basis of social class. The participants included Finnish women who smoked during pregnancy matched with non-smoking mothers with the same number of children, marital status, age, parity, and place of residence. Fourteen years after having given birth, within each social class strata, smoking mothers tended more often to be unemployed, to not live with their family, to be on sick leave or pension, or to be deceased. Thus, being a smoking mother was associated with negative conditions for child development. Rantakallio concluded from

these results that mothers who smoke may not be as capable of caring for their children. Thus, these studies indicate that it is imperative that while determining the relationship between maternal smoking during pregnancy and child development, differences in home environment should be critically examined.

Fried and Watkinson (1988) examined neurobehavioral effects of maternal cigarette smoking on 12 and 24 month children to assess the effects of the home environment and parental involvement. Scores on the Home Observation for Measurement of the Environment scale (HOME, Caldwell and Bradley, 1979) showed a strong negative correlation with maternal smoking during pregnancy. More specifically, the subscales measuring maternal involvement and opportunities for variety and stimulation had the highest negative correlations with maternal smoking. At the same time, these subscales were also powerful predictors of cognitive and language performance. Hence, this study provided further evidence that smoking mothers are different from non smoking mothers in that they tend to not be as involved with their children and provide less environmental stimulation.

There is some evidence to suggest that decreased maternal involvement among smoking mothers occurs very early during child development. Research reveals that women who smoke heavily are significantly less likely to breastfeed, a factor that may be due, in part, to the desire to not pass on the teratogen through breast milk (Mackey & Fried, 1981), along with other possible lifestyle and cultural factors. There also appears to be a dose dependent relationship between the tendency to wean earlier and an increased amount of smoking (Goodine & Fried, 1984). Hence, evidence indicates that smoking mothers make lifestyle decisions, such as not breastfeeding, which influences

their behavior towards their children. At the same time, cigarette smoking has been shown to be a possible behavioral teratogen (Bagley, 1992; Bertolini, Bernardi & Genedani, 1982; Rantakallio, 1983; Wakschlag et al., 1997), thus influencing child behaviors. A transactional relationship has been proposed (Fried, 1992; Sameroff & Chandler, 1975) whereby the mother's lifestyle and behaviors, along with the teratogenic effects of cigarette smoking influence child development. Furthermore, the child's resulting behaviors reciprocate and affect the mother's interactions with the child. Fried (1992), postulates that this transactional cycle ultimately results in the cognitive and behavior deficits that have been observed in children of smoking mothers.

Post-Natal Effects of Passive Smoking on Children. The effect of passive smoking on child development is another confounding factor which may seriously cloud the influences of maternal smoking during pregnancy. Growing up in a smoke filled environment has been shown to lead to deficits in child development (Rush & Callahan, 1989). It has been reported that passive smoking exposure can double the risk of delivering a low birth weight baby (Martin & Bracken, 1986). Furthermore, research indicates that exposure to passive smoke as a result of paternal smoking in the home results in a negative association with mental and physical development (Rantakallio, 1983). In a study examining exposure to smoke from various environments, children of mothers who were passively exposed to cigarette smoke during pregnancy were compared to children of mothers who actively smoked during pregnancy and children of mothers who were exposed to neither conditions (Makin, Fried & Watkinson, 1991). Results of this study indicate that the effects of passive smoking were similar, but smaller in magnitude than that of active maternal smoking during pregnancy. Both active and

passive maternal smoking groups had significantly poorer performance on measures of speech and language and the freedom from distractibility scale of the WISC-R than the non- smoking group. However, the magnitude of effect of the passive smoking group was smaller on these measures. Although the results were not statistically significant, a similar pattern prevailed with respect to scales measuring behavioral problems. Hence, this study reveals that passive smoking may also play a prominent role in deficits found in child development and as such this confounding factor must be examined carefully in order to clearly determine the specific effects of active maternal smoking.

Evidence of a dose-dependent relationship

Various studies have examined the effect that different levels of maternal smoking, as calculated by the nicotine dose per day, may have on child development. Research examining the dose-dependent nature of the effects of prenatal exposure to maternal smoking has consistently been related to cognitive performance (Bauman & Flewelling, 1991; Fogelman, 1980; Naeye & Peters, 1984; Rantakallio, 1983; Sexton, Fox & Hebel, 1990). Research has also consistently shown results of a dose-response gradient when examining the relationship between maternal smoking and spontaneous abortions (Armstrong, McDonald, & Sloan, 1992), lower birth weight (McDonald, Armstrong, & Sloan, 1992) and height (Rantakallio, 1983). Other research studies found statistically significant negative affects on cognition and language development when mothers smoked heavily during pregnancy, (> 15 mg nicotine/day which is roughly greater than one pack of cigarettes smoked), but no statistical evidence when mothers were either light or moderate smokers (less than one pack of cigarettes per day) (Fried & Watkinson, 1988; Fried, O'Connell, & Watkinson, 1992).

Evidence of an Association from True Experiments with Humans

Several factors restrict the availability of evidence from experimental research with humans that could ferret out a causal relationship. Ethically, randomizing groups, manipulating the many variables involved, and controlling conditions is not possible when studying the post-natal effects of maternal smoking on children, making a determination of a causal relationship impossible. Quasi-experimental research is also hindered due to the sample sizes required to examine the many variables involved, the need to recruit women early in pregnancy, as well as the need to collect information on children throughout development. However, associational research using human subjects has been conducted which indicates that cigarette smoking during pregnancy increases the risk of various deleterious cognitive and behavioral effects on children.

Research has shown strong evidence of auditory deficits in children whose mothers smoked during pregnancy (Fried & Makin, 1987; McCartney, Fried & Watkinson, 1994; Saxton, 1978). In a study by Fried and Makin (1987) examining the effect of maternal smoking on infant neonatal behavior, prenatal cigarette exposure was associated with increased tremors and poorer auditory habituation. McCartney, Fried, and Watkinson (1994) also found an increase in central auditory processing difficulties in children 6 to 11 years pre-natally exposed to cigarettes. In addition to auditory deficits, there was evidence indicating an association between prenatal cigarette exposure and lower cognitive and receptive language abilities (Fried, O'Connell, & Watkinson, 1992).

Cognitive deficits have also been consistently associated with maternal smoking. Rantakallio (1983) examined how smoking during pregnancy affected the physical and mental development of children up to the age of 14. The results indicated that children

of heavy smokers were more prone to respiratory diseases, and on the average they had shorter height and poorer school performance. These differences were still significant even after adjusting for the mother's height, parity, socio-economic status, and the sex of the child. However, it is not clear from the study whether poor school performance was the result of maternal smoking, or the type of mother who smokes and the environment they grew up in. Furthermore, alcohol consumption during pregnancy was not examined which confounds the results obtained.

In a study by Naeye and Peters (1984), cognitive, behavioral, and biological measures were used to assess the mental development of children of mothers who smoked during pregnancy. Furthermore, the study also attempted to test the theory that the negative outcomes of maternal smoking are the result of fetal hypoxia. This study recognized the limitations of previous research due to the lack of control for confounding factors and attempted to control for genetic and child rearing practices. Siblings from birth to the age of eight were compared among mothers who smoked during one of their pregnancies but not the other. Presumably child rearing practices would be similar and major life stressors and life changes between pregnancies were taken into consideration as they may affect parenting practices. The results revealed that the children of mothers who smoked during the pregnancy had slightly lower spelling and reading scores (using the Wide Range Achievement Test), tended to have shorter attentions spans, and were more often hyperactive than their comparison siblings. Furthermore, this study examined hemoglobin levels which are an indicator of fetal hypoxia. The results indicated a dose dependent relationship whereby the levels increased with the number of cigarettes smoked. Additionally, among the children of the heavy smoking group who had short

attention spans and were hyperactive, there was evidence that they had significantly higher hemoglobin levels as compared to the children of the smoking group who had normal attention spans and activity levels. These results indicate that differences in outcomes of maternal smoking may be due in part to the fact that there is variation in the degree to which maternal smoking resulted in fetal hypoxia. Researchers have postulated that fetal hypoxia may be the primary explanation for why maternal smoking is associated with deficits in child development (Abel & Hannigan, 1995; Naeye, 1992). Hence this study may provide some clues as to why not all research consistently shows a link between maternal smoking and deficits in child development.

In another study, (Gusella & Fried, 1984), the effect that maternal smoking had on cognitive development at 13 months was examined. In this study three confounding factors were controlled for: father's education, mother's education and birth weight. The results indicated that smoking was associated with decreased verbal comprehension, and poorer fine and gross motor skills as measured by the Bayley Mental and Motor Scales. Fried and Watkinson's (1988) study examining the effects of prenatal exposure to cigarettes found similar results. This study also utilized the Bayley Scales of Infant Development in addition to the Reynell Developmental Language Scales. The influence of the home environment was measured using the HOME (Caldwell and Bradley, 1979). Results of this study revealed a significant association between maternal smoking and decreased mental scores at age 12 months in addition to increased auditory difficulties at ages 12 and 24 months. However, no significant decreases in mental score were found for children at 24 months of age. The scores on the HOME were strong and positively associated with mental scores on the Bayley Scales and negatively correlated with

maternal smoking, thus resulting in the loss of unique predictive power for maternal smoking at this age. Fried and Watkinson (1988) postulate that the strong influence of postnatal environmental factors play a more prominent role in determining a child's cognitive performance when a child reaches this age.

Sexton, Fox, and Hebel (1990) examined the effects of prenatal exposure to tobacco on cognitive functioning of three year olds. Children of mothers who smoked ten or more cigarettes a day at the beginning of the pregnancy were recruited, and children of mothers who quit during the pregnancy were compared to children whose mothers did not stop smoking. In this study, the McCarthy Scales of Children's Abilities and the Minnesota Child Development Inventory were used to determine mental and motor development scores. Results from these measures indicated that children of mothers who persisted in smoking through their pregnancy had significantly poorer cognitive performance. These results remained significant after adjusting for socio-demographic factors, parity, passive smoking, and maternal time available to the child. Unlike Fried and Watkinson (1988), an association between maternal smoking and cognitive deficits after the age of two was found when different assessment measures and confounding factors were examined.

The issue of measurement of cognitive performance and the age at which it is measured has been addressed by other studies which have examined adolescent children of mothers who smoked during pregnancy. Bauman and Flewelling (1991) examined longitudinal data from birth to age 17 at five year intervals. Children were examined at age 5, then between ages 9 and 11, and then when they were adolescents between the ages of 15 and 17. Results showed a trend for children of prenatal smoking parents to

have poorer cognitive scores. The study also found that exposure to environmental tobacco smoke had a significant association with reduced cognitive scores. In another study examining the effects of maternal smoking on cognitive abilities of 16 year olds, results indicated that there was a relationship with poorer scores on reading and mathematics (Fogelman, 1980).

However, not all research reveals evidence of a consistent, strong association between maternal smoking and deficits in child development. In many instances, a pattern of deficits is revealed, however the effect is small and statistically insignificant. A study by Nicols and Chen (1981) examining possible cognitive deficits in children exposed to maternal smoking found that there was not an increased risk of developing learning difficulties as measured by examining reading, spelling, arithmetic, audio-vocal associations, and performance on the Bender Gestalt. Furthermore, no evidence for neurological soft signs was found as measured by examining coordination, gait, mirror movements, abnormal movements, reflexes, position sense, nystagmas, strabismus, and asteriognosis. Results were significant until demographic and socio-economic factors were taken into account. The Port Pirie cohort study found similar inconclusive results (Baghurst, Tong, Woodward, & McMichael, 1992). The results of this study indicated slight differences between children of smoking mothers and non-smoking mothers on developmental test scores. However, these differences were not statistically significant after adjusting for socio-economic status, home environment, and mother's intelligence. The results of both of these studies emphasize the importance of examining the role that environmental and social factors play in the association between maternal smoking and child development.

Other researchers have also found no effects of maternal smoking after adjusting for confounding variables (Streissguth, Barr, Martin, & Herman, 1980). In particular, alcohol use during pregnancy has been identified as an important variable which must be independently examined in relation to maternal smoking. One study examining the deleterious effects of maternal alcohol and cigarette use found there were effects of smoking when coupled with alcohol use, but no influences were found when examined separately (Martin, Martin, Lund & Streissguth, 1977).

Other studies also raise some uncertainty about the relationship between cognitive deficits and maternal smoking. In a matched-pair prospective study conducted with the Collaborative Perinatal Project (Hardy & Mellits, 1972), no significant difference in intellectual functioning was found between children of mothers who smoked during pregnancy and those whose mothers did not smoke.

The inconsistent results presented by these studies renders the hypothesis of an association uncertain. Moreover, each study examined used different testing measures and controlled for different confounding variables, making direct comparisons of results difficult. An examination of this issue by Tong and McMichael (1992) pointed to various inconsistent methodological issues which may clarify why results are not always in agreement. According to Tong and McMichael (1992), an accurate assessment of the influences of maternal smoking on child development requires precise measurements of both exposure and outcome. In the above mentioned studies, exposure was frequently measured using questionnaires identifying the estimated number of cigarettes smoked during pregnancy which may provide an inaccurate assessment. Furthermore, Tong and McMichael (1992) point to the fact that not all of the research conducted in this field use

standardized, psychometrically sound neuropsychological tests. Hence, a need for a standardized methodological procedure is imperative to clarify the association between maternal smoking and child development.

Evidence of an Association Between Maternal Smoking and Behavioural Difficulties

More recent research has revealed a possible link between maternal smoking and serious behavioural difficulties in children. Milberger, Biederman, Faraone, Chen, and Jones (1996) examined the relationship between maternal smoking and Attention Deficit Hyperactive Disorder (ADHD). This study examined maternal smoking history of 6 to 17 year old boys who had been diagnosed with ADHD and those who were not. The study found compelling results indicating that a significantly higher proportion of children with ADHD had mothers who smoked during pregnancy even after socio-economic status, parental IQ and parental ADHD status were adjusted for. Even more concerning was the fact that the results indicate a significant difference in IQ between those children whose mothers smoked during pregnancy and those who did not. Milberger et al. (1996) indicate that one theory of the underlying pathophysiology of ADHD is that it involves the dysregulation of dopaminergic systems. Animal studies involving prenatal nicotine exposure in rats and mice have found that exposure does alter dopaminergic and nicotinic systems (Fung & Lau, 1988; Van de Kamp & Collins, 1994). Although this study does not provide a clear causal link between maternal smoking and ADHD, the results do indicate that it may be a contributing risk factor.

Other research examining the behavioral effects of maternal smoking also support the hypothesis that it may be a risk factor for developing ADHD. A follow up study examining the attentional behavior of 6 year old children prenatally exposed to cigarettes

revealed a dose-dependent relationship between maternal smoking and increased impulsive behavior (Fried, Watkinson, & Gray 1992). In addition to results indicating increased behavioral difficulties, the study also found that maternal smoking was related to poorer performance on verbal memory recall tasks.

Barkley's (1997) theoretical model of ADHD proposes that poor behavioral inhibition is the central deficiency in children with this disorder and that this deficit subsequently effects working memory, self-regulation of affect, internalization of speech, and reconstitutional abilities. Fried, Watkinson and Gray's (1992) study used a response inhibition task to determine impulsive behavior and the results indicated poorer response inhibition and difficulties with sustained vigilance, thus suggesting another possible association between prenatal cigarette exposure and ADHD.

Kristjansson, Fried, and Watkinson (1989) also examined the association between maternal smoking during pregnancy and the vigilance performance in children ages 4 to 7 years old. Auditory and visual vigilance tasks were used and confounding factors such as socio-economic and other drug use variables were controlled for. The results of this study indicate a significant association between maternal smoking and increased activity levels. Furthermore, children of mothers who smoked during pregnancy had increased auditory and visual errors of commission. Commission errors are thought to be related to both impulsivity and poor attention in that children are unable to exhibit behavioral inhibition and restrain themselves from responding to non-critical stimuli (Kristjansson, Fried & Watkinson, 1989).

Evidence of an association between maternal smoking and conduct disorders has also recently been reported in the literature (; Fergusson, 1999). Rantakallio, Laara,

Isohanni, and Moilanen, (1992) found that after controlling for social demographic variables, sons of mothers who smoked during pregnancy were 1.74 times more likely to exhibit delinquent behaviors and have a criminal record at the age of 22 than sons of nonsmoking mothers. Bagley (1992) also found that maternal smoking of 10 or more cigarettes a day was a highly significant predictor of delinquent behavioural problems in 16 year old children. The behavioral problems associated with maternal smoking included frequent fighting, disobedience, truancy, trouble with the police, and a higher likelihood to smoke themselves.

Wakschlag, Lahey, Leober, Green, Gordon, and Leventhal (1997) studied maternal smoking during pregnancy and the risk of conduct disorders in boys age 7 to 12 years. The results from this study indicate that mothers who smoked more than half a pack of cigarettes a day during pregnancy were 4.4 times more likely to have a child with conduct disorder than nonsmoking mothers. The association remained significant even after accounting for socioeconomic status, maternal age, parental antisocial personality, other substance abuse during pregnancy and maladaptive parenting.

An extensive study by Weitzman, Gortmaker, and Sobol (1992) examined the relationship between maternal smoking only, passive smoking, or both with child behavioral problems. Participants included 2256 mothers and children ages 4 to 11 participating in the National Longitudinal Survey of Youth. The results of this investigation reveal increased rates of child behavior problems (as measured by the Behavior Problem Index) for all three levels of smoking exposure, with evidence of a dose response relationship. This association remained even when race, age, sex, birth weight, chronic asthma, family structure, income, divorce, mother's education,

intelligence, self-esteem, employment status, health, use of alcohol during pregnancy and overall home environment (as measured by the HOME) were controlled for.

Fergusson, Woodward, and Horwood (1998) examined the extent to which maternal smoking during pregnancy was associated with an increased risk of psychiatric symptoms in late adolescence. This longitudinal study examined children born in New Zealand, and data was collected over the course of approximately 18 years. The results found that those children exposed to cigarette smoke during pregnancy had a higher psychiatric symptom rates for conduct disorders, alcohol abuse, substance abuse and aggression later in adolescence.

Brennan, Grekin, and Mednick (1999) also found similar results when examining the association between crime rates and maternal smoking during pregnancy. This study examined Scandinavian men in their 30's and found a link between a higher crime rate at this age and exposure to cigarettes during pregnancy. This association was still prevalent even after confounding social, familial, and personality factors were examined as covariates. The study postulated that children exposed to maternal smoking during pregnancy have an increased risk of later externalizing behaviours that extend over the course of life.

Rationale of the Study

In summary, an evaluation of the literature does indicate there is a consistent, dose-dependent relationship between maternal smoking and negative physiological, cognitive and behavioral outcomes in offspring. The research does, however, caution that the results, although consistent, are not always statistically significant due to numerous co-existing factors which also contribute to child development. Hence the

literature indicates a need for research to be conducted which examines this myriad of factors in order to clarify the role of maternal smoking in affecting child development.

The goal of this study was to test four main hypotheses in an attempt to clarify the role of maternal smoking while examining other potential contributors to child behavioral problems. One potentially significant contributor to child behavioral difficulties is degree of parenting ability. More specifically, the degree of parental stress experienced by smoking and non-smoking mothers has not yet been examined in previous research. Abidin's (1976) parenting stress model has posited that the total stress a parent experiences is a result of contributing factors such as the child's characteristics, parental characteristics and situational life-stress variables. According to this model, the level of parental stress experienced is a good predictor of the degree of dysfunctional parenting that is exhibited. Thus, measuring the level of parental stress, experienced by both smoking mothers and non-smoking mothers will assist in differentiating parenting ability. Differences in parenting ability may in turn clarify differences in child behaviors between children of smoking and non-smoking mothers.

Abidin's (1976) parenting stress model also indicates the contribution that situational life stress variables play in parenting stress and parenting ability. These variables were evaluated, and potential differences between life stress experienced by smoking and non-smoking families in the past year were investigated.

As discussed previously, research has taken into account the differences in home environments of smoking and non-smoking families through the use of psychometric tools such as the HOME (Caldwell and Bradley, 1979). Research however has not thoroughly considered specific aspects of the home environment, such as family stability

and integration. This study attempted to explore this aspect of the home environment by examining whether smoking and nonsmoking families vary in their family routines and time spent together and how this further contributed to child behavioral development.

In addition to these variables, this study attempted to examine whether smoking and non-smoking families are significantly different on a number of lifestyle, demographic, and descriptive variables.

In order to achieve these goals, the following hypothesis were tested:

Hypothesis 1:

Smoking and non-smoking mothers as well as their families are likely to differ on various lifestyle, demographic and descriptive characteristics. Specifically, it is hypothesized that smoking and non-smoking families will differ with respect to their income, education level, parental stress, overall life stressors, and family routines. Thus, these differences would indicate that in addition to smoking status, smoking and non-smoking families are in fact substantially different groups of people, which in turn also contributes to behavioral differences in their children.

Hypothesis 2:

Children of smoking mothers may have more exposure to environmental tobacco smoke in their home than children of non-smoking mothers.

Hypothesis 3:

Maternal smoking, along with the increased post natal exposure to environmental tobacco smoke (ETS) as evidenced in Hypothesis 2 contributes to the display of post-natal child behavioral problems. This relationship may be dose dependent.

Hypothesis 4

The relationship between maternal smoking, (along with the additive influences of ETS exposure throughout childhood), and increased post-natal behavioral problems may remain significant even when other potential contributors to child behavioral problems are examined. Specifically, parenting stress, life stress, family stability, parental education and family income will be investigated as covariates and their contribution to child behavior considered.

Finally, the goal of this study was to also to be exploratory in nature. Specifically, this study explored how smoking and non-smoking mothers varied on individual sub-scales that contributed to overall parental stress. Furthermore, this study explored which specific behavioral problems maximally differentiated children of smoking and non-smoking mothers. In addition to these exploratory questions, this study was to explore the relationship between any significant variables found in Hypothesis #1 and their association with behavioural problems in children.

Method

Participants

Mothers of children from ten Thunder Bay schools and various Vancouver daycare and Parks Board programs were recruited for this study. Participants were also recruited through newspaper and radio requests. Only biological mothers who smoked during pregnancy and non-smoking mothers with children ages 4 to 6 years were recruited to participate. In order to minimize the influence that external non-home environments may play in child behaviours, only children of this age range were selected. Children ages 4 to 6 do not attend school daily or for full school days, thus the influences that a school environment may have on child behaviours were limited. Data from participants with children born with severe health complications, disabilities, or data from non-biological caregivers were excluded from this study. Data from one non-smoking participant was excluded as her child experienced chronic, severe ear infections and had serious hearing impairments. Data from one mother who smoked during pregnancy were also excluded as her child was seven years of age, attended school daily, and thus did not fit the age restrictive parameters of this study.

Participants included 44 mothers; 25 mothers who did not smoke during pregnancy, and 19 mothers who did smoke during pregnancy. Non-smoking mothers ranged in age of 28 to 46, with the mean age being 34.7 years ($SD = 4.06$). Smoking mothers ranged in age from 23 to 40, with the mean age being 32.3 ($SD = 4.98$). Using an alpha level of .05, there were no significant group differences with respect to the age of the participating mother ($t(42) = 1.76$, $p = .09$). The data collection process was undertaken for a period of one year due to difficulties obtaining a sufficient number of

participants who smoked during pregnancy and had children ages 4 to 6. During the course of data collection, some smoking mothers commented that they had been reluctant to participate because they felt they should have not smoked during pregnancy, and were afraid that the assessment would uncover deficits in their children.

Total Sample Characteristics

Preliminary analyses were conducted to determine if the groups were comparable on the basis of the following criteria: the age and sex of the child, present health and use of medication by the child, ethnicity, health of the mother during pregnancy, and the use of alcohol, marijuana, medications, or illegal drugs during pregnancy. Participants were selected if they had children between the ages of 4 and 6 years. No significant differences were found with respect to the age of the children of participating mothers ($\chi^2(2, N = 44) = 4.26$, $p = .12$). The mode age of the children of all participating mothers was four years, and the mean age was 4.7 years. Among the non-smoking mothers, 60% of their children were female and 40% male whereas among participating maternal smoking mothers, 53% of their children were female, and 47% were male. No significant differences were revealed ($\chi^2(1, N = 44) = .24$, $p = .63$) indicating that the groups were comparable with respect to the sex of the child. Group differences were evidenced with respect to the present health of the children ($\chi^2(1, N = 44) = 4.73$, $p = .03$), with 40% of non-smoking mother's indicating their children were presently dealing with chronic health problems versus 11% of the children of maternal smoking mothers. However, when queried regarding their child's present use of medication, groups did not vary ($\chi^2(1, N = 44) = .59$, $p = .44$). With respect to ethnic origin, both groups were comparable, ($\chi^2(1, N = 44) = .2.03$, $p = .15$), with 80% of all participants indicating a Caucasian

Canadian ethnic origin, and the remaining 20% identifying various other ethnic origins. Non-smoking and maternal smoking mothers did not significantly differ with respect to the frequency of alcohol use during pregnancy ($\chi^2(2, N = 44) = .13$, $p = .94$), of marijuana use during pregnancy, ($\chi^2(1, N = 44) = 1.35$, $p = .25$), or the frequency of the use of medication during pregnancy ($\chi^2(1, N = 44) = .59$, $p = .44$). No participant of either group reported ever having used any type of illegal, non-prescribed drugs during pregnancy. Groups did not differ with respect to their health during pregnancy ($\chi^2(2, N = 44) = .61$, $p = .74$), with 90% of maternal smoking mothers indicating good health as compared to 84% of non-smoking mothers. Groups were also comparable with regards to whether there were any complications during pregnancy ($\chi^2(2, N = 44) = .79$, $p = .67$), with 68% of maternal smoking mothers and 80% non-smoking mothers reporting no complications.

Smoking characteristics of Maternal Smoking Mothers

The number of cigarettes mothers smoked before their pregnancy ranged from 4 to 25, with $M = 19.47$, $SD = 7.4$. During the first trimester, the mean number of cigarettes was 16.13, $SD = 7.74$, during the second trimester $M = 13.71$, $SD = 8.21$, and during the third trimester, $M = 13.89$, $SD = 9.54$. Overall, the number of cigarettes smoked throughout the pregnancy ranged from 3 to 29, with $M = 14.58$, $SD = 7.93$. The nicotine content of the cigarettes that were smoked ranged from .40 mg/cigarette to 1.30 mg/cigarette ($M = 1.04$, $SD = .33$). The average amount of nicotine consumed each day was calculated by multiplying the number of cigarettes smoked by the nicotine content per cigarette for each individual participant. The daily amount of nicotine consumed by smoking mothers ranged from 1.87mg to 35.00 mg, with $M = 15.24$, $SD = 9.98$. Table 1 displays the number of light, moderate, and heavy smoking mothers. As discussed

previously, studies have shown teratogenic effects due to heavy smoking during pregnancy, but often have not found statistically significant effects for mild or moderate levels of prenatal cigarette exposure. Due to the small number of participants in each category, smokers were not divided into individual groups during the analysis. Although examining all smoking mothers together regardless of amount smoked increases the overall sample used in the analyses, it also would minimize the statistical significance that the influence heavy smoking may play. This minimization would be a bias towards the null hypothesis.

Table 1
Number of Mothers who were Light, Moderate and Heavy Smokers During Pregnancy

	Light	Moderate	Heavy
	(1-10 cigarettes)	(11-20 cigarettes)	(21+ cigarettes)
Number	7	9	3
Of	(<7 mg nicotine/day)	(8 – 15 mg nicotine/day)	(>15 mg nicotine/day)
Mothers	6	5	8

Measures

Participating mothers received four questionnaires which included the Parenting Stress Index (Third Edition) (PSI) ((Abidin, R. R., 1995), the Family Times and Routine Index (FTRI)(McCubbin, McCubbin & Thompson, 1986), the Conners' Parent Rating Scales Revised (CPRS-R:L) (Conners, 1997), and a questionnaire developed to gather socio-demographic, health, drug use and family information.

Family Integration and Stability. The Family Times and Routine Index (FTRI) is a 32 item instrument which examines family time together and the routines families

adopt as indicators of family integration and stability. A total score consisting of the summed scores of eight factors was examined and utilized to determine if any differences exist between families with smoking mothers and those of nonsmoking mothers. These factors included: work day and leisure-time routines, parents' routines, family bedtime routines, family meals, extended family routines, leaving and coming home, family disciplinary routines, and family chores (See Appendix A). The overall internal reliability for the FTRI is .88 (Chronbach's alpha). Tests of construct validity reveal positive correlations with other measures examining family bonding, family coherence, and family satisfaction (see McCubbin, McCubbin & Thompson, 1986).

Parental Stress. Parenting stress was assessed using the Parenting Stress Index (PSI). This assessment tool consists of 120 questions which examines how parental characteristics, child characteristics and life stress interact and determine overall parental stress. Seven child domain factors (distractibility, hyperactivity, adaptability, demandingness, reinforces parent, mood, acceptability); seven parental domain factors (competence, isolation, attachment, health, role restriction, depression, and spouse) along with overall life stress were examined. As the child domain factors were highly correlated with the Conners Parent Rating Scale total score for child behaviors (r (42) = .78, $p < .01$), falsely inflated correlations were avoided by only examining the parental domain factors and the life stress factors. Parental stress was used as an indicator of potentially disturbed parent-child dyads and subsequent dysfunctional parenting. This assessment measure was utilized to determine if any differences in parental stress exists between the two groups which may subsequently account for differences in behavior. (See Appendix B)

Lifestyle, Demographic, Descriptive Variables and Cigarette Smoking Information. Cigarette smoking during pregnancy and environmental tobacco smoke exposure was retrospectively determined using a brief questionnaire filled out by the participating mother. This questionnaire also gathered information about various other demographic, descriptive, and lifestyle factors such as income level, education level, medical health, other drug use during pregnancy, parity, and family history. Furthermore, this questionnaire included several questions which were redundant to questions asked in the other measures, hence, serving as a lie scale measure (see Appendix C).

Child Behaviors. Behavioral difficulties were assessed using Conners' Parent Rating Scale Revised Long Form (CPRS-R:L, 1997), a multi-source behavioral questionnaire filled out by the participating mothers. The parent form consisted of 80 items taking approximately 20 minutes to complete (See Appendix D). This behavioral questionnaire includes 14 subscales assessing the following areas: oppositional behaviors, cognitive problems and inattention, hyperactivity, anxious-shy, perfectionism, social problems, psychosomatic, Attention Deficit Hyperactive Disorder Index, Conner's Global Index (CGI): Restless-Impulsive, CGI: Emotional Lability, CGI: Total, DSM-IV inattentive symptoms, DSM-IV Hyperactive-Impulsive symptoms and DSM-IV symptoms subscale. High scores on each of these scales indicate higher levels of the specified behavioral difficulties.

The CPRS-R:L has good psychometric properties. With respect to reliability, internal consistency coefficients ranged from .75 to .90, and six to eight week test-retest reliability coeffecients ranged from .60 to .90. The examination of factor validity revealed mean intercorrelations of all the subscales to be .34 for males and .32 for

females. Research on the discriminant validity of the CPRS-R:L revealed that overall the subscales were able to discriminate between children with a diagnoses of ADHD, children with emotional problems, and a non-clinical group (see Conners et al., 1997).

Since a total behavioral score is not available with this instrument, the T-scores of 12 of these 14 scales were combined in the present study to form a total overall behavioral problem score thereby improving statistical power. The DSM-IV symptoms and the CGI: Total subscales were removed as they are summations of other scales. Reliability data of the combined behavioral score, a total of the T-scores of the 12 scales, have shown adequate alpha coefficients for each subscale with the overall alpha = .95 for the combined scales (see Appendix E). Thus, higher behavioral scores indicate higher levels of overall behavior difficulties.

Procedure

Each participating mother received a package of four questionnaires which took approximately 50 minutes to complete. Instructions on how to fill out each questionnaire were provided with the questionnaires as well as given over the phone or in person. Participants received either a self-addressed, stamped envelope in order to mail their responses back to the researchers, or packages were picked up from the participants' home. Participating mothers were requested to place the child's initials and the name of the daycare or school they were affiliated with in order to remain anonymous if they chose. Those mothers who wished to contact the researcher in order to gain information about the questionnaires they filled out were instructed to place their full names on all questionnaires in order to facilitate future correspondence. All participants were provided with an opportunity for personal feedback on the results of their

questionnaires as well as an opportunity to discuss and receive referrals for resources. All participants were provided with a phone number and address in order to contact the researcher at any time in order to ask questions about the study. All participants were informed that all information would remain confidential, anonymous for those who chose, and that their participation was completely voluntary. Participants were also informed that upon completion of the study that a copy of the results would be made available upon request.

Results

The results of this study are presented in five sections. The first section investigates the first hypothesis proposed, namely that smoking and non-smoking families vary on a variety of lifestyle, demographic and descriptive variables. Chi-square statistics and multivariate analysis of variance (MANOVA) were used to examine these variables. In the second section, the second hypothesis was tested chi-square statistics. This hypothesis predicted higher frequency of ETS exposure for children with maternally smoking mothers. Section three presents the results testing the third hypothesis which postulates that maternal smoking, along with ETS exposure throughout childhood, is associated with increased behavioral difficulties in a dose-dependent relationship. Bivariate Pearson correlations and a one-way ANOVA were used to test this possibility. The fourth hypothesis positing that the relationship between maternal smoking status and child behaviors remain significant even after family stability, parenting stress, life stressors, parental education level, and family income was examined using a series of hierarchical multiple regression. Finally, the fifth section presents the exploratory examination of the relationship between smoking status and individual subscales of the CPRS-R:L and the PSI using MANOVA statistics.

An alpha level of .05 was utilized for all statistics performed with the exception of the chi-square statistics which were followed by Bonferroni correction. An evaluation of the assumptions of normality, linearity and heteroscedasticity of the data revealed that the data did meet the requirements of these assumptions. Analysis also found no evidence of mulitcollinearity or singularity among variables employed in the various analyses. One case emerged as a multivariate outlier during regression analyses

examination of Mahalanobis distances. Specifically, this case emerged as an outlier for the regression analyses examining the association between FTRI scores and child behavior scores, and life stressors and child behaviour scores. However, upon careful examination of the responses of the participant, no errors in responding or scoring were identified. Therefore, as no measurement or response errors were apparent, this case was considered valid and included in the analyses.

Hypothesis 1: Differences between Smoking and Non-smoking Families

Group Comparison of Demographic and Descriptive Characteristics

MANOVA and chi-square statistics followed by Bonferroni correction were employed to examine any differences on several descriptive variables. A between subjects MANOVA was conducted to assess the effects of smoking status on the following descriptive variables: number of months child was breast fed, birth-weight, number of children in the family presently, number of residences the child has lived in since birth. The multivariate F test indicated no significant main effects for smoking group status, Hotelling's Trace $= .19$, $F(4,39) = 1.85$, $p = .14$, $\eta^2 = .16$. Table 2 displays the means, standard deviation, and measures of the strength of association (η^2) for univariate F-tests.

Table 2

Mean, Standard Deviation, p-values and η^2 for Descriptive Variables by Smoking Status

	Non-smoking mothers (n = 25)		Smoking mothers (n = 19)		p-value	Strength of Association
Descriptive Variables	M	SD	M	SD	p	η^2
Number of months spent breast feeding	12.00	11.36	6.87	9.52	.12	.06
Birth weight in pounds	8.18	.88	7.81	.77	.15	.30
number of children in household	2.24	.83	2.05	.85	.47	.01
number of residences child has lived in since birth	1.80	.96	2.42	1.80	.15	.05

No significant differences between the groups was found for time mother spent breast feeding ,$F(1,42) = 2.52$, $p = .12$, birth weight, $F(1,42) = 2.16$, $p = .15$, number of children in the family, $F(1,42) = .54$, $p = .47$, or the number of residences the child has lived in since birth, $F(1,42) = 2.17$, $p = .15$.

Chi-square statistics were utilized to examine the following discrete descriptive variables: employment status of the mother and father, whether the pregnancy was planned, the gestation period (premature, full-term, over-term), if the mother breast fed her child, if the child's parents are separated or divorced, the frequency with which the child is exposed to second hand smoke in the home by the mother, the frequency with which the child is exposed to second hand smoke by others in the home and parity (see Table 3). Bonferroni correction was utilized to control for Type One error. Using this correction factor, an alpha level of .007 was calculated as being necessary to obtain significance. Of these variables, one indicated a significant difference between the

groups, namely if there had been a separation or divorce since the birth of the child in question. Smoking mothers reported a higher separation/divorce rate, with 47% indicating they were separated or divorced as compared to 8% of non-smoking mothers.

Table 3
Demographic Variable Comparison of Smoking and Non-smoking Mothers

	Mother's Smoking Status						
	Non-smoking (n=25)		Smoking (n=19)		Statistic		
Demographic Variable	%	cases	%	cases	χ^2	d.f	p
Employed Father	96%	24	100%	16	.66	1	.42
Employed Mother	84%	21	74%	14	.71	1	.40
Gestation time		25		19	.94	2	.62
Premature	16%	4	10%	2			
Full term	60%	15	53 %	10			
Over term	24%	6	37%	7			
Mother breast fed	96%	24	79%	15	3.12	1	.08
Parents are separated/divorced	8%	2	47%	9	8.92	1	.003*
Parity		25		19	.93	3	.82
Only child	16%	4	26%	5			
Eldest child	32%	8	32%	6			
Middle child	24%	6	16%	3			
Youngest child	28%	7	26%	5			
Planned pregnancy	56%	14	47%	9	.32	1	.57

*p < .007, alpha level set by Bonferroni correction

Group Comparison of Family Stability, Parenting Stress, Life Stress, Income, and Parental Education

MANOVA and chi-square analysis followed by Bonferroni correction were conducted comparing group differences on variables theorized to be significant contributors to child behavioral development. A between subjects MANOVA was used to explore group differences between family stability, parental stress and life stress. Group differences on income and parental education level, both also posited as contributors to child behavioral development, were investigated using chi-square analysis.

The multivariate F test indicated no significant main effects for smoking group status, when examining family stability, parenting stress, and life stress. Results approached significance with Hotelling's Trace = .21, $F(3,40) = 2.76$, $p = .055$, $\eta^2 = .17$. No significant groups differences were revealed for parenting stress levels, $F(1,42) = 3.30$, $p = .07$, or for family stability, $F(1,42) = 3.62$, $p = .08$. Thus, smoking and non-smoking mothers did not have appreciable differences in their levels of parenting stress or in their family's level of integration and stability. Smoking and non-smoking mothers did vary with respect to the overall life stressors that they had experienced in the past year. Univariate F-tests revealed a significant group difference for life stress $F(1,42) = 4.49$, $p = .04$. Smoking mothers life stress scores varied from 0 to 30 (maximum score possible is 79), $M = 13.68$, $SD = 9.67$. Non-smoking mothers scores also ranged from 0 to 30, but with $M = 8.28$, $SD = 7.26$. Thus, smoking mothers and their immediate family experienced more life stressors in a one-year period of time than non-smoking mothers.

A chi-square analysis was used to examine group differences in family income level, mother's education level, and father's education level. Bonferroni correction was

employed in order to control for Type One error resulting from multiple comparisons. Alpha level of .01 was used to determine significance. Results indicated that there were no significant differences with respect to the highest level of education achieved by mothers, $\chi^2(4, N = 44) = .5.01$, $p = .29$, the highest level of education achieved by fathers , $\chi^2(5, N = 43) = 7.42$, $p = .19$, or income level, $\chi^2(6, N = 43) = 9.86$, $p = .13$. Thus, groups did not differ on variables used to determine social economic status.

Hypothesis 2: Greater Environmental Tobacco Exposure for Children of Smoking Mothers

A chi-square analysis followed by Bonferroni correction was performed to determine group difference on the child's environmental tobacco smoke exposure (ETS) (see Table 4). An alpha level of .025 was established to determine significance. Results indicate significant differences in the frequency that children of smoking mothers are exposed to ETS as compared to children of non-smoking mothers. Children of smoking mothers were not only exposed to greater levels of ETS from their mothers, but also from various other household members. Although children of smoking mothers were found to be significantly more frequently exposed, actual levels of exposure were not measured due to the retrospective nature of the data collection process. As such, the actual association that passive smoke exposure may have had with increased behaviour problems was not distinguishable from influences that smoking during pregnancy may have played, and as such was not examined in this study.

Table 4

Frequency of ETS Exposure Between Smoking and Non-smoking Households

	Mother's Smoking Status						
	Non-smoking (n=25)		Smoking (n=19)		Statistic		
Demographic Variable	%	cases	%	cases	χ^2	d.f.	p
Frequency of smoke exposure in home by other household members		25		19	17.90	2	.001**
often	4%	1	47%	9			
occasionally	8%	2	26%	5			
rarely/never	88%	22	26%	5			
Frequency that mother smokes in presence of child		25		19	44.00	3	.001**
daily			63%	12			
occasionally			21%	4			
rarely			16%	3			
never	100%	25					

** $p < .001$

Hypothesis 3: Maternal Smoking is Associated with Post-Natal Behavioral Problems in a Dose-Response Relationship

The relationship between the number of cigarettes smoked, amount of nicotine consumed, and child behavioural difficulties was investigated using one tailed bivariate Pearson correlation. The analyses indicate that the number of cigarettes smoked is significantly and positively correlated with increased behavioral problems, $r(42) = .35$, $p = .01$. The amount of nicotine intake per day was determined by multiplying the nicotine content per cigarette for each brand smoked by the total number of cigarettes smoked for each participant. These results also reveal a nicotine dose-response relationship, with $r(42) = .46$, $p = .001$.

The hypothesis of an existing association between maternal smoking along with greater frequency of post-natal ETS exposure and child behavioral problems was tested using a one way between subjects ANOVA. As determined in the analysis conducted in the previous section, ETS exposure occurred significantly more frequently for children of smoking mothers than for non-smoking mothers. Analysis of both the effects of smoking during pregnancy combined with post-natal passive smoking thereby provided a more realistic examination of the possible consequences of growing up in a smoking family. The results of this ANOVA analysis indicated a significant relationship between maternal smoking along with ETS exposure during development and increased reported behavioural difficulties, with $F(2,39) = 8.09$, $p = .01$.

Hypothesis 4: Maternal Smoking Remains a Significant Predictor of Child Behavioral Problems After Family Stability, Life Stress, Parenting Stress, and Social Economic Variables are Considered

Hypothesis four proposed that a relationship between maternal smoking, along with greater ETS exposure throughout childhood, and increased post-natal behavioral problems will remain significant even when other potential contributors to child behavioral problems are accounted for. Specifically, parenting stress, life stress, family stability, parental education and family income were investigated as covariates and their contribution to child behavior considered. A series of hierarchical multiple regressions were employed to determine if maternal smoking improved prediction of child behavioral difficulties beyond that afforded by parenting stress, family stability, life stress, and social economic variables.

Family Stability

The first hierarchical regression examined if maternal smoking status improved prediction of behavioral problems above and beyond that provided by family stability. Family stability was entered in the first step, with smoking status entered as the second step, and the two way interaction entered in the last step. In step one, $R^2 = .13$, $F(1,40) = 5.95$, $p = .019$, indicating that family stability and integration, as measured by the FTRI, significantly predicted 12.9% of the variance of child behavior problems. When smoking status was entered in step 2, the change in R^2 was significant, with change in $R^2 = .09$, $F(1,39) = 4.75$, $p = .035$. Thus, maternal smoking during pregnancy significantly increased the prediction of post-natal behavior problems by explaining an additional 9.4% of the variance. Change in R^2 for the last step which involved the interaction of smoking status by family stability did not reliably improve R^2. (see Table 5 for summary of sequential multiple regression). Thus both family stability levels and maternal smoking have a significant relationship with child behavior problems, however, maternal smoking is found to be a unique contributor which increases the prediction of child behavioral problems.

Parenting Stress

The second sequential multiple regression performed tested if smoking status added to the prediction of child behavioral problem above that afforded by parental stress. Parenting stress variable was entered in the first step, maternal smoking status in the second, and the interaction variable smoking status by parental stress entered last.

Parenting stress, entered in the first step, explained 36.7% of the variance of the dependent variable, child behavioral problems, $R^2 = .37$, $F(1,40) = 23.22$, $p = .001$.

Maternal smoking status significantly added to the variance explained by 6.1%, change in $R^2 = .06$, $F(1,39) = 4.13$, $p = .049$. The interaction of these variables was not significant (see Table 5). Thus, both parenting stress levels experienced by the mother, along with the mother's smoking status had a significant relationship with child behavior problems. Maternal smoking however, increased the prediction of child behavioral difficulties.

Life Stress

The third hierarchical regression was utilized to investigate whether maternal smoking status increased prediction of behavioral problems above that provided by life stress in the past year. Life stress was entered in the first step, with smoking status entered as the second step, and the two way interaction entered in the last step.

The results indicate that life stress, which was entered in the first step, does not significantly predict child behavior difficulties, $R^2 = .05$, $F(1,40) = 1.87$, $p = .18$. However, maternal smoking, as entered in step two, did significantly increase prediction of child behaviors, explaining an additional 13.8% of the variance, change in $R^2 = .14$, $F(1,39) = 6.61$, $p = .014$. The interaction of life stress by smoking status did not significant increase prediction (see Table 5). Thus the degree of life stressors experienced by the family in the past year was found not to have a significant relationship with child behaviors. Maternal smoking was however found to be a significant predictor of child behavior difficulties.

Parental Education and Family Income

The final sequential regression performed examined if maternal smoking status increased the prediction of child behavioral problems above that afforded by parental education and income. In the first step, the maternal education level, paternal education

level, and family income was entered. In the second step, maternal smoking status was entered, and in the third the interaction variable social economic variables, namely parental education and family income by smoking status.

Parental education level and income, entered in the first step, significantly predicted 23.4% of the variance of child behavior problems, $R^2 = .23$, $F(1,40) = 3.67$, $p = .021$. Maternal smoking, as entered in step two, significantly increased the amount of variance predicted by 8.7%, change in $R^2 = .09$, $F(1,39) = 4.47$, $p = .042$. The interaction term did not significantly increase prediction (see Table 5). Hence, social economic variables were found to be significantly related to child behaviors, however, maternal smoking status was a significant, additive predictor of child behavioral difficulties.

Table 5
Summary of Hierarchical Regression Analysis

Independent Variables	R	p	df	R^2	ΔR^2	Δ F	Δp
Family Stability							
Step 1	.360	.019*	1, 40	.129	.129	5.946	.019*
Step 2	.473	.007**	1, 39	.224	.094	4.746	.035*
Step 3	.476	.020*	1, 38	.226	.002	.118	.733
Parenting Stress							
Step 1	.606	.001***	1, 40	.367	.367	23.215	.001***
Step 2	.654	.001***	1, 39	.428	.061	4.130	.049*
Step 3	.664	.001***	1, 38	.441	.013	.902	.348
Life Stress							
Step 1	.211	.179	1, 40	.045	.045	1.872	.179
Step 2	.428	.019*	1, 39	.183	.138	6.610	.014*
Step 3	.432	.047*	1, 38	.186	.003	.153	.697
Parental Education and Income							
Step 1	.484	.021*	3, 36	.234	.234	3.673	.021*
Step 2	.567	.008**	4, 35	.321	.087	4.465	.042*
Step 3	.574	.056*	7, 32	.330	.009	.138	.936

* $p < .05$. ** $p < .01$. *** $p < .001$

Exploratory Analyses

Exploratory analyses were conducted to examine questions unrelated to the main hypotheses of this study. The first analyses utilized a between subjects MANOVA to determine if there were individual behavioral scales on the Conner's Parent Rating Scale (CPRS-R:L) which differentiated children of maternal smoking and non-smoking mothers. The second exploratory analyses conducted also employed a between subjects MANOVA in order to determine if there were differences between smoking and non-smoking mothers with respect to individual scales on the Parenting Stress Index (PSI).

Group Differences on Individual Scales of the Conners'Parent Rating Scale - Revised

A MANOVA was employed to determine if there were any group differences with respect to the following CPRS-R:L scales: anxious-shy scale, cognitive problems/inattention scale, hyperactivity scale, ADHD index scale, DSM:IV hyperactive impulsive scale, DSM:IV inattentive scale, restless-impulsive scale, emotional lability scale, oppositional scale, perfectionism scale, psychosomatic scale, social problems scale. The multivariate F test indicated no significant main effects for smoking group status with Hotellings Trace = .83, $F(12,29) = 2.01$, $p = .06$. Univariate F tests reveal significant group differences for the following behavioral scales: social problems ($F(1,40) = 6.82$, $p = .01$), perfectionism ($F(1,40) = 4.24$, $p = .05$), emotional lability ($F(1,40) = 7.33$, $p = .01$), anxious-shy ($F(1,40) = 16.36$, $p = .001$), cognitive problems/inattentive ($F(1,40) = 4.87$, $p = .03$), hyperactivity ($F(1,40) = 6.82$, $p = .04$), DSM:IV hyperactive-impulsive ($F(1,40) = 6.84$, $p = .01$), and DSM:IV inattentive scale ($F(1,40) = 4.48$, $p = .02$) (see Table 6 for descriptive statistics).

Table 6

Mean, Standard Deviation, p-values and η^2 for CPRS-R:L Scales by Smoking Status

	Non-smoking Mothers (n = 25)		Smoking Mothers (n = 19)		p-value	Strength of Association
CPRS-R:L Behavior Scales	M	SD	M	SD	p	η^2
Anxious-Shy	45.32	6.29	55.76	10.46	.001***	.29
Cognitive problems/ Inattention	52.68	8.32	59.24	10.92	.033*	.11
DSM:IV Hyperactive Impulsive	52.08	8.63	60.11	11.28	.012*	.15
DSM:IV Inattentive	52.00	8.40	58.71	10.10	.024*	.12
Hyperactivity	51.60	9.37	58.18	10.95	.043*	.10
Emotional Lability	46.84	6.54	55.00	12.87	.010**	.16
Perfection	48.52	7.22	54.06	10.24	.046*	.10
Social Problems	49.52	6.03	57.12	12.62	.013*	.15
Oppositional	52.28	8.11	58.88	13.23	.052	.09
Psychosomatic	51.00	7.12	52.12	11.83	.704	.01
Restless-Impulsive	52.56	10.25	58.24	12.82	.120	.06
ADHD Index	52.12	8.77	58.00	11.12	.063	.08

*p < .05. **p < .01. ***p < .001.

Group Differences on Parenting Stress Index Scales

A between subjects MANOVA was employed to determine any differences on the parent domain stress scales of the PSI between smoking and non-smoking mothers. The scales that were examined included: parent's feelings of isolation, parent's feelings of

lack of spousal support, parent's feelings of role restriction, parent's feelings of depression, parent's feelings of attachment to child, parent's feelings of competence, and parent's feelings of health. Multivariate F test reveals no significant main effect of group, with Hotelling's Trace = .19, $F(7,36) = .99$, $p = .45$, $\eta^2 = .16$.

Univariate F tests revealed that there were group differences for two of these scales, namely feelings of isolation ($F(1,42) = 4.35$, $p = .04$, $\eta^2 = .09$), and feelings of depression, ($F(1,42) = 4.35$, $p = .04$, $\eta^2 = .09$). The mean isolation score for non-smoking mothers ($M = 11.88$ $SD = 3.40$ $n = 25$) was lower than that for smoking mothers ($M = 14.05$ $SD = 3.46$, $n = 19$), indicating smoking mothers had greater feelings of isolation. Smoking mothers also had a greater mean score for feelings of depression ($M = 23.10$ $SD = 5.59$ $n = 19$) as compared to non-smoking mothers ($M = 19.84$ $SD = 4.78$ $n = 25$).

The Prediction of Child Behavioural Problems from Divorce and from Smoking Status

The final exploratory analyses that was conducted involved whether smoking status increased the prediction of child behavioural problems when divorce was examined, a variable which significantly differentiated smoking and non-smoking mothers in Hypothesis #1. A hierarchical multiple regression was used to examine this question. Whether or not the mother has been divorced or separated was entered in step 1, the smoking status of the mother was entered in step 2, and the interaction of these two variables was entered in the last step.

The results indicate that divorce, entered in the first step, significantly explained 9.4% of the variance of the dependent variable, child behavioural problems, $R^2 = .094$, $F(1,40) = 4.17$, $p = .048$. Maternal smoking status significantly added to the variance

$F(1,40) = 4.17$, $p = .048$. Maternal smoking status significantly added to the variance explained by an additional 8.7%, with change in $R^2 = .09$, $\Delta F(1,39) = 4.12$, $\Delta p = .049$. The interaction of these two variables was not significant. Thus, divorce, which was significantly higher for smoking mothers, was a significant predictor of child behavioural problems, but, maternal smoking status continued to add to the prediction of these problems above that which divorce predicted.

Discussion

The objective of this study was to consider the role that maternal smoking, and other variables of specific research interest play in post-natal child behavioral problems. The first step undertaken in this study was to clarify if families of smoking mothers were a significantly unique population when compared to families of non-smoking mothers. This was undertaken by examining a number of relevant descriptive and demographic variables. It was hypothesized that these demographic and descriptive variables might in turn contribute to the development of child behavioral difficulties. In addition to these variables, maternal smoking and non-smoking families were compared with respect to their parenting stress levels, life stress levels in the past year, parental income, level of education, and family integration. The contribution of these variables to child behavioral problems was then examined relative to maternal smoking status. Four hypotheses were tested in order to clarify the relationship between maternal smoking, environmental tobacco smoke (ETS) exposure, lifestyle differences, and child behavioral problems.

The first hypothesis of this study postulated that maternal smoking and non-smoking families differ significantly on various lifestyle, demographic, and descriptive characteristics, thereby indicating that maternal smoking families may be a unique population. These differing characteristics may in turn explain why children of smoking families have greater behavioral problems. The results indicated that maternal smoking and non-smoking families did not significantly diverge with respect to parental employment status, income level, or highest parental education level achieved. These findings did not support the findings of other researchers in that there are a number of other studies that found that smoking mothers and their families tended to be of lower

socio-economic status (Fried, 1992; Makin, Fried, & Watkinson, 1991; Rantakallio, 1983; Sexton, Fox, Hebel, 1990). These findings are also contradictory to the findings of the Statistics Canada Health Promotion Survey (Statistics Canada, 1988), which found that individuals with lower income levels and lower education levels tended to have higher rates of smoking. There are several potential hypotheses as to why the present study's results were not commensurate with previous research. As indicated in the methodology section, considerable difficulty was encountered in obtaining smoking mother participants. Participants were gathered through the school system, but primarily through radio and newspaper announcements. Thus, participating mothers were those who read the newspaper, listened to the news radio, and were willing to take out their time in the interest of furthering science. Specifically, some smoking mothers expressed a reluctance to participate because of a fear that the assessment may discern deficits in their children resulting from their maternal smoking. Thus, those smoking mothers who participated despite this fear may represent a subset of smoking mothers who have a higher education and are more confident that their children do not have any deficits as compared to the mothers sampled by other research studies. Furthermore, the sample size of this study relative to previous studies is considerably smaller, hence, more apt to be influenced. Thus, increasing the sample size and diversifying sampling methods to include smoking mothers who do not read the paper or listen to the news may allow access to a broader range of mothers from varying socio-economic backgrounds. No significant differences between smoking and non-smoking families were found with respect to parity, number of children in the family, number of residences the child has resided in since birth, and whether the pregnancy was planned. The results did, however,

reveal that smoking families had a significantly higher rate of divorce/separation, with 47% of smoking mothers indicating separation/divorce as compared to 8% of non-smoking mothers. These findings corroborate those of Naeye and Peters (1984) who also found that smoking mothers had higher divorce rates. Furthermore, there was a higher reported rate of chronic or serious health problems for children of non-smoking mothers than children of mothers who smoked during pregnancy. These results are completely contradictory to other research which indicates increased health problems in children of smoking mothers (Fried, 1992). Interestingly, although non-smoking mothers indicated their children had more chronic health problems, they did not report giving more medications to their children. Presumably, if their children were experiencing more serious chronic health problems, they would also have a higher medication usage. As the use of the terms chronic and serious health problems was not clearly defined in the questionnaire, it is likely that the interpretation of this was varied, resulting in these results. Furthermore, there may have been a reporting bias by smoking mothers towards positive impression management, whereby they were more likely to minimize health difficulties in their children. In the future, clarification of the exact illness that the children suffering from, in the addition to having access to actual doctor's reports would clarify this issue.

The family demographic and descriptive variables chosen were those believed to possibly contribute to the overall home environment, and thus subsequently give rise to problematic child behaviors. The results indicate, however, that with the exception of divorce rates, smoking and non-smoking families were generally undistinguishable. As divorce may be quite disruptive to the home environment, it is possible that dealing with

divorce may in turn negatively influence child behaviors and possibly explain to some degree why children of smoking mothers may have higher behavioral problems. This variable was therefore examined in the latter exploratory analyses to determine its contribution to child behavioural problems. The results of these analyses indicated whether or not the mother had a divorce or separation did significantly predict child behavioural problems. Yet, whether the mother smoked or not still was significantly more predictive of these problems, after divorce was examined as a covariate. Thus, although divorce does seem to contribute to the display of behavioural difficulties, this contribution is not as important as whether or not a mother smoked throughout pregnancy and subsequently exposed their child to more second hand smoke in the home environment.

Variables of specific research interest were also included in the comparison between smoking and non-smoking families. Previous researchers examined gestation time, birth weight, and breast feeding while comparing children of smoking and non-smoking mothers (Fox, Sexton, & Hebel, 1990; Goodine & Fried; 1984; Mackey & Fried, 1981; Naeye, R. & Peters, E. 1984; Picone, Allen, Olsen & Ferris, 1982). The results of this study indicate that there were no differences with respect to gestation time or birth weight, thus contradicting findings by Picone, Allen, Olsen & Ferris (1982) and Naeye & Peters (1984), but supporting the results of Fox, Sexton, & Hebel (1990). Fox et. al., (1990) did find a significant difference of weight before controlling for confounding variables such as pre-pregnancy weight, race, education, household income, parity, number of members in the family and obstetric care. However, once these variables were controlled for, no appreciable difference in birth weight remained. Picone et al. (1982)

did find differences in birth weight of children of smoking and non-smoking mothers, however, the same covariates were not examined. This study did not find any appreciable differences on these variables, however, as in the Fox et. al. (1990) study, race, education, household income, and parity were examined as potential covariates, but found not to be significantly different between smoking and non-smoking participants. Also, maternal pre-pregnancy weight was not measured, a factor which would assist in standardizing birth weights. Furthermore, research also indicates that the effects of maternal smoking may not be statistically evident at lower smoking doses, but is apparent when mothers smoke heavily (greater than one pack a day) during pregnancy. Due to the small number of heavy smoking participants, results may have been biased towards the null. Thus, a overall larger sample size may have assisted in uncovering potential differences among these variables which may be small but significant.

The present study also found no significant differences when comparing breast-feeding practices of smoking and non-smoking mothers. Although 96% of non-smoking mothers breast fed as compared to 79% of maternal smoking mothers, there was no significant statistical difference. Furthermore, when the number of months spent breast-feeding were compared, smoking mothers did not significantly differ from the results of non-smoking mothers. These results are different from those of other researchers, (Goodine & Fried, 1984; Mackey & Fried, 1981), who found that heavily smoking mothers were less likely to breast feed and more likely to wean earlier. The smoking mothers of this sample generally were not heavy smokers, thus possibly explaining the differences in results. Heavy smoking has been defined in the Ottawa Prenatal Prospective Study (Fried, 1992) as being an average of one pack of cigarettes a day or

more, or approximately 16 mg nicotine/day or greater. Only 20% the smoking mothers in this study smoked a package of cigarettes a day or more, and 45% of mother had nicotine intake of more than 15mg of per day. Thus, differences in the results of this study as compared to others may be a consequence of differences in the amount smoked relative to other studies.

The first hypothesis, which examined possible differences between smoking and non-smoking families, also examined variables posited as potential contributors to child behavior problems. These included parenting stress, family integration and stability, and life stress. Maternal smoking and non-smoking participants did not significantly differ with respect to their parenting stress levels or their overall family stability and integration levels. The results did, however, indicate that smoking and non-smoking families are significantly different with respect to the level of life stressors experienced in the past year. The questions querying life stress were part of the PSI and included questions about divorce, death of family member or friend, marriage, pregnancy, debt, moving, income decrease, trouble with teachers at school, alcohol or drug problems, legal problems, starting a new job, entering a new school, among others. Thus, these situations may create a stressful home environment that in turn could influence child behaviors. This postulate was tested in hypothesis four and will be discussed in a later section.

As discussed previously, Rantakallio (1983) discovered various descriptive and demographic lifestyle differences between smoking and non-smoking mothers and concluded that these variables were associated with negative conditions for child development. Fried and Watkinson (1988) also assessed aspects of the home environment (using HOME, Caldwell & Bradley, 1979) and found that the measures for

maternal involvement and opportunities for variety and stimulation were negatively related to maternal smoking. The results of the present study did not find any overall differences in family stability or integration, as measured by the FTRI. The FTRI, also a measure of home environment, examined several areas: child routines, couple's togetherness, meals together, parent-child togetherness, family togetherness, relative's connection, family chores, and family management. These scales measure very different aspects of the home environment than the HOME, which was utilized in Fried and Watkinson's (1988) study. Thus, differences in these findings are likely due to the fact that these studies measured very different aspects of the home environment that would in turn influence child behavioural development. Due to the limited scope of this study, and the small sample size, analyses of how smoking and non-smoking families varied on individual subscales was not examined. Future examination of these scales, along with the individual scales of the HOME may elucidate specific differences between the two groups with respect to various components of the home environment

In conclusion, overall, smoking and non-smoking families were quite similar, thus disproving the first hypothesis that smoking and non-smoking families were uniquely different populations. Smoking mothers were unique in that they had significantly higher divorce rates and experienced more life stressors in the course of a year than did non-smoking mothers. In general, these two groups were comparable on various family demographic, descriptive, and lifestyle variables, thus any differences in child behavior were not attributed to differences on these variables.

The second hypothesis postulated that the children of smoking mothers would be exposed to greater levels of ETS. The results of this study indicated that children of

smoking mothers did have significantly more frequent ETS exposure in their home both as a consequence of their mother smoking in their presence, and other family members. As the amount of ETS exposure was not measured, and the frequency only retrospectively determined via questionnaires, actual levels of ETS exposure were not determinable. Researchers, however, have found that ETS exposure throughout childhood resulted in various deleterious effects (Makin, Fried & Watkinson, 1991; Rush & Callahan, 1989). Makin, Fried & Watkinson's study (1991) examined behavioural problems in children passively exposed to cigarette smoke prenatally, children actively exposed to cigarettes due to mothers smoking during pregnancy, and children exposed to neither. This study found that children exposed to passive smoke during pregnancy were reported as having poorer behavior ratings as compared to children of non-smoking mothers when tested using an older version of the Conners Parent Rating Questionnaire. These poor behaviour scores, however, were not as low as those for children who had been exposed to maternal smoking during pregnancy.

Results of Makin, Fried & Watkinson's study (1991) study lend some support for the hypothesis that ETS exposure is not only greater in children born to smoking mothers, but that this exposure in turn is associated with increased child behavioral problems. The behaviors manifested by children of maternal smoking mothers are thus likely influenced by both prenatal teratogenic exposure and ETS exposure post-natally. Thus, in order to gain a realistic picture of the possible behavioral consequences of growing up in a smoking family, and having a mother who smoked maternally, both maternal smoking and ETS exposure were examined together in this study with respect to their relationship to child behavioral problems in the following hypothesis.

Hypothesis three proposed that maternal smoking in addition to ETS exposure was significantly associated with post-natal behavioral problems and that this relationship would be dose-dependent in nature. The results indicated that maternal smoking status (along with higher ETS exposure throughout childhood) did have a significant relationship with mothers' ratings of child behavioral problems. These findings corroborate those of various other researchers who also found a sequelae of behavioral difficulties associated with maternal smoking (Bagley, 1992; Fried, Watkinson, & Gray, 1992; Milberger et al., 1996; Naeye & Peters, 1984; Wakschlag, 1997).

Furthermore, this association did reveal a dose-dependent relationship, both for the number of cigarettes smoked and for the amount of nicotine consumed per day. The results indicated that the amount of nicotine consumed per day during pregnancy was significantly positively correlated with increased child behavioural scores. Furthermore, the number of cigarettes smoked, irrespective of nicotine content, was also positively correlated with higher behavioral problem scores. These findings lend support to the theory that hypoxia caused by maternal smoking may be a major contributor to the deficits found in children of smoking mothers (Naeye, 1992). Thus, the results indicate that it is likely that nicotine acts as a behavioural teratogen, but even if mothers smoke low nicotine and tar cigarettes, the resulting hypoxia caused by increased fetal carbon monoxide exposure still has deleterious behavioural consequences.

Hypothesis four postulated that the relationship between maternal smoking and child behavioral problems would remain significant even after other potential

contributors to child behavior, namely family stability levels, parenting stress, life stressors, and socio-economic variables were examined as covariates.

The results indicated that both family stability levels and maternal smoking predicted child behavioral problem levels. However, maternal smoking status increased the prediction of child behavioral problems by 9.4%, thereby explaining more of the variance. As mentioned previously, smoking and non-smoking participants did not differ with respect to their reported family stability levels. Therefore, although family stability levels predicted child behavioral difficulties, it did so for both smoking and non-smoking mothers. Thus, no interaction between smoking status and family stability levels was found. Maternal smoking, therefore, emerges as a significant unique predictor of child behavioral difficulties.

Family stability and integration levels, as measured by the FTRI, were examined as a means of assessing a specific aspect of the home environment. The role of family stability in this study was somewhat different from what Fried & Watkinson (1988) found when they examined the contribution of both the home environment (as measured by the HOME, Caldwell & Bradley, 1979) and maternal smoking to child development. In their study, prenatal maternal smoking was significantly associated with lower cognitive scores until the home environment was examined at which point the post-natal home environment played a more significant role. The results of the present study may differ from those of Fried & Watkinson's (1988) in part because the assessment measures used are different, and thus may measure completely different aspects of the home environment. It is also possible that the home environment may play a greater role with respect to cognitive development than with behavioral development when maternal

smoking is the primary influence. Further assessment of both cognitive and behavioral development using several home and family environment assessment measures would be required in order to clarify the influences of maternal smoking.

Life stress was also investigated as a covariate and its predictive contribution in relation to child development was examined in comparison to maternal smoking. The results of the present study indicated that life stressors occurring in the immediate family in the past year do not contribute to the development of child behavioral problems. Maternal smoking, however, was found to be a significant predictor, explaining 13.8% of the variance. Results of the first hypothesis indicated that smoking and non-smoking families did significantly differ with respect to the life stressors experienced, with smoking mother's families experiencing more stressors relative to non-smoking families. However, despite this differentiation, life stressors did not contribute to child behavioral problems, thus no significant interaction was revealed. Therefore, even though smoking families experienced more stressors over a period of one year, these experiences were found to not contribute to the increased behavioral problem scores as reported by mothers. Rather, smoking during pregnancy emerged as a more powerful predictor of child behavioral problems.

Abidin's (1976) parenting stress model posits that the level of parenting stress experienced is a good predictor of the degree of dysfunctional parenting that is exhibited, thus influencing child behavioral development. On the basis of this model, parenting stress levels, as experienced by participating mothers was also examined as a potential covariate which may contribute to child behavioral development. The results indicate that both parenting stress and maternal smoking are significant predictors of child

behavioral problem scores, with parenting stress explaining 36.7% of the variance. However, maternal smoking still emerged as a significant unique predictor as it explained an additional 6.1% of the variance beyond that explained by parenting stress. Results of hypothesis one revealed that smoking and non-smoking mothers did not differ in their parenting stress levels, thus the interaction between smoking status and parenting stress was not significant. The results therefore indicated that the behavioral difficulties of children of smoking mothers were associated with their maternal smoking status, and not to the fact that they are somehow less capable parents.

Finally, parental education and family income levels were examined as potential contributors to child behavioral development. The present study's results indicated that the socio-economic variables and maternal smoking both significantly predicted child behavioral problem scores. Maternal smoking, however, once again emerged as a unique significant predictor by explaining 8.7% more of the variance than that explained by the socio-economic variables. Previous research findings indicate that smoking and non-smoking families differed on various socio-economic variables (Fried, 1992; Makin, Fried, & Watkinson, 1991; Rantakallio, 1983; Sexton, Fox, Hebel, 1990) however, the results of this study found no significant differences between groups. Thus, no interaction between smoking status and socio-economic variables was found. Therefore, although parental education level and family income were found to have a relationship to child behavioral problems, this study found that maternal smoking status was a better predictor of these problems.

In conclusion, the analyses of the results of hypothesis four indicate that parenting stress, education, and income levels along with family stability are significant predictors

for higher reported child behavioral problems. Yet, as was discovered when testing the first hypothesis, smoking and non-smoking families were not differentiable on these variables. Therefore, although family stability, parenting stress, parental education, and family income do have bearing on child behavior, they do so for both smoking and non-smoking families.

The present study did, however, find that smoking mothers reported experiencing more life stressors in the course of the year than non-smoking mothers did. These stressors could potentially influence parental mood, time spent with a child, and ultimately the overall nurturing home environment, thereby influencing child behavioral development. However, when examining the influence that these stressors may have on child behavioral problems, the results of the present study found no significant contribution. Rather, the analysis indicated that maternal smoking was, once again, the primary predictor of increased child behavioral problems as measured by maternal ratings on the CPRS-L:R.

Exploratory analyses were also conducted to examine the possible relationship between maternal smoking status (along with childhood exposure to ETS) and higher ratings on child behavioral problem scores. As discussed above, results of this study revealed a significant association between maternal smoking, along with childhood ETS exposure, and higher ratings of child behavioral problems. Further exploratory analyses were conducted in order to determine which specific child behavioral problem subscales differentiated the children of smoking and non-smoking mothers. The results revealed that the children of smoking mothers had significantly higher reported scores on the following CPRS-L:R scales: anxious-shy, cognitive problem/inattention, DSM:IV

hyperactive, DSM:IV inattentive, hyperactivity, emotional lability, perfection and social problems. Children of maternal smoking mothers also scored higher on the oppositional scale, however, these results were not significant. These findings suggest that children of smoking mothers tended to be more inattentive, had more academic difficulties, displayed greater levels of hyperactivity, were more fastidious about they way they do things, displayed more anxious behaviors, had more social problems, and were more emotional according to the ratings of their mothers.

These findings are consistent with those of Fried, Watkinson, & Gray (1992) who utilized an older version of the Conner's Parent Rating Scale and also found that children of maternal smoking mothers had significantly higher ratings on the impulsive/hyperactive scale.

The results of the present study are also similar to those found by Milberger et al. (1996) who examined children with an ADHD diagnosis and found that a significant proportion had a maternal history of smoking. The association between increased ratings of hyperactivity and attentional difficulties as found in this study were also found in the study conducted by Naeye and Peters (1984) who found greater hyperactivity and shorter attention spans for children of maternally smoking mothers.

Although the differences between children of non-smoking and maternally smoking mothers on the oppositional scale of the CPRS-L:R were not significant, children of maternal smoking mothers were generally rated as being more oppositional. Results from studies by Rantakallio, Laara, Isohanni, & Moilanen (1992) and Wakschlag et al., (1997) found that maternal smoking during pregnancy increased the risk of conduct disorders and oppositional behavior in children. The results from the present study,

although not significant, support these findings. A limited sample size due to data collection difficulties reduced the statistical power of this study, however, significant results may emerge in a future study that accesses a larger sample.

Exploratory analyses were also conducted to determine which of the parenting domain stress scales of the PSI most differentiated smoking and non-smoking mothers. The results of these analyses revealed that smoking mothers had significantly higher scores on subscales measuring isolation and depression. Thus, suggesting that smoking mothers tended to feel more isolated in their role as a parent in addition to having more feelings of depression. Therefore, the results of this study suggest that smoking mothers experience greater levels of life stressors, in addition to having to cope with feelings of isolation and parental role restriction, while parenting children who exhibit behavioral problems. These factors combined may explain why they reported feeling significantly greater levels of depression.

Limitations and Future Research

It should be noted that the present investigation was limited by the size of the sample. Due to the limited power of analyses, more sophisticated analyses were not performed. In addition, many of the variables were examined in various individual or univariate analyses as opposed to exploring them using a more advanced comprehensive multivariate statistic. Thus, future research examining these variables would require a larger sample in order to better determine group differences. A larger sample size may also expose associations that remained statistically non-significant in these analyses due to a limited level of power.

Another major limitation to the present study is that information collected on smoking habits during pregnancy was retrospective in nature, thus making it difficult to ascertain a realistic picture of how maternal smoking may be associated with child behavioral problems. As mentioned by Tong and McMicheal (1992), it is essential to acquire an accurate measurement of maternal smoking intake in order to clearly determine the resulting postnatal influences. Unfortunately, accurate measurement was not within the economical or time scope of the present study. A future investigation may overcome this retrospective issue by collecting data from participants in a longitudinal fashion throughout child development as has been done in larger data base studies. Furthermore, future research studies will have to address the issue of accurate measurement of daily cigarette consumption.

Another measurement limitation of the present study involved the subjective nature of the measurement instruments. The PSI measures parenting stress on the basis of the parent's perspective, and thus is not an objective measure of the degree of actual parental stress experienced. The PSI does include a validity scale which detects defensive responding, however, it is still possible that responders who were dishonest, unaware, or defensive may have not been detected. The CPRS-L:R's assessment of child behavioral difficulties is also a subjective measure which determines child behavioral problems on the basis of parent observations. Although an attempt was made to verify parent observations by having teachers also fill out behavioral questionnaires, due to a lack of teacher support, this form of verification was not possible. Although these measures are subjective, they still provide valuable information. A parent's perception of a problem regardless of its subjective nature, provides insight into the nature of the

parent-child interaction. Ideally, data collected on child behaviors, maternal smoking patterns, family stability, and parenting ability throughout child development would have provided a more accurate picture of the relationship between all of these variables. Larger studies such as the Ottawa Prenatal Prospective Study have been able to measure and reassess their participants throughout child development, thereby lending stronger, more consistent support for their findings.

The results from the present study indicated no differences in family stability and integration. Future research studies incorporating various measures of family and home environment may discover specific factors that differentiate smoking and non-smoking families that may also explain differences in child behaviors.

The present study was also limited by the fact that the results are correlational in nature and causal inferences cannot be made. Therefore, although the results clearly indicated that maternal smoking is a significant unique predictor for higher behavioral scores, it does not provide any evidence of causation. Thus, this study cannot provide any definitive answer to the question of whether maternal smoking causes behavioral problems in children, but the significant findings, despite the limited sample size, strongly suggest an association between maternal smoking and post-natal child behavioral problems.

Implications and Conclusions

The central goal of this study was to clarify the association between maternal smoking and post-natal child behavioral problems. An examination of previous literature investigating this question had presented a series of other variables which may also explain why children of maternally smoking mothers have a higher risk of developing

behavioral difficulties. It has also been posited (Bagley, 1992) that smoking mothers may possess unique personality traits which are also associated with a child's behavioral outcome. These personality traits, may influence their life style choices, for example, choosing to smoke and to continue smoke during pregnancy. These traits may also influence other factors, such as parenting ability and their ability to create a stable nurturing family home environment. These factors in turn may influence the development of their children. In light of this quandary, the present study set forth to examine several covariate variables which may differentiate smoking and non-smoking families and also contribute to child behavioral development. If smoking mothers did possess unique traits, these would likely be reflected in their lifestyle choices and the home environment they provide their children, thereby influencing child behavioral development.

The overall picture presented by these results suggests that smoking and non-smoking families are, overall, very similar with respect to the limited number of variables examined. Although parenting stress, family stability, parental education level, and family income factors did predict child behavioral problem outcomes, smoking and non-smoking families did not differ on these variables. Thus, maternal smoking emerged as the main factor which differentiated between participants and significantly predicted child behavioral difficulties. Although no clear answer regarding causation can be made, the results do suggest that increased child behavioral problems in children of maternal smoking mothers may be the consequence of maternal smoking and growing up with passive smoke exposure.

The implications of these findings are wide ranging. As discussed previously, a transactional relationship (Fried, 1992; Sameroff & Chandler, 1975) between the mother's lifestyle and behaviors and the behavioral teratogenic effects of cigarette smoke may exist. The resulting child behaviors influence the mother's interactions with the child creating a detrimental cycle. As postulated by Fried (1992), this transactional cycle ultimately results in the cognitive and behavior deficits that have been observed in children of smoking mothers. Furthermore, the resulting behavioral problems may also influence the child's performance in school, thereby also influencing cognitive development.

On the basis of the implications of these findings, further research, information and funding directed towards smoking cessation programs for mothers and women of child bearing age would be highly recommended in order to prevent development of potential deleterious behavioral teratogenic consequences.

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Appendix A

Family Times and Routine Index (FTRI)

Family Stress, Coping and Health Project
School of Human Ecology
1300 Linden Drive
University of Wisconsin-Madison
Madison, WI 53706

FTRI

FAMILY TIME AND ROUTINES INDEX©

Hamilton I. McCubbin Marilyn A. McCubbin Anne I. Thompson

Directions:

First, read the following statements and decide to what extent each of the routines listed below is false or true about your family: **False (0), Mostly False (1), Mostly True (2), True (3).** *Please circle the number (0, 1, 2, 3) which best expresses your family experiences.*

Second, determine the importance of each routine to keeping your family together and strong: **NI = Not Important, SI = Somewhat Important, VI = Very Important.** *Please circle the letters (NI, SI, or VI) which best express how important the routines are to your family. If you do not have children, relatives, teenagers, etc., please circle NA = Not Applicable.*

Routines	False	Mostly False	Mostly True	True	How Important to Keeping the Family Together and United *Important to Family* Not	Somewhat	Very	Not Applicable
Work Day and Leisure Time Routines								
1. Parent(s) have some time each day for just talking with the children	0	1	2	3	NI	SI	VI	NA
2. Working parent has a regular play time with the children after coming home from work	0	1	2	3	NI	SI	VI	NA
3. Working parent takes care of the children some time almost every day	0	1	2	3	NI	SI	VI	NA
4. Non-working parent and children do something together outside the home almost every day (e.g., shopping, walking, etc.)	0	1	2	3	NI	SI	VI	NA
5. Family has a quiet time each evening when everyone talks or plays quietly	0	1	2	3	NI	SI	VI	NA
6. Family goes some place special together each week	0	1	2	3	NI	SI	VI	NA
7. Family has a certain family time each week when they do things together at home	0	1	2	3	NI	SI	VI	NA
8. Parent(s) read or tell stories to the children almost every day	0	1	2	3	NI	SI	VI	NA
9. Each child has some time each day for playing alone	0	1	2	3	NI	SI	VI	NA
10. Children/teens play with friends daily	0	1	2	3	NI	SI	VI	NA

Please Continue on other side →

Routines	False	Mostly False	Mostly True	True	How Important to Keeping the Family Together and United: Not	Somewhat	Very	Not Applicable
Family Disciplinary Routines								
27. Parent(s) have certain things they almost always do each time the children get out of line	0	1	2	3	NI	SI	VI	NA
28. Parents discuss new rules for children/teenagers with them quite often	0	1	2	3	NI	SI	VI	NA
Family Chores								
29. Children do regular household chores	0	1	2	3	NI	SI	VI	NA
30. Mothers do regular household chores	0	1	2	3	NI	SI	VI	NA
31. Fathers do regular household chores	0	1	2	3	NI	SI	VI	NA
32. Teenagers do regular household chores	0	1	2	3	NI	SI	VI	NA

Appendix B

Parenting Stress Index (PSI)

PSI Item Booklet

Instructions:

On the PSI Answer Sheet, please write your name, gender, date of birth, ethnic group, marital status, child's name, child's gender, child's date of birth, and today's date. Please mark all your responses on the answer sheet. DO NOT WRITE ON THIS BOOKLET.

This questionnaire contains 120 statements. Read each statement carefully. For each statement, please focus on the child you are most concerned about, and circle the response which best represents your opinion.

Circle the SA if you strongly agree with the statement.
Circle the A if you agree with the statement.
Circle the NS if you are not sure.
Circle the D if you disagree with the statement.
Circle the SD if you strongly disagree with the statement.

For example, if you sometimes enjoy going to the movies, you would circle A in response to the following statement:

I enjoy going to the movies. SA (A) NS D SD

While you may not find a response that exactly states your feelings, please circle the response that comes closest to describing how you feel. YOUR FIRST REACTION TO EACH QUESTION SHOULD BE YOUR ANSWER.

Circle only one response for each statement, and respond to all statements. DO NOT ERASE! If you need to change an answer, make an "X" through the incorrect answer and circle the correct response. For example:

I enjoy going to the movies. SA A NS (X) (SD)

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25. My child does a few things which bother me a great deal.

26. My child is not able to do as much as I expected.

27. My child does not like to be cuddled or touched very much.

28. When my child came home from the hospital, I had doubtful feelings about my ability to handle being a parent.

29. Being a parent is harder than I thought it would be.

30. I feel capable and on top of things when I am caring for my child.

31. Compared to the average child, my child has a great deal of difficulty in getting used to changes in schedules or changes around the house.

32. My child reacts very strongly when something happens that my child doesn't like.

33. Leaving my child with a babysitter is usually a problem.

34. My child gets upset easily over the smallest thing.

35. My child easily notices and overreacts to loud sounds and bright lights.

36. My child's sleeping or eating schedule was much harder to establish than I expected.

37. My child usually avoids a new toy for a while before beginning to play with it.

38. It takes a long time and it is very hard for my child to get used to new things.

39. My child doesn't seem comfortable when meeting strangers.

For statement 40, choose from choices 1 to 4 below.

40. When upset, my child is:
    1. easy to calm down
    2. harder to calm down than I expected
    3. very difficult to calm down
    4. nothing I do helps to calm my child

For statement 41, choose from choices 1 to 5 below.

41. I have found that getting my child to do something or stop doing something is:
    1. much harder than I expected
    2. somewhat harder than I expected
    3. about as hard as I expected
    4. somewhat easier than I expected
    5. much easier than I expected

For statement 42, choose from choices 1 to 5 below.

42. Think carefully and count the number of things which your child does that bothers you. For example: dawdles, refuses to listen, overactive, cries, interrupts, fights, whines, etc. Please circle the number which includes the number of things you counted.
    1. 1–3
    2. 4–5
    3. 6–7
    4. 8–9
    5. 10+

For questions 59 and 60, choose from choices 1 to 5 below.

59. What were the highest levels in school or college you and the child's father/mother have completed?
Mother:
    1. 1st to 8th grade
    2. 9th to 12th grade
    3. vocational or some college
    4. college graduate
    5. graduate or professional school

60. Father:
    1. 1st to 8th grade
    2. 9th to 12th grade
    3. vocational or some college
    4. college graduate
    5. graduate or professional school

For question 61, choose from choices 1 to 5 below.

61. How easy is it for you to understand what your child wants or needs?
    1. very easy
    2. easy
    3. somewhat difficult
    4. it is very hard
    5. I usually can't figure out what the problem is

62. It takes a long time for parents to develop close, warm feelings for their children.

63. I expected to have closer and warmer feelings for my child than I do and this bothers me.

64. Sometimes my child does things that bother me just to be mean.

65. When I was young, I never felt comfortable holding or taking care of children.

66. My child knows I am his or her parent and wants me more than other people.

67. The number of children that I have now is too many.

68. Most of my life is spent doing things for my child.

69. I find myself giving up more of my life to meet my children's needs than I ever expected.

70. I feel trapped by my responsibilities as a parent.

71. I often feel that my child's needs control my life.

72. Since having this child, I have been unable to do new and different things.

73. Since having a child, I feel that I am almost never able to do things that I like to do.

74. It is hard to find a place in our home where I can go to be by myself.

75. When I think about the kind of parent I am, I often feel guilty or bad about myself.

76. I am unhappy with the last purchase of clothing I made for myself.

77. When my child misbehaves or fusses too much, I feel responsible, as if I didn't do something right.

78. I feel every time my child does something wrong, it is really my fault.

For statements 102 to 120, choose from choices Y for "Yes" and N for "No."
During the last 12 months, have any of the following events occurred in your immediate family?

102. **Divorce**
103. **Marital reconciliation**
104. **Marriage**
105. **Separation**
106. **Pregnancy**
107. **Other relative moved into household**
108. **Income increased substantially (20% or more)**
109. **Went deeply into debt**
110. **Moved to new location**
111. **Promotion at work**
112. **Income decreased substantially**
113. **Alcohol or drug problem**
114. **Death of close family friend**
115. **Began new job**
116. **Entered new school**
117. **Trouble with superiors at work**
118. Trouble with teachers at school
119. **Legal problems**
120. **Death of immediate family member**

Appendix C

Lifestyle, Demographic, and Cigarette Smoking Questionnaire

ID # 1

FAMILY INFORMATION QUESTIONNAIRE

Completed by: **Date:**

Child's Name: **Birth date:** **Age:**

Sex of child: **Ethnic origin:** **Grade:**

Name of school:

Name of teacher:

Biological Father's Birth date: _____ **Age:**_____

Present Occupation: _____
(Please be specific. Indicate if unemployed)

Highest Level of Education: Highschool College Technical/Trade School University Graduate school
(circle one) Other (please specify) _____

Last completed grade: _____

Biological Mother's Birth date: _____ **Age:**_____

Age at time of pregnancy: _____

Occupation: _____
(Please be specific and indicate if unemployed)

Highest Level of Education: Highschool College Technical/Trade School University Graduate school
(circle one) Other (please specify) _____

Last completed grade/level: _____

The following are general questions about your household

Present average yearly family income: Less than $10 000 ____

$10 000 - $19 999 ____
$20 000 - $29 999 ____
$30 000 - $39 999 ____
$40 000 - $49 999 ____
$50 000 - $59 999 ____
Greater than $60 000 ____

What is your child's position in the family(circle one): Only child Oldest Child Youngest Child One of middle Children

How many children in the family: _____

How has your family structure changed since the birth of this child.
Please mark all that apply

How many different residences has this child lived in since his/her birth? _____

Do both biological parents presently live with this child? ____yes no____

If not, has there been a separation or divorce? yes no
Since when? _____

Who presently lives in your home with your son/daughter. Specific names are not necessary, only family position ie father, step-father, sister, step-mother, brother, sister, grandparents, etc.

_____

TO BE FILLED OUT BY BIOLOGICAL MOTHER

Answer the following 7 questions if you have ever smoked:

Did you smoke prior to the pregnancy of your son/daughter? ____yes no____

If so, approximately how many cigarettes a day did you smoke? _____

Did you smoke at any time during the pregnancy of your child? ____yes no____

Approximately how many cigarettes did you smoke per day:
during the first 3 months of your pregnancy: _____
during the second 3 months of your pregnancy : _____

during the last 3 months of your pregnancy : _____

If you quit smoking at some point during your pregnancy, please specify at what point did you completely stop smoking? _____

On average, how many cigarettes per day do you presently smoke? _____

Since the birth of your son or daughter, have you smoked in the presence of your child or in the home (check one) :

_____ Daily, whenever I'm at home
_____ Occasionally, a few times a week
_____ Rarely, I hardly ever smoke in front of my child or in the home

Since the birth of your son/daughter, have other members of your household smoked in the presence of your child or in the home?

_____ Often
_____ Occasionally
_____ Rarely

Were any of the following substances used during the pregnancy?

Alcohol yes no If yes, how many times a week _____, in a month _____?

Marijuana yes no If yes, how many times a week _____, in a month _____?

Illegal drugs yes no If yes, how many times a week _____, in a month _____?
Please specify which drugs: _____

Medication yes no If yes, how many times a week _____, in a month _____?
Please specify what medication: _____

The following questions ask about your child's developmental and medical history

How was the mother's health during the pregnancy:

good _____
fair _____
poor _____

Were there any complications during the pregnancy, please specify:

_____

Were you ever hospitalized during your pregnancy? yes no

Were you seriously ill during the pregnancy? yes no
If so, please specify: _____

Was this a planned pregnancy? yes no

Family adjustment to the pregnancy was:
_____good
_____fair
_____poor

Was your son/daughter born on schedule? _____premature. If yes how early_____
_____ full term
_____ over term

Birth weight: _____

How would you describe your child's health:
_____good
_____fair
_____poor

Does he/she have any chronic/serious health problems? yes no
If yes, please describe: _____

Has your child ever been hospitalized?
If yes, please describe: _____

Is your child currently taking any medications, please specify reasons why:
yes no _____

Appendix D

Conners Parent Rating Scale Revised Long Form

Conners' Parent Rating Scale - Revised (L)

by C. Keith Conners, Ph.D.

	NOT TRUE AT ALL (Never, Seldom)	JUST A LITTLE TRUE (Occasionally)	PRETTY MUCH TRUE (Often, Quite a Bit)	VERY MUCH TRUE (Very Often, Very Frequent)
38. Inattentive, easily distracted	0	1	2	3
39. Talks excessively	0	1	2	3
40. Actively defies or refuses to comply with adults' requests	0	1	2	3
41. Fails to give close attention to details or makes careless mistakes in schoolwork, work, or other activities	0	1	2	3
42. Has difficulty waiting in lines or awaiting turn in games or group situations	0	1	2	3
43. Has a lot of fears	0	1	2	3
44. Has rituals that he/she must go through	0	1	2	3
45. Distractibility or attention span a problem	0	1	2	3
46. Complains about being sick even when nothing is wrong	0	1	2	3
47. Temper outbursts	0	1	2	3
48. Gets distracted when given instructions to do something	0	1	2	3
49. Interrupts or intrudes on others (e.g., butts into others' conversations or games)	0	1	2	3
50. Forgetful in daily activities	0	1	2	3
51. Cannot grasp arithmetic	0	1	2	3
52. Will run around between mouthfuls at meals	0	1	2	3
53. Afraid of the dark, animals, or bugs	0	1	2	3
54. Sets very high goals for self	0	1	2	3
55. Fidgets with hands or feet or squirms in seat	0	1	2	3
56. Short attention span	0	1	2	3
57. Touchy or easily annoyed by others	0	1	2	3
58. Has sloppy handwriting	0	1	2	3
59. Has difficulty playing or engaging in leisure activities quietly	0	1	2	3
60. Shy, withdrawn	0	1	2	3
61. Blames others for his/her mistakes or misbehavior	0	1	2	3
62. Fidgeting	0	1	2	3
63. Messy or disorganized at home or school	0	1	2	3
64. Gets upset if someone rearranges his/her things	0	1	2	3
65. Clings to parents or other adults	0	1	2	3
66. Disturbs other children	0	1	2	3
67. Deliberately does things that annoy other people	0	1	2	3
68. Demands must be met immediately — easily frustrated	0	1	2	3
69. Only attends if it is something he/she is very interested in	0	1	2	3
70. Spiteful or vindictive	0	1	2	3
71. Loses things necessary for tasks or activities (e.g., school assignments, pencils, books, tools or toys)	0	1	2	3
72. Feels inferior to others	0	1	2	3
73. Seems tired or slowed down all the time	0	1	2	3
74. Spelling is poor	0	1	2	3
75. Cries often and easily	0	1	2	3
76. Leaves seat in classroom or in other situations in which remaining seated is expected	0	1	2	3
77. Mood changes quickly and drastically	0	1	2	3
78. Easily frustrated in efforts	0	1	2	3
79. Easily distracted by extraneous stimuli	0	1	2	3
80. Blurts out answers to questions before the questions have been completed	0	1	2	3

Appendix E

RELIABILITY ANALYSIS - SCALE (ALPHA)

1.	ANXSHY	anxious-shy scale D
2.	COGINAT	Cognitive problems/Inattention scale B
3.	DSMHYPIM	DSM:IV Hyperactive Impulsive Scale M
4.	DSMINATT	DSM:IV inattentive Scale L
5.	HADHDIND	ADHD Index Scale H
6.	HYPERACT	hyperactivity scale C
7.	ICGIRES	CGI: Restless-Impulsive scale I
8.	JCGIEML	Conners Global Index: Emotional Lability
9.	OPPOSITN	oppositional scale A
10.	PERFECTN	Perfectionism Scale E
11.	PSYCHSOM	Psychosomatic Scale G
12.	SOCPROB	social problems scale F

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
ANXSHY	588.9048	8222.5273	.4689	.9491
COGINAT	583.1190	7725.7660	.7544	.9401
DSMHYPIM	583.1190	7406.4001	.9001	.9349
DSMINATT	583.7381	7641.9053	.8342	.9375
HADHDIND	583.9524	7543.6074	.8496	.9368
HYPERACT	584.1905	7465.9628	.8650	.9361
ICGIRES	583.5952	7280.0517	.8723	.9357
JCGIEML	588.3095	7495.9750	.8589	.9364
OPPOSITN	583.5000	7626.9390	.7338	.9409
PERFECTN	587.6905	8081.7799	.6088	.9446
PSYCHSOM	587.0000	8035.2195	.6152	.9444
SOCPROB	585.8571	8036.9059	.5640	.9463

Reliability Coefficients

N of Cases = 42.0 N of Items = 12

Alpha = .9451

Appendix F

Participant Consent Form

My signature on this form indicates that I consent to participate in this study, as described in the attached information sheet, conducted by Dr. Satinder and Harjit Aulakh. I am also aware that this study is examining the long-term effects of maternal smoking during pregnancy, parental stress, family stability, and life stressors on child behaviours.

I have read and understood the purpose of the research study as explained in the cover letter, and I am aware that this study involves my filling out four questionnaires and that participation will require approximately 50 minutes of my time.

I understand the following:

1. I am a volunteer and can withdraw at any time from the study.
2. There are no apparent risks associated with my participation in this study.
3. The information I provide will remain confidential, and I have the option of remaining anonymous if I do so choose.
4. The responses will be stored confidentially for seven years by the research supervisor, Dr. Satinder.
5. I will receive a summary of the project and feedback from the results of the questionnaires that I have completed, upon request, following the completion of the project.

Signature:_____

Name (please print):_____

Name of my child that is participating: _____

School:_____

Date:_____