

EXAMINING THE ROLES OF EARLY PROXIMITY, DEGREE OF GENETIC
RELATEDNESS, AND DISGUST IN EXPLAINING FATHER-DAUGHTER AND
BROTHER-SISTER INCEST

by

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Author's Declaration Page

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Abstract

The goal of this dissertation was to evaluate proximate mechanisms that facilitate incest avoidance, and elucidate under what circumstances these mechanisms may fail, integrating insights from the fields of forensic and evolutionary psychology. To set the stage, Study 1 was a meta-analysis that examined differences between biological and sociolegal incest offenders on two major risk dimensions (antisociality and atypical interests). While sociolegal incest offenders were more problematic on some indicators of antisociality, these groups did not differ in atypical sexual interests. These findings suggest that current models of child sexual abuse may not be sufficient to fully explain incest offending. Studies 2 and 3 examined the viability of the Westermarck hypothesis (1891/1921) - that early physical proximity leads to incest avoidance - and the mediating role of disgust in father-daughter (Study 2) and brother-sister (Study 3) relationships. The primary hypothesis for these studies was that disgust toward incest would mediate the relationship between physical proximity and incest propensity or behaviour. The results of Study 2 did not support the Westermarck hypothesis among fathers. While physical proximity may not activate incest avoidance in fathers, disgust toward incest may still be a proximate mechanism. The results of Study 3 were consistent with the Westermarck hypothesis and the mediating role of disgust as an incest avoidance mechanism among siblings, and also suggest that moderators, such as sexual behaviour that could result in offspring, could influence the strength of this mechanism. These findings suggest that mechanisms responsible for incest avoidance may be different for fathers and siblings.

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Dedication

I dedicate this work to my parents, who have supported my academic career since the beginning. I owe my success to the skills and perseverance that you instilled in me (although some may call it stubbornness!), and your unwavering support. I also dedicate this work to my husband, who has brought much needed balance to my life.

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CHAPTER 1 – Introduction

Incestuous sexual behaviour is not rare. Indeed, in a random sample of almost 1000 women in the United States, 16% reported at least one incident of incestuous sexual abuse by a relative prior to the age of 18 (Russell, 1983). In a subsequent report (Russell, 1984), this same author found that 17% of females who had a step-father reported they had been sexually abused by them, while 2% had reported sexual abuse by a biological father. Furthermore, of all incidents of child sexual abuse reported to police in Canada in 2012, 38% were classified as being perpetrated by a relative (Cotter & Beaupré, 2014). These statistics do not include cases of sexual behaviour between relatives that were not considered coercive, a phenomenon that is primarily relevant for siblings. The prevalence of sexual behaviour between siblings is between 7%-24%, and when reported, approximately 80% of these encounters are characterized as non-coercive by participants (Bevc & Silverman, 1993; Greenwald & Leitenberg, 1989; Hardy, 2001).

Prior forensic research has investigated risk factors for sexual behaviour between family members. Most research in this area, however, has not given sufficient consideration to what is known about the mechanisms that regulate human incest avoidance from an evolutionary perspective. Prior research within evolutionary psychology has elucidated the adaptive functionality of human *incest avoidance* mechanisms, which allows for predictions of the contexts in which human incest avoidance might fail to develop and function properly. In this chapter, I first provide an introduction to understanding human behaviour through an evolutionary framework. Next, I cover key concepts in the theoretical and empirical understanding of incest, including incest taboo, incest avoidance, and the proposed mechanisms that explain why and how incest is prohibited and controlled. The goal of this dissertation is to

evaluate proximate mechanisms that facilitate incest avoidance, as well as elucidate under what circumstances these mechanisms may fail, gaining important theoretical insight from the evolutionary psychology literature.

An Evolutionary Introduction to the Psychology of Human Behaviour

Darwin's (1859) theory of evolution explains the process of change over time. Evolution is fuelled by *natural selection*, which is the differential survival and reproduction of individuals based on variability in the expression of genes (Shackelford & Liddle, 2014). Briefly, parents pass on genes to their offspring. There is variability in the genes being passed to the next generation, however, and thus variability in the expression of traits in a population. Different genes/combinations of genes result in the expression of different traits (known as *phenotypic expression*). If the traits expressed provide an advantage to the individual, specifically increasing the likelihood of survival and reproduction, these genes are more likely to be passed down through successive generations in the population, compared to genes that do not provide such advantages. This is the basic process by which human traits, including behavioural tendencies, have evolved over time. Important to this process is the concept of *selection pressures*. Traits are more or less likely to be advantageous under different environmental conditions. Selection pressures refer to environmental interactions that shape evolution based on whether the expression of a trait, within a given environment, increases *fitness* - the probability that an individual's genes will remain in the population. For example, in colder climates, genes that result in an increased production of body fat would help to ensure the survival of those who expressed them. However, in warmer climates, this same expression of genes would likely not be beneficial to the fitness of the individual, and may actually be harmful to their fitness if, for example, the excess body fat resulted in premature death due to its metabolic costs or due to

overheating, before reproduction could occur.

There are also sex specific selection pressures. Females are required to carry their offspring for nine months before giving birth, and once born, offspring require constant care until they are of an age when they can survive on their own, which takes years. This means that females are required to invest many resources in their children, at the expense of their ability to devote efforts elsewhere, in order to ensure their genes propagate in the population. Therefore, females have evolved a tendency toward a *parental investment strategy* to augment their fitness. This is a selection pressure for females which has shaped evolution; on average, females who did not provide this degree of investment in their children faced worse outcomes in regard to fitness. Comparatively, males do not need to provide this same degree of investment in their children to ensure their genes remain in the population. Though many fathers care for their children, their minimal investment - the production of sperm and the act of sexual intercourse - is much smaller than for mothers. As a consequence, males have evolved a tendency toward a *mating effort strategy*, by devoting resources and time to finding new sexual partners and therefore increasing the number of offspring they have. This increase in total fitness comes at the expense of caring less for each of their offspring.

Not only have humans evolved to express traits to promote their own fitness, but also the fitness of their genetic relatives. *Inclusive fitness* can be described as being comprised of *direct fitness* (an individual's direct survival and reproductive success) and *indirect fitness* (survival and reproductive success of genetic relatives). In regard to indirect fitness, Trivers (1972) defined investment as a resource, in that investment is the time and energy required to increase a relative's fitness, at the cost of one's ability to devote efforts elsewhere. Therefore, increasing a relative's fitness (via investment) increases one's own fitness, because the relative carries

common genes. It is necessary to understand the basic principles of evolution in order to understand how they are applicable to incest. The following section will elaborate on how the tenets of evolution apply to understanding the causes of incest.

Understanding the Causes of Incest

From a biological perspective, selection pressures have promoted the evolution of mechanisms to avoid incest (known as *incest avoidance*) because incest reduces reproductive fitness. *Inbreeding depression* is the reduced biological fitness from breeding between close relatives, particularly nuclear family relatives, caused by increased genetic homozygosity that increases morbidity and mortality in offspring (Seemanová, 1971). Based on the fitness consequences associated with inbreeding depression, incestuous behaviour was selected against in our ancestral past because of this selection pressure. The biological costs of incest are shared by both parties, based on the tenets of inclusive fitness. However, the costs of incest are higher for females than for males, because on average, females are more likely to employ a parental investment strategy as opposed to a mating effort strategy. This perspective is important to describe the evolution of mechanisms to ensure humans avoid incest.

In order to investigate the causes of incest, such examinations can and should be accomplished across multiple steps in an etiological sequence. A *distal cause* refers to why a trait exists (i.e., what selection pressures existed in evolutionary history which caused the selection of genes that favoured this trait). In regard to incest avoidance, the distal cause of incest avoidance is the reduced fitness consequences associated with inbreeding depression. Conversely, a *proximate cause* refers to how that mechanism works (i.e., the mechanisms responsible for facilitating the selected trait). Proximally, both second and first order proximate mechanisms that explain how incest avoidance works can be highlighted. *Second order proximate mechanisms* are

those responsible for facilitating the selected trait. These are inputs that incest avoidance mechanisms receive that allow it to perform the function for which it was designed. *First order proximate mechanisms* are the psychological mechanisms that are immediately responsible for incest avoidance. Investigating both second and first order proximate mechanisms that facilitate incest avoidance allow examinations of whether these mechanisms are defective or weakened in those who have engaged in incestuous behaviour (see Figure 1).

Second Order Proximate Mechanisms that Facilitate Incest Avoidance

In order to facilitate the avoidance of incestuous behaviour, incest avoidance mechanisms must be able to identify kin. Genetic relatedness is not a trait that can be directly observed. Therefore, in our ancestral past, selection pressures have promoted the retention of genes that expressed traits that allowed us to distinguish kin from non-kin. Prior work on kin detection in humans suggests that perceived relatedness is based on the presence or absence of cues that ancestrally correlated with genetic relatedness (Wolf, 2014) and that humans avoid incest according to these cues (Lieberman, Tooby, & Cosmides, 2007). Importantly, the ability to identify kin (via various *kinship cues*) is a second order proximate mechanism, in that the evolution of this trait is required in order for incest avoidance mechanisms to function. Humans need to be able to identify kin to ensure sexual relationships with them are avoided. These cues signal to our kin-detection system that we are more or less likely to be genetically related to someone. In the absence of these cues of relatedness (or in the presence of cues that indicate *relatedness uncertainty*), the incest avoidance mechanism may fail to inhibit incestuous behaviour.

Relatedness uncertainty. There are a variety of kinship cues that have been shown to reliably help humans distinguish kin from non-kin. The most prominent include: (1) phenotypic

similarity (e.g., Apicella & Marlowe, 2004; Burch & Gallup, 2000), (2) suspicions of maternal infidelity (e.g., Anderson, 2006), as well as (3) maternal perinatal association (Lieberman et al., 2007) and (4) co-residence/physical proximity (e.g., Bevc & Silverman, 1993, 2000). These cues signal to our kin-detection system that we are more likely to be genetically related to someone. In the absence of these cues of relatedness (or in the presence of cues that indicate relatedness uncertainty), the incest avoidance mechanism may fail to inhibit incestuous behaviour. A brief description of these cues will be illustrated below, followed by a more in-depth examination of the kinship cue that is the focus of this dissertation - *physical proximity*. This kinship cue was chosen as the focus for this dissertation because, as will be described below, it has been well validated in hypothetical sexual encounters between siblings, but very little research has focused on siblings who self-report engaging in incestuous behaviour with a sibling. Additionally, while a variety of studies have focused on the role that physical proximity in sibling or pseudo-sibling relationships have on incest avoidance, these studies have primarily used special/unique populations. Furthermore, it has not been extensively investigated in fathers. These limitations provide an opportunity to make novel contributions to this body of literature.

Phenotypic similarity. Phenotypic similarity refers to the extent to which relatives share a similar expression of phenotypic traits. There are a variety of phenotypic traits that have been investigated in human and animal models that have been shown to act as kinship cues. Among avian species, auditory vocal signals are often used as kinship cues (Beecher, 1988). In both humans and mammals, similarity in odor has been shown to distinguish kin from non-kin (e.g., Heth, Todrank, & Johnston, 1999). Phenotypic resemblance in physical features can also be used as a kinship cue. Indeed, fathers tend to favour children (i.e., provide more resources) who look more like them (Apicella & Marlowe, 2004; Burch & Gallup, 2000). In a hypothetical scenario,

parents (particularly fathers) are more likely to adopt unfamiliar infants when the perceived level of physical resemblance between the parent and infant is high (Volk & Quinsey, 2002, 2007). In a college sample of participants, DeBruine (2005) found that, when presented with the faces of opposite-sex strangers that were either physically similar to or different from themselves, participants rated the similar strangers as less sexually attractive and more trustworthy.

Maternal perinatal association. In humans, parents (especially mothers) expend extensive resources in caring for their children. In our ancestral past, observing your mother care for an infant was a reliable indicator that this infant was likely your relative, since the subsistent conditions of ancestral societies would limit the degree of solicitude expended to non-relatives. This is referred to as maternal perinatal association (MPA), and has been found to be a reliable kinship cue for older siblings. Importantly, this cue is only valid for older siblings (e.g., an older brother seeing his mother caring for a younger sister as an infant), as this cue cannot be available for younger siblings. Lieberman et al., (2007) found that, in older siblings, MPA predicted altruistic behaviour directed toward their younger sibling as well as incest avoidance, even after controlling for the effects of physical proximity.

Maternal infidelity. A mother has the evolutionary advantage of being certain that her child shares 50% of her genes, because (ancestrally) mothers carry their child during pregnancy and give it birth. A father, however, is unable to guarantee genetic relatedness to his child, as his partner may have conceived the child with another man. Unless genetic testing is conducted, a father can never be certain of his paternity. Indeed, it has been conservatively estimated that approximately 2% of men in the general population are unknowingly raising a child who shares none of their genes (see Anderson, 2006). Genetic testing is a new technology, thus selection pressures have promoted the evolution of traits that allowed humans to identify cues of paternity

in ancestral environments. Suspicions of maternal infidelity either by one's mother (in the case of siblings), or one's spouse in the case of fathers, are an indication of relatedness uncertainty. For siblings, this may include conflict between parents, suspected infidelity by their mother, as well as a lack of solicitude by their father toward their sibling, a cue that their father suspects the child is not his own. For fathers, this may include spousal relationship conflict, suspicions of infidelity, and relationship quality (e.g., time spent together or apart) prior to and around time of conception (Billingsley, Antfolk, Santtila, & Lieberman, 2018).

Physical proximity. Westermarck (1891/1921) postulated that close physical proximity during childhood facilitates sexual indifference because early physical proximity is a kinship cue. Family members who do not have early, close physical proximity with one another are theorized to be at an increased risk of incestuous behaviour, because this lack of physical proximity has facilitated the incest avoidance mechanism to fail to activate or to be weakened. This theory has been empirically supported in sibling incest avoidance.

Shepher (1971) studied Israeli *kibbutzim* - collective communities where communal child rearing practices are observed - to examine incest avoidance. From birth, children live separately from their parents, in groups of same-aged peers (known as a *kitah*) that are taken care of by an unrelated caregiver (e.g., a nanny). Children of the same *kitah* live together, play together, and are educated together, from birth to adulthood. Importantly, no formal or informal pressures or sanctions exist in these communities against sexual activity between members of the same *kitah*. Utilizing a naturalistic observational design in one kibbutz community, Shepher (1971) found that there were no instances of sexual activity between members of the same *kitah*, nor were there any recorded marriages between members of the same *kitah*. There were, however, instances of sexual activity between members of different *kitahs* from the same kibbutz.

community. Furthermore, in a historical analysis of marriage records from all kibbutzim in Israel, the author found no cases of true intra-kitah marriage ($N = 2,769$). While there were a small number ($N = 14$) of marriages that involved members of the same kitah, these cases involved children who joined the same kitah after the age of 6, or, if they joined the same kitah before the age of 6, they were never in the same kitah for more than two years. These results suggest that children who are raised together from before the age of 6 are unlikely to form romantic or sexual relationships. Other authors have found similar results when studying this unique population (Spiro, 1958; Talmon, 1964). Relatedly, these observations could also be associated with ancestral selection pressures that favoured genetic diversity. Ancestral humans lived in small, isolated communities. Even among unrelated individuals from the same community, there was little genetic differentiation in the population (Tishkoff & Verrelli, 2003). It was therefore advantageous from a fitness perspective to seek reproductive partners from outside of the community, to increase genetic diversity. Indeed, in a meta-analysis of 34 datasets across multiple species (e.g., plants, invertebrates), there is a moderate-large correlation ($r=.43$) between genetic diversity and population level fitness (Reed & Frankham, 2003).

In another study involving a different population, Wolf (1995) examined Taiwanese marriage records associated with major and minor forms of arranged marriage. Major marriages were those where the bride and groom do not know each other in childhood, often not meeting until the day of the wedding. Minor marriages, in contrast, were those where the bride is adopted into the groom's family in infancy or early childhood and raised alongside the groom until they marry as adults. Wolf (1995) found that couples in minor marriages had fewer children and more divorces compared to major marriages, which suggests that there are factors that inhibit reproductive fitness in couples who are raised together from a young age.

In a more modern examination of incest avoidance, Bevc and Silverman (1993/2000) surveyed a sample of university students and found that siblings who were separated for more than one year in the first 10 years of their life were more likely to engage in behaviour that could lead to reproduction (i.e., penile-vaginal intercourse) compared to siblings who were not separated in childhood; these two groups of siblings did not differ in non-reproductive behaviours such as kissing or masturbation. Moreover, Lieberman et al. (2007) found that the amount of physical proximity in childhood between siblings significantly predicted both altruistic motivations and opposition to sibling incest, but only when a younger sibling was detecting an older sibling. Lieberman et al. (2007) suggested that the effect of physical proximity on incest avoidance is particularly important for younger siblings. This is because older siblings have access to an additional kinship cues that younger siblings cannot access: *Maternal Perinatal Association* (MPA). However, when a younger sibling is detecting an older sibling, they do not have access to the MPA kinship cue and must rely more heavily on other kinship cues, such as physical proximity.

Although not originally intended to explain father-daughter incest avoidance, the Westermarck (1891/1921) hypothesis may have implications for this form of incest as well. Parker and Parker (1986) found that non-incestuous fathers were more likely to be present in the home during their daughters' early childhood compared to incestuous fathers. However, a very prominent confound existed in this study - fathers could be voluntarily choosing to spend less time with their children. As such, men who choose not to spend time with their children (e.g., because of a lack of *parental solicitude* - the degree of affection, care, and concern a parent experiences toward their child - or because of a high degree of antisociality) may also be more likely to engage in incest. Williams and Finkelhor (1995), on the other hand, controlled for this

potential confound by examining physical proximity between fathers and their daughters in a sample of men in the Navy. These men were often deployed, and thus spent significant amounts of time away from their children, but these separations were not voluntary. These authors did not find a meaningful difference in the proportion of time spent away from home in the first four years of their daughter's life between incestuous and non-incestuous fathers, but did find that a lower frequency of performing behavioural measures of solicitude (e.g., feeding child, bathing child), and higher levels of marital dissatisfaction, were related to an increased risk of incest. These results do not support the Westermarck hypothesis as a viable explanation for father-daughter incest, although do suggest that other family dynamic factors could be important.

First Order Proximate Mechanisms that Facilitate Incest Avoidance

On the individual level, reactions to the idea of incest typically do not involve conscious thought. Almost no one thinks to themselves, "*I'm going to avoid sexual behaviour with this person because it is maladaptive*". Instead, humans have developed psychological mechanisms that promote incest avoidance. When there is relatedness uncertainty, these psychological mechanisms are less likely to be activated or are less effective (Lieberman et al., 2007).

Disgust. Humans usually have no interest in sexual or romantic relationships with their family members. When asked to think about such a relationship, the idea of sex with a close relative usually evokes strong emotional responses, especially disgust. Disgust is an emotional reaction that has been shown to promote the avoidance of objects, situations, and behaviours (including sexual behaviours) that may be harmful to evolutionary fitness (see Tybur, Lieberman, & Griskevicius, 2009, for a review). Once an incest avoidance mechanism has been triggered, due to the presence of cues that indicate kinship or the absence of cues that indicate relatedness uncertainty, a disgust response occurs toward the idea of sex with that particular

individual. It is important to note that disgust toward incest might also be culturally influenced, as there are very strong incest taboos in most societies (see Wolf, 2014, for a review). Not only is it likely that our motivation to engage (or not) in incest has been shaped by evolutionary forces during our natural history, but also social norms that prohibit incestuous behaviour.

There are very few behaviours that are considered universally forbidden. From a social and moral perspective, however, the universal condemnation of sexual behaviour with a close relative (known as the *incest taboo*) is one example. Regardless of whether an individual has a potential incestuous partner, most people will express an aversion to incest based on the incest taboo. Disgust toward incest, however, is stronger in individuals who have an opposite-sex sibling than those who have a same-sex sibling, and in men, ratings of disgust linearly increase as the number of opposite-sex siblings increase (Fessler & Navarrete, 2004). These findings suggest that although anyone could have a disgust response toward incest, the relative response is higher in individuals who have a potential incestuous partner (e.g., an opposite-sex sibling). Lieberman et al., (2007) found that the more physical proximity between siblings there was in childhood (aged 0-18), the more disgust they felt toward sibling incest, using multiple measures of disgust toward incest (see also Lieberman, Tooby, & Cosmides, 2003). This hypothesis, however, has not been explored in father-daughter incest. Based on studies of sibling incest avoidance, we would expect heterosexual fathers who have daughters to exhibit more disgust toward incest than heterosexual fathers who have sons, and ratings of disgust would be expected to increase as the number of daughters increase.

There is a small body of research that suggests that, as opposed to developing a disgust response to protect ourselves from maladaptive sexual behaviour, the nature of sexual activity in-and-of itself includes many disgust eliciting properties (e.g., saliva, sweat, semen). Thus, humans

have evolved an arousal response to sexual activity, in order to overwhelm the disgusting nature of sexual activity. In an experimental study with male university students, Stevenson, Case, and Oaten (2011) found that participants who were in the experimental condition - induced sexual arousal via erotic female images – self-reported less disgust toward sex related disgust elicitors than participants in the control condition who were not sexually aroused. Furthermore, in a sample of female university students, Borg and de Jong (2012) sorted participants via a mood induction procedure into a sexual arousal (erotic film), positive arousal (e.g., skydiving, mountain climbing) or neutral arousal (a train ride) group. After viewing the films, participants were asked to engage in a variety of behavioural tasks designed to induce different types of disgust. For example, to elicit sexual disgust, participants were asked to stick their finger in a bowl of used condoms. In reality, the condoms were new and covered in lubricant. To elicit core disgust, participants were asked to take a sip of juice from a cup with a large insect in it (in reality, the insect was plastic). The sexual arousal group rated the sex related disgust stimuli as less disgusting, compared to both the positive arousal and neutral groups. Furthermore, the sexual arousal group completed more of the tasks than the other groups, indicating that sexual arousal inhibited disgust generally, as opposed to being specific to sexual disgust. This body of

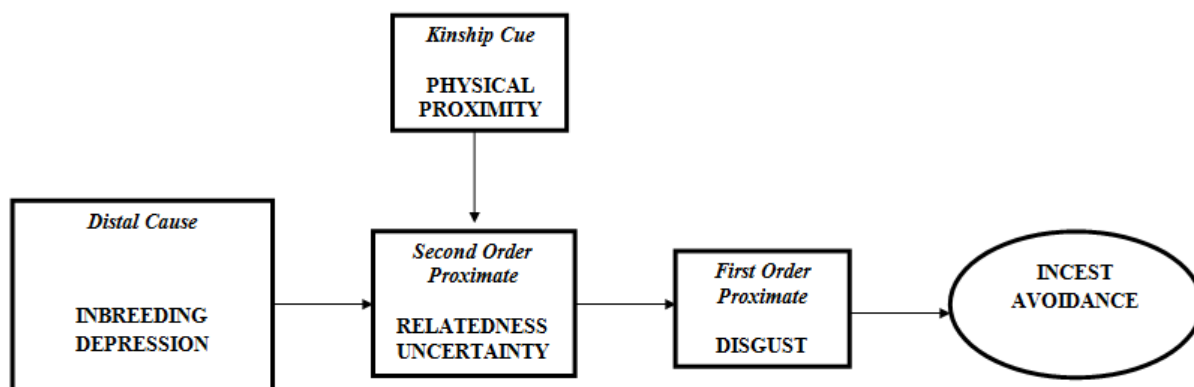


Figure 1. *Etiological Sequence for the Development of Incest Avoidance*

research yields alternative interpretations of the Westermarck hypothesis. For example, as opposed to physical proximity promoting the development of disgust, disgust is already present, and physical proximity prevents the development of sexual arousal, so that disgust cannot be overwhelmed.

Methodological Obstacles to Studying Incest

There are a variety of issues that arise when studying the topic of incest. This section highlights some of these obstacles, and provides an explanation of how these obstacles can be addressed for the purpose of research.

Degree of relatedness. One of the methodological obstacles when researching incestuous behaviour is how to define incest. There are important reasons to distinguish between different types of incest, especially when viewing incestuous behaviour through an evolutionary psychology framework. For example, the risk of inbreeding depression increases as the amount of shared genes between relatives increases. Full siblings (same mother and father) share 50% of their polymorphic genes (genes that determine individual differences in the population), as do biological fathers with their biological children. However, half-siblings (one shared parent) only share 25% of their polymorphic genes. Furthermore, step-siblings share no common polymorphic genes; neither do step-fathers with their step-children. Due to the risk of inbreeding depression, all else being held constant, it is therefore expected that incest will be rarest among full siblings and between fathers and their biological children, but less rare as the number of shared genes between relatives decrease.

Indeed, from a biological perspective, sexual behaviour involving a sociolegal relative (e.g., step-child, step-sibling) is not incest, though it can still trigger the incest taboo, and therefore is not accompanied by the potential costs of in-breeding depression. Moreover,

investment in a non-relative doesn't increase inclusive fitness. Daly and Wilson (1998) suggest that, on average, step-parents expend less investment into step-children than would a biological parent. This is because such investments do not promote the step-parents' inclusive fitness as the child they are caring for does not carry the parents' genes. Consistent with this view, the authors found that in blended families (those with one genetic parent and one step parent), children have 100 times greater odds of being fatally abused compared to children in families with two genetic parents (see also Archer, 2013; Hilton, Harris, & Rice, 2015; Sedlak, 2010). Although these authors do not specifically address the proposition, the same tenets would be applicable in biological vs. sociolegal sibling relationships as well. Indeed, being sociolegal siblings is associated with an increased risk of severe intra-sibling violence (Khan & Cooke, 2008).

As previously mentioned, however, genetic relatedness cannot be directly observed. Humans rely on cues to genetic relatedness, such as physical proximity. For example, in the examination of kibbutzim communities (Shepher, 1971), children who were completely unrelated but were raised together from a young age were still unlikely to develop sexual relationships with one another, even though there was no risk of inbreeding depression. On average, sociolegal relatives are less likely to receive kinship cues such as physical proximity, given the nature of typical sociolegal family compositions and trajectories (e.g., step-siblings are more likely to join the family later, after the dissolution of a person's biological parent's relationship and one parent forming a new romantic relationship). Nonetheless, it is the presence of kinship cues, and not the actual degree of genetic relatedness, that facilitates incest avoidance. The question still remains, therefore, whether incest occurring between biological and sociolegal relatives stem from the same defective incest avoidance mechanisms that rely on such kinship cues, or if understanding the causes of sociolegal incest can more accurately be explained by

non-evolutionary theories focused on the causes of child sexual abuse more generally.

Socially desirable responding. The most straightforward method for investigating incestuous behaviour is asking participants to self-report whether they have ever engaged in sexual behaviour with a given type of relative. In non-forensic samples (e.g., general population), however, this may evoke socially desirable responding, especially if such behaviour is illegal. This obstacle is particularly salient when examining father-daughter incestuous behaviour because not only is incest in and of itself illegal in many countries (including Canada), but so is sexual behaviour with a person under the age of 18, if you are in a position of authority, trust, or supervision. Additionally, depending on the sample being studied, the rate of incestuous behaviour may be very low, making it difficult to perform quantitative analyses unless very large samples are collected. In situations where self-report of incestuous behaviour is not feasible or ideal, researchers can measure an individual's propensity for incestuous behaviour.

Based on the premise of *egocentric empathy* (Fessler & Navarrete, 2004), in which an individual experiences another person's behaviour as if it were their own, participants can be asked to read a description of third-party incestuous behaviour. The described actors are not themselves or one of their own relatives, but the relationship is the same (Fessler & Navarrete, 2004), and asked questions that would indicate a propensity for the behaviour described. Indirect questions assessing the likelihood that the individuals in the description would continue to engage in the incestuous behaviour, as well as direct measures of arousal toward the incestuous behaviour described may be used to measure a propensity for incestuous behaviour.

Measuring disgust. To explore disgust as a proximate mechanism that facilitates incest avoidance, researchers must first identify the best way to measure disgust toward incest. In a community sample, asking a participant how disgusting they find the idea of sex with a specific

family member may produce results that are biased by socially desirable responding, and thus may generate ceiling effects (i.e., many respondents would rate their disgust as maximally high, with little to no variability). Ceiling effects would prevent the meaningful analysis of disgust responses. One method for reducing this ceiling effect, again based on the premise of egocentric empathy (Fessler & Navarrete, 2004), is to ask participants to read a description of third-party incestuous behaviour and rate how disgusting they find the described scenario. This method reveals feelings of disgust toward the idea of incest with one's own kin, but reduces the possibility of generating a ceiling effect (Antfolk, Lieberman, & Santtila, 2012). More recently, Lespiau and Kaminski (2016) replicated the results of Antfolk et al. (2012), confirming that third-party descriptions of incest elicit a level of disgust toward incest that is reflective of true level of disgust but the magnitude is reduced, compared to first-party descriptions of incest.

Furthermore, researchers have begun to speculate that there is a connection between the emotion of disgust and moral judgements. Based on the Affect-as-Information theory introduced by Schwarz and Clore (1983), when people make judgements about an object or situation, they rely on their affect as signaling information. Situational evaluations typically involve an attitude heuristic (i.e. "how do I feel about this?"). Individuals will infer their judgement based on their affect. If a person feels disgust, therefore, they will judge a situation more severely than if they do not feel disgust. Asking an individual to rate how morally wrong they view a particular situation should involve a moral judgement which uses the feeling of disgust as diagnostic information.

Empirical evidence for the connection between disgust and moral judgements has been found using many different research designs. For example, there is substantial neurological overlap between areas of the brain that are activated when feeling disgust and when making a

moral judgement (Moll et al., 2005). Additionally, disgust is known as one of the six universal facial expressions (Ekman et al., 1987), and facial expressions of disgust elicited by aversive tastes or viewing contaminants are very similar to facial expressions produced from moral transgressions (Chapman, Kim, Susskind, & Anderson, 2009). Schnall, Haidt, Clore, and Jordan (2008) conducted a series of experiments in which they found that artificially eliciting a disgust response provoked participants to rate a number of situations more severely in regard to moral wrongness than individuals in the control conditions when disgust was not provoked. This was a linear relationship: The more disgust that was evoked, the more severely they regarded the moral transgression. Additionally, the effect was specific to the induction of disgust, in comparison to sadness, suggesting that it is not non-specific negative affect that is influencing this relationship. Based on this literature, disgust toward incest can be measured through third-party descriptions of incestuous behaviour, as well as with judgements of moral wrongness toward the incestuous behaviours described.

Limitations of the Current Literature

Most of what is currently known about incestuous behaviour is based on criminal or clinical samples of sexual offenders, particularly in the case of incest perpetrated by fathers. This type of research can provide useful information to inform forensic and clinical practices with correctional samples. Additionally, although results from these forensic samples cannot be generalized to the larger population of those who engage in incestuous behaviour, it is expected that evidence of the same risk factors would be found in non-forensic populations of those who engage in incest as well. However, much of this research has neglected to incorporate evolutionary theory into their examination of factors associated with incest. Furthermore, many of these studies do not take into account different types of relationships (biological vs.

sociolegal) between the offender and the victim, which is an important consideration for evolutionary literature. Only a select few studies (Parker and Parker, 1986; Williams & Finkelhor, 1995) have examined how physical proximity influences the likelihood of incest between fathers and daughters, albeit in forensic samples; much more evidence is needed, particularly in non-forensic samples. Additionally, these studies do not address first order proximate mechanisms that are directly responsible for inhibiting incest.

While some research in the area of sibling incest has investigated correlates of incest in non-forensic samples with a focus on evolutionary hypotheses, many of these samples are either of special populations (e.g., on kibbutzim; Shepher, 1971) or rely on university student samples (e.g., Fessler & Navarrete, 2004). Research examining first and second order proximate mechanisms that facilitate incest avoidance among siblings is much farther along than research examining these mechanisms among fathers. To the best of my knowledge, however, no study has formally tested the prediction that disgust toward incest mediates the relationship between physical proximity and incestuous *behaviour* among siblings.

Aim of Dissertation

The current dissertation addresses many of the limitations of past research. The goal of this dissertation is to broaden our understanding of factors associated with incest by drawing predictions from the vast evolutionary literature on incest avoidance mechanisms. Study 1 is a meta-analysis that examines differences between adult biological and sociolegal incest offenders, primarily fathers. Although offender samples are not necessarily generalizable to the larger population of individuals who engage in incest, this study can help to establish knowledge about differences between these two groups, as a context for the design of studies with non-forensic populations. Findings of meaningful differences between biological and sociolegal incest

offenders provides a rationale for why these two types of offenders should be separated when examining risk factors for incestuous offending in forensic samples. Furthermore, finding differences between these two types of offenders also provides a meaningful justification for why differences between individuals who engage in biological and sociolegal incest in non-forensic samples should be examined, to assess whether the etiology of each type of incest could involve different mechanisms. Lastly, it also determines what is known about differences between biological and sociolegal incest offenders, which in-and-of itself can guide research and clinical practice in this area. For example, finding that biological and sociolegal incest offenders differ in their criminality would indicate that clinical interventions with sexual offenders that focus on antisociality may be more appropriate for one type of incest offender than the other. Information gathered from this study has been used to inform the methodological design and statistical analyses of Studies 2 and 3.

The goals of Studies 2 and 3 were to evaluate second order proximate mechanisms that facilitate incest avoidance, first order proximate psychological mechanisms that are directly responsible for incest avoidance, as well as under what circumstances these mechanisms may fail, using more representative populations than have been used in much of the previous research in this area. One kinship cue associated with relatedness uncertainty will be investigated: Physical proximity. Additionally, disgust toward incest will be examined as a mediator of the relationship between physical proximity and the likelihood/propensity for incestuous behaviour. These hypotheses will be examined in a non-forensic sample of fathers who have daughters (Study 2), and a university and general population sample of opposite-sex siblings (Study 3). These evolutionary predictions have not been thoroughly examined in the context of father-daughter incest. It is therefore unknown whether physical proximity is a kinship cue used to

regulate incest avoidance for fathers. Although there have been previous studies that have examined the relationship between physical proximity and incestuous behaviour in samples of siblings, the majority of these studies have relied on special populations. Moreover, to the best of my knowledge, no study has formally tested the prediction that disgust toward incest mediates the relationship between physical proximity and incestuous behaviour among siblings. My hope is to contribute to the development of a comprehensive theoretical model of incest avoidance. Understanding is the first step to prevention. By understanding why and how incestuous behaviour happens, attention can, in turn, focus on prevention, assessment, and treatment to address this important social and clinical problem.

CHAPTER 2 – Study 1

General Introduction

There is a solid foundation for understanding the causes of sexual offending against children. This introduction will provide a summary of the theoretical and empirical literature concerning the etiology of sexual offending against children, followed by a discussion of how the existing literature addresses the puzzle of incestuous sexual offending. Finally, the rationale for the undertaken meta-analysis – to examine differences between biological and sociolegal incest offenders - will be presented.

Etiology of Sexual Offending

While an exhaustive examination of theories that have been proposed to explain the etiology of sexual offending is beyond the scope of this section, a brief review of some of the most prominent models have been described below. A more in-depth and critical examinations of these and other models of sexual offending can be found elsewhere (e.g., Ward, Polaschek, & Beech, 2006). This section focused on theoretical models of sexual offending against children, as the current body of literature on father-daughter incest in forensic samples has also focused on this population, and thus these are the studies available for analysis in the meta-analysis.

Finkelhor's (1984) precondition model was one of the first to acknowledge the complex nature of sexual offending against children. Finkelhor (1984) proposed a multi-factorial model that specified four preconditions in order for sexual offending against a child to take place: 1) a motivation to sexually abuse a child, 2) overcoming internal inhibitions, 3) overcoming external inhibitions, and 4) overcoming a child's resistance to the abuse. Finkelhor specified emotional congruence with children (affective and cognitive affinity with children; McPhail, Hermann, & Nunes, 2013), sexual interest in children, and blockage – the inability to satisfy emotional and

sexual needs in conventional ways – as key motivational factors. Overcoming internal inhibitions against child sexual abuse is also necessary, even in the face of a motivation to offend. Factors that may promote overcoming internal inhibitions include alcohol use, and self-regulation difficulties. Additionally, overcoming external inhibitions may include creating the opportunity to offend against a child; for example, by volunteering in a position that provides close contact with children. Lastly, the individual must overcome the child's resistance to the abuse. This may include giving gifts, grooming practices, or coercion and force.

Marshall and Barbaree's (1990) integrated theory of sexual offending was designed to explain the development and maintenance of sexual offending. These authors postulated that biological predispositions to aggressive behaviour in males, as well as developmental vulnerabilities in childhood (insecure attachment) caused by abuse and neglect, results in the development of social skills deficits and self-regulation issues in adolescents and adulthood. These issues inhibit an individual's ability to form appropriate relationships, and thus these individuals may turn to children or coercive sexual activity to fulfill their emotional and sexual needs.

Ward and Siegert (2002) reviewed these as well as other prominent theories of sexual offending (e.g., Hall & Hirschman, 1992), and based on this synthesis, created a comprehensive pathways theory of sexual offending. The authors postulate that there are a number of distinct etiological pathways that lead to sexual offending against a child. Each pathway is the result of a combination of different dysfunctional psychological mechanisms: Emotional dysregulation, cognitive distortions, social skill deficits and intimacy problems, and distorted sexual scripts. Importantly, the manifestation of distorted sexual scripts is the development of atypical sexual interests (e.g., pedophilia - sexual interest in prepubescent children) as a result of conditioning

through negative childhood experiences. The process by which all of these mechanisms become dysfunctional can stem from social learning (e.g., childhood abuse and neglect), biological vulnerabilities, and cultural factors.

More recently, Seto (2017) suggested a *motivation-facilitation model* (MFM) of adult sexual offending against children (see also Pullman, Stephens, & Seto, 2016; Seto 2008; Seto 2013). The MFM was utilized as the theoretical model that underpinned the structure and drove the hypotheses in Study 1, and thus is reviewed in more detail below. This model is strongly influenced by Finkelhor's precondition model of sexual offending (Finkelhor, 1984) described above, as well as Gottfredson and Hirschi (1990) general theory of crime – individuals who are low in self-control are more likely to commit a crime, if the opportunity to do so presents itself.

The MFM (Figure 2) postulates that there are a variety of factors, such as atypical sexual interests, hypersexuality, and high mating effort, which act as motivators to commit a sexual offence. In the presence of such motivations, both trait (e.g., self-regulation issues, antisocial personality) and state (e.g., alcohol intoxication, negative affect) facilitators can increase the likelihood of committing an offence, as can situational factors such as opportunity and victim vulnerabilities. The MFM is a parsimonious model of sexual offending. Unlike other theories that only identify specific risk factors as central to the etiology of sexual offending (e.g., insecure attachment), the MFM provides a general framework for understanding the relationship between a variety of motivational, facilitating, and situational factors associated with sexual offending, while also incorporating specific risk factors known to be related to the initiation and maintenance of sexual offending. For example, motivators such as atypical sexual interests and facilitators such as antisociality have been implicated in both the initiation (Whitaker et al., 2008) and persistence (Hanson & Morton- Bourgon, 2005) of sexual offending. Additionally,

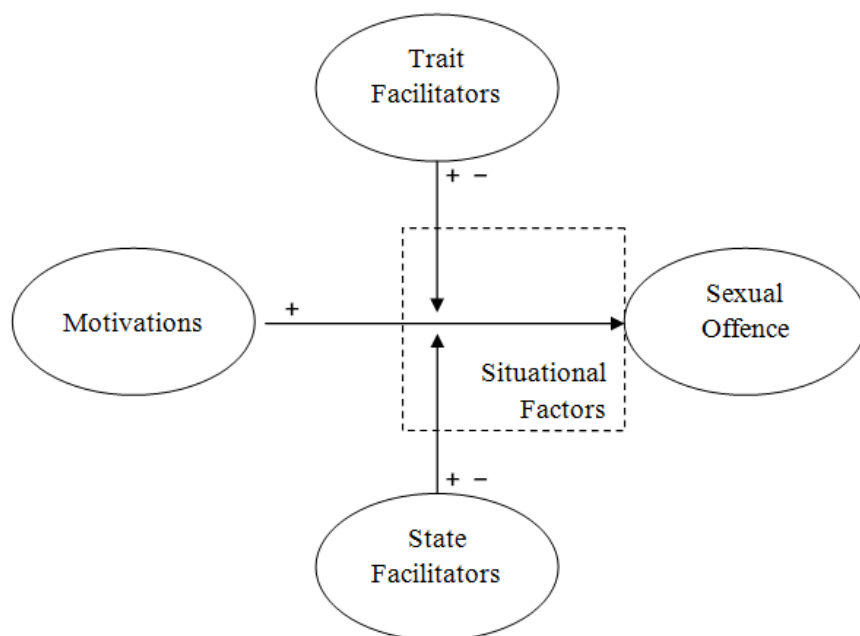


Figure 2. *Motivation-Facilitation Model of Adult Sexual Offending*

Note: Reproduced from Seto (2017)

state factors such as negative mood (e.g., Cortoni & Marshall, 2001) and alcohol use (Felson & Staff, 2010), as well as situational factors such as victim vulnerability (Barnes, Noll, Putnam, & Trickett, 2009) have been implicated in the offence process of sexual offenders as well.

Importantly, this model of sexual offending can be applied to sexual offending against children and adults. However, based on existing literature, it is unclear whether this model can be applied to many cases of incest offending between nuclear family members.

Etiology of Incestuous Sexual Offending

Incest offenders should have more external forces inhibiting their behaviour compared to those who offend against unrelated children, specifically, incest avoidance and incest taboo. It is expected that individuals who engage in incest would be more problematic in atypical sexual interests and/or antisociality, factors known to be associated with sexual offending, in order to overwhelm these inhibitions. However, a recent meta-analysis found that incestuous sexual

offenders against children are *less* likely to display atypical sexual interests or antisociality compared to sexual offenders against unrelated children (Table 1; Seto, Babchishin, Pullman, & McPhail, 2015). This meta-analytical review found that the factors known to explain sexual offending against unrelated children are not sufficiently present or robust in incestuous offenders to overwhelm inhibitory biological mechanisms and social mores. Hence, the factors that explain why someone offends against a related versus an unrelated child are likely different.

Table 1. *Differences Between Extrafamilial and Intrafamilial Sexual Offenders Against Children (Seto et al., 2015)*

Variables	Cohen's <i>d</i> [95% CI]	<i>Q</i>	<i>I</i> ²	N (k)
Atypical Sexual Interests				
Pedohebephilia (via PPG)	0.33 [0.24, 0.42]	11.24	0.0%	2,227 (15)
Other paraphilias	0.49 [0.35, 0.63]	10.68	34.4%	1,179 (8)
Sexual Preoccupation	0.13 [0.03, 0.24]	20.55*	56.2%	1,752 (10)
Antisociality				
Psychopathy (PCL-R)	0.22 [0.15, 0.30]	24.80**	55.6%	3,713 (12)
Self-regulation problems	0.10 [0.02, 0.19]	20.81	8.7%	2,939 (20)
Offence supportive attitudes	0.12 [0.03, 0.20]	19.82	29.4%	2,649 (15)
Low victim empathy	1.05 [0.75, 1.36]	3.38	40.9%	192 (3)

Note: Fixed-effect results presented. A positive *d* indicates that extrafamilial offenders had more characteristics that were inherently problematic (e.g., pedophilia) than intrafamilial offenders. If the 95% confidence interval does not include 0, it is statistically significant at $p < .05$. *k* = the number of studies included in the comparison. *N* = the number of participants across all studies in this comparison. *Q* = Cochran's *Q* statistic (Borenstein et al., 2009), a measure of variability. $I^2 = I^2$ statistic (Borenstein et al., 2009), an effect size for variability

In the robust literature examining characteristics and predictors of recidivism in sexual offenders, the distinction is typically made between individuals who commit sexual offences against related and unrelated children. However, theoretical models of the etiology of sexual offending either do not explicitly make this distinction and it is assumed that the model will also apply to incestuous offenders, or specify that the utility of the model with incestuous offenders is unknown. Thus, further examination of unique theories to explain incest offending is needed. Insights from evolutionary psychology are a promising starting point for examining the gaps that currently exist in the literature regarding the causes of incest in forensic populations.

Rationale for the Current Study

The rationale for undertaking the current study – a meta-analysis examining differences between biological and sociolegal incest offenders – is multi-faceted. First, although the distinction between individuals who offend against related and unrelated children is typically made in the empirical literature that examines characteristics and risk factors for recidivism among these populations, the distinction between different degrees of incest (i.e., biological or sociolegal) is not. It is unclear, therefore, whether heterogeneity in this population could be explained by this distinction. This examination in-and-of itself can be useful for practical intervention and treatment with offender populations.

Furthermore, theoretical models to explain the etiology of incest are not well developed. As more attention is being paid to this endeavour, it is important to provide a context for research that attempts to address this gap in the theoretical literature. For example, there are solid theoretical models that explain the etiology of sexual offending against children generally. If sociolegal incest offenders are found to be more problematic than biological incest offenders in domains known to be associated with the initiation and maintenance of sexual offending against children more generally (e.g., atypical sexual interests and antisociality), then these existing models may be able to account for individuals who commit crimes against sociolegal relatives. This finding would indicate that the puzzle of incest is less applicable to sociolegal relatives, and the development of theoretical models about incest should focus on biological relatives.

Differences Between Biological and Sociolegal Incest Offenders: A Meta-Analysis¹

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Contributions

While Lesleigh E. Pullman was the primary author of this manuscript, all authors contributed during manuscript preparation. L. E. Pullman conducted the systematic literature search, primary coding, and all primary analyses for this manuscript. M. L. Sawatsky double coded all studies included in the meta-analysis so inter-rater reliability could be conducted. Furthermore, she re-ran all analyses that were conducted to ensure accuracy. Fifteen studies that were found and initially coded from a previous meta-analysis (Seto et al., 2015) were also included in this meta-analysis. K. M. Babchishin, I.V. McPhail, and L. E. Pullman coded those previous studies. Therefore, K. M. Babchishin, and I.V. McPhail are included as co-authors. M. C. Seto supervised all work conducted for this manuscript.

Abstract

There is an important theoretical distinction between biological and sociolegal incest offenders, but this is not always recognized in clinical or empirical work. The purpose of the current meta-analysis was to examine the extent to which biological and sociolegal incest offenders differ on a number of theoretically or clinically relevant domains. In this meta-analysis, we compared a total of 4,192 biological incest offenders to 2,322 sociolegal incest offenders across 27 samples that were disseminated between 1984 and 2012 (*Mdn* = 1993). Sociolegal incest offenders exhibited more antisocial tendencies (general self-regulation problems, impulsivity, drug and alcohol problems) compared to biological incest offenders. Biological incest offenders exhibited more psychopathology (repression, mental health difficulties) compared to sociolegal incest offenders. Differences were generally small to moderate in magnitude. Contrary to expectations, there were no meaningful differences between groups on atypical sexual interests (*d*'s ranged from -0.09 to 0.11), though sociolegal incest offenders were more likely to have sexual self-regulation problems. One meaningful moderator emerged: whether the biological incest offender group was composed only of biological fathers or of both biological fathers and other biological relatives (e.g., uncles, grandfathers). The theoretical implications of these results are discussed, and areas of future research are highlighted.

Keywords: Biological incest; sociolegal incest; sexual offending; antisocial tendencies; atypical sexuality

Differences Between Biological and Sociolegal Incest Offenders: A Meta-Analysis

The global prevalence of child sexual abuse has been estimated as 18% for girls and 8% for boys (Stoltenborgh, van IJzendoorn, Euser, & Bakermans-Kranenburg, 2011; see also Stoltenborgh, Bakermans-Kranenburg, van IJzendoorn, & Alink, 2013), with approximately one third of these cases perpetrated by family members (Ogrodnik, 2010). There can be serious mental and physical health costs associated with child sexual abuse (e.g., Fergusson, McLeod, & Horwood, 2013; Ratican, 1992; Roberts et al., 2004), and incest victims experience greater negative consequences than victims of child abuse committed by non-relatives (Stroebe et al., 2012). Given the prevalence of child sexual abuse, as well as the mental and physical health costs associated with this behavior, understanding the causes of child sexual abuse is vital for prevention and may have implications for the treatment of the perpetrators.

Two broad factors that explain the onset and persistence of sexual offending against children are atypical sexuality and antisocial tendencies. *Atypical sexuality* includes paraphilias such as pedophilia and hebephilia (sexual interest in prepubescent and pubescent children, respectively) as well as excessive sexual preoccupation (sometimes referred to as hypersexuality or sexual compulsivity). *Antisocial tendencies* comprise a number of antisocial traits, including impulsivity, risk-taking, callousness, and offense-supportive attitudes and beliefs. These two factors have been highlighted in theoretical explanations of the onset of child sexual abuse (e.g., Quinsey, 1986; Seto, 2008, 2013). Indicators of atypical sexuality are highlighted as motivations for sexual offending against children, while antisocial tendencies are highlighted as facilitators of sexual offending against children (Pullman, Stephens, & Seto, in press; Seto, 2008). Indicators of atypical sexuality and antisocial tendencies are two of the strongest predictors of sexual and nonsexual recidivism in sexual offenders, indicating these variables play important roles in the

persistence of these behaviors (Hanson & Morton-Bourgon, 2004; Hanson & Morton-Bourgon, 2005).

Given evidence of incest avoidance and incest taboos (Thornhill, 1991; Wolf, 2014), we would expect incest offenders to be more problematic than extrafamilial offenders on indicators of atypical sexuality and/or antisocial tendencies in order to overcome these incest prohibitions. A recent meta-analysis, however, found that incest offenders against children were less problematic on multiple indicators of atypical sexuality (e.g., pedophilia, hebephilia, sexual self-regulation) and antisocial tendencies (e.g., criminal history, general self-regulation problems, psychopathy) compared to extrafamilial offenders against children (Seto, Babchishin, Pullman, & McPhail, 2015). This suggests that atypical sexuality and antisocial tendencies alone are not adequate to explain the crimes committed by incest offenders.

Only 3% of the samples included in the Seto et al. (2015) meta-analysis sampled exclusively biological incest offenders, defined as those who commit a sexual offense against a biologically related child (e.g., son/daughter, niece/nephew, grandchild). In 29% of the samples, incest groups comprised a mixture of biological and sociolegal incest offenders, where sociolegal incest was defined as those who commit a sexual offense against a socially or legally related child (e.g., stepchild, adopted child, child of a common-law partner). In 68% of the samples, the composition of the incest offender group was unknown. It is therefore unclear to what extent the results reported by Seto et al. are applicable across different types of incest offending.

Biological versus Sociolegal Incest

Among sex offenders against children, it is common practice to differentiate offenders based on their relationship to their victims, that is, between incest and extrafamilial offenders. However, another distinction that has been less widely recognized is that between biological and

sociolegal incest offenders (see Seto, 2008). There are important reasons to suspect there would be differences between biological and sociolegal incest offenders. From a biological perspective, sexual behavior involving a sociolegally related child is not incest because it is not accompanied by the potential costs of inbreeding depression and reduced offspring fitness. Inbreeding depression refers to the reduced survival and reproduction of offspring born from closely related individuals, as a result of combining harmful recessive alleles (see Charlesworth & Willis, 2009, for a review). Any offspring born from these incestuous unions would, on average, have greater morbidity or mortality and therefore would reduce the fitness of both parents.

Moreover, the genetically related child may experience psychological or physical injuries that reduce her later reproduction (e.g., later avoidance of sexual relationships or sexually transmitted infection that causes infertility). These effects in turn impact the fitness of the perpetrating relative, because inclusive fitness theory states that traits are selected for their impact not only on direct reproduction but on indirect reproduction of close genetic relatives (Hamilton, 1964). Thus, evolutionary theory expects selection against reproductive behavior between close genetic relatives. These same costs – inbreeding depression and reduced inclusive fitness as a result of harm to the child – do not apply to sociolegal relatives. Instead, sociolegal relatives might be inhibited by cultural taboos against incest and the resulting legal and social sanctions.

Additionally, the costs associated with inbreeding depression vary by the degree of genetic relationship. The cost of inbreeding depression would be lower for an uncle offending against his niece than for a father offending against his daughter, because fathers share more common genes with their daughters. Similarly, the inclusive fitness cost of psychological or physical harm to genetically related children is lower for uncles or grandfathers than for fathers.

These extended relatives (i.e., biological relatives other than fathers) will be referred to as non-paternal biological relatives.

Because of inclusive fitness and related parental investment, Daly and Wilson (1998) suggested that, on average, a stepparent expends less investment into a stepchild than a biological parent would toward a biological child. Although not explicitly stated by the authors, the same is true for a non-paternal biological relative. In a systematic review conducted by Archer (2013), the author found that children living with at least one stepparent had 7.7 times greater odds of being physically abused than those living with two genetic parents (median odds ratio across all studies reviewed). Similar results have been found for the incidence of sexual abuse in genetic parent versus stepparent families (Sedlak, 2010). Though most stepparents are loving and caring towards their sociolegally related children, Daly and Wilson suggest that less parental solicitude is related to less inhibition in expressing anger and physical abuse, which increases the risk of harm to stepchildren. Given these theoretical and empirical differences between biological and sociolegal parents, it is possible that sociolegal incest offenders will exhibit indicators (e.g., atypical sexuality and antisocial tendencies) that more closely resemble extrafamilial offenders than biological incest offenders.

The Present Study

The purpose of the current meta-analysis was to examine the extent to which biological and sociolegal incest offenders differ on a number of theoretically and clinically relevant factors. If there are meaningful differences between these two groups, then future research should account for these differences, which may eventually lead to more effective risk assessment, treatment, and case management with incest offenders.

Sociolegal incest offenders are expected to be more similar to extrafamilial offenders

against children than to biological incest offenders (Seto, 2008), because inbreeding depression and inclusive fitness explanations do not apply to the crimes committed by either sociolegal incest offenders or extrafamilial offenders. Specifically, we predicted that sociolegal incest offenders would be more problematic in the domains of antisocial tendencies and atypical sexuality compared to biological incest offenders, just as extrafamilial offenders are more problematic in these domains than incest offenders in general (Seto et al., 2015). Variables related to childhood abuse/neglect history, interpersonal deficits, and psychopathology were also examined because of their clinical importance in sexual offender management and treatment.

Method

Defining Incest

For the purposes of this meta-analysis, *biological incest* was defined as physical sexual contact or attempted contact by an adult toward a child (i.e., an individual under the legal age of consent in the jurisdiction where the study was conducted) who was genetically related to the offender, up to and including first cousins. This included those who offended against their biological child, niece/nephew, grandchild, sibling, or first cousin. Biological incest was defined broadly for this meta-analysis in order to acquire an adequate sample size to conduct the meta-analysis, because many studies did not differentiate between biological fathers and non-paternal biological relatives. We excluded adult-adult incest because few empirical studies exist.

Sociolegal incest was defined as physical sexual contact by an adult toward a child who was sociolegally but not genetically related to the victim. This included those who offended against stepchildren, adopted children, common-law children (i.e., the child of the offender's romantic partner, with whom they had been living with for at least one years), and other legally related relatives (e.g., step-siblings). Inclusion criteria specified that the offender sample: (1) was

predominantly adult, (2) was predominantly male, (3) included a sociolegal and biological incest group, (4) included at least 10 participants in each group, and (5) reported on one of the variables targeted by this review.

Selection of Studies

Web searches for studies comparing biological incest offenders and sociolegal incest offenders were conducted using PsycINFO, ProQuest Dissertations and Theses, Web of Science, National Criminal Justice Reference Service, and Medline using the following search terms: keywords (*child* molest*, or sex* offend**) AND (*incest* or intrafam**) AND (*bio* or genet* or step* or socio* or fath* or relat**). This search ended on May 31, 2014. Additional studies were also found by reviewing conference proceedings from the Association for the Treatment of Sexual Abusers (www.atsa.com), Google Scholar, and reviewing the reference lists of collected studies. Lastly, a call for unpublished studies was made using a number of email listservs, including the Association for the Treatment of Sexual Abusers, SexNet, and SexLab.

Fifteen studies that included a comparison between biological and sociolegal incest offenders were identified during the searching and coding process of the Seto et al. (2015) meta-analysis. The comparisons between biological and sociolegal incest offenders were coded by that group of authors for those 15 studies. However, those results were not presented in the Seto et al., (2015) manuscript because there were too few studies to make meaningful comparisons. Inter-rater reliability for the Seto et al. meta-analysis which included these 15 studies was found to be acceptable (absolute intra-class correlation [ICC] based on one-way random and single measure = .88; κ *Mdn* = .73). The current meta-analysis included those 15 studies that had already been identified and coded, in addition to 16 new studies found during the database search.

Coding Procedure

The variables reported in this meta-analysis are restricted by the types of variables that have been previously reported. Broadly, they fall into the domains of atypical sexuality (e.g., pedophilia, sexual self-regulation), antisocial tendencies (e.g., criminal history, psychopathy), psychopathology (e.g., depression, anxiety), social deficits (e.g., detached relationship style, poor social skills), and adverse childhood history (e.g., childhood sexual abuse, physical abuse). Assignment of variables to domains was informed by the Seto et al. (2015) incest review to allow for comparison across the two meta-analyses. At the end of coding, only variables with three or more studies were included in the analysis.

For the 15 studies that were previously identified and coded by Seto et al. (2015), the descriptive information about the study and sample was recoded because an updated form was used for the current meta-analysis. However, the previously computed effect sizes remained the same because the same list of variables was used in this meta-analysis. The only exception was for three studies that had an overlapping sample with the newly found studies. In these cases, the previously coded study was grouped with the new overlapping study and recoded following the rules pertaining to overlapping studies in our coding manual (a copy of the coding manual is available upon request²).

Interrater Reliability

Interrater reliability analyses were conducted using the majority of the new studies collected. A small number of studies were used for practice coding ($k = 4$) and those collected during the Seto et al. (2015) meta-analysis which did not overlap with a new sample ($k = 12$) were previously found to have acceptable interrater reliability. All of the new studies were coded by the first and second authors. Continuous variables were assessed using absolute intra-class

² Coding manual can be found in Appendix A

correlations [ICC] based on a two-way mixed single measure design (Hallgren, 2012). Cicchetti (1994) suggests interpretive guidelines for ICC ratings of .40 as fair agreement, .60 as good agreement, and .75 as excellent agreement. Categorical variables were assessed using Cohen's kappa statistic (Cohen, 1960) and, given that kappa cannot always be computed, percent agreement was also provided. Landis and Koch (1977) suggest interpretive guidelines for Cohen's kappa of .21 for fair agreement, .41 for moderate agreement, .61 for substantial agreement, and .81 for almost perfect agreement.

Interrater reliability analyses for the descriptive statistics and moderators were based on 23 samples and excluded the 4 practice cases. ICCs for continuous variables ranged from .65 to 1.00 ($M = .96$, $Mdn = .99$). Percent agreement for categorical variables ranged from 52% to 100% ($M = 91\%$, $Mdn = 96\%$). Cohen's Kappa statistic for categorical variables (where kappa could be computed) ranged from .47 to 1.00 ($M = .77$, $Mdn = .83$). One variable was excluded from all analyses (i.e., whether the gender of the victim was based on the index offense or the complete victim pool) because the kappa value indicated that agreement between raters was below what you would expect by chance ($k = -.07$; percent agreement = 23%).

The two raters identified 92 common effect sizes, with a high rate of interrater agreement (absolute ICC based on a two-way mixed effects model and single measure = .98). Additionally, Rater 1 identified 10 additional effect sizes and Rater 2 identified 9 additional effect sizes. In such cases, the effect sizes were double coded once identified.

Overview of Analyses

Effect size. The effect size indicator used for this meta-analysis was Cohen's d . Cohen's d is a measure of the magnitude of the difference between two groups, in standardized units. For continuous variables, Cohen's d was calculated as: $d = (M_1 - M_2)/S_w$, where S_w signifies the

pooled within standard deviation (Cohen, 1988; Hasselblad & Hedges, 1995). For categorical variables expressed as a 2 x 2 frequency table, Cohen's d was calculated using Sánchez-Meca, Marín-Martínez, and Chácon-Moscoso's (2003) formula. Additionally, 0.5 was added to each cell to permit analyses when there were empty cells (Fleiss, 1994).

A positive d indicated that sociolegal incest offenders presented with a characteristic that was more problematic, rare, or risk-relevant compared to biological incest offenders. The problematic response category for each variable was explicitly stated prior to coding. For example, higher scores on a measure of psychopathy were considered risk relevant, but lower scores on a measure of income were considered more problematic. Cohen (1988) suggested that a d of 0.20 is small, 0.50 is moderate, and 0.80 is large; although these conventions do not necessarily conform to what would be considered clinically or practically meaningful (Hill & Black, 2006).

Aggregation of findings. Effect sizes across studies were aggregated using both fixed-effect and random-effects meta-analysis (Borenstein, Hedges, Higgins, & Rothstein, 2009). Meta-analysis is a statistical method for aggregating weighted findings across multiple samples, with the presumption that the aggregated findings are a more accurate measure of the effects associated with the variable of interest. While the results of both meta-analysis models are presented, we focused on the fixed-effect model to interpret results because all of the aggregated effect sizes included less than 30 studies, and the between-study variability component necessary for random-effects meta-analysis (T^2) becomes imprecise with a small sample size (Schulze, 2007).

Heterogeneity in effect sizes. In order to assess the degree of heterogeneity across studies, Cochran's Q statistic and the I^2 statistic were used (Borenstein et al., 2009). The Q

statistic provides a statistical significance test for variability in effect sizes across studies, above what would be expected by chance. The I^2 value is a measure of effect size for variability across studies and indicates the percentage of observed variability that is due to true heterogeneity as opposed to chance. I^2 values of 25% are considered low, 50% moderate, and 75% high (Higgins, Thompson, Deeks, & Altman, 2003).

A finding was considered an outlier if the overall variability (Q) was statistically significant ($p < .05$) and if a single extreme value (highest or lowest) accounted for more than 50% of the total variance (see Hanson & Bussière, 1998). When outliers were identified, results were presented both with and without the outliers in the analysis table, and the main interpretation focused on the finding with the outliers removed. Outliers were not removed in analyses with three samples because this would produce unstable results.

Moderator analyses. When there was a reasonable amount of variability in an aggregated effect size (e.g., $I^2 > 20\%$), fixed-effect meta-regression was used to examine the extent to which a continuous moderator candidate influenced the magnitude/direction of group differences (Borenstein et al., 2009). There are no definitive rules for sample size requirements and meta-regression (see Borenstein et al., 2009); moderator analysis was only conducted when there were at least six studies that reported on the moderator variable of interest in order to maintain some statistical power to detect an effect.

The between-level Q statistic was used to examine the extent to which a categorical moderator variable influenced the magnitude/direction of group differences. A statistically significant between-level Q statistic indicates that the moderator variable explained a significant portion of the variability across samples (Borenstein et al., 2009). Moderator analysis using the between-level Q statistic was only conducted when there were at least three studies at each level

of the moderator, consistent with the outlined procedure for this meta-analysis of only aggregating findings when there were three or more studies. The fixed-effect results are presented in text for the aggregated effect at each level of the moderator.

Publication bias. One of the largest threats to the validity of a meta-analysis is publication bias (Souza, Pileggi, & Cecatti, 2007). Publication bias is the tendency for studies that find null results to be less likely to be submitted or accepted for publication. The sources from which studies are gathered (primarily online databases of published journal articles) may therefore be biased towards significant findings. In this meta-analysis, 59% of the samples were from published studies ($k = 16$) and 41% of the samples were from unpublished studies ($k = 11$); therefore, unlike many meta-analyses and systematic reviews, there was a relatively even distribution of published versus unpublished work.

Evidence of publication bias can be assessed in a number of different ways (see Borenstein et al., 2009 for a review). For this meta-analysis, a series of Egger's regressions (Egger, Smith, Schneider, & Minder, 1997) were conducted. Egger's regression is a test of the asymmetry of the standard error by effect size funnel plot for a given variable. Publication bias is evident when this plot does not follow the standard funnel pattern (see Borenstein et al., 2009). Due to the low statistical power of these tests, evidence of asymmetry in the funnel plot was suggested when $p < .10$ (Egger et al., 1997). Egger's regressions were conducted for all variables that included six or more studies in the aggregated effect (outliers removed), in order to maintain statistical power.

Results

In total, 27 non-overlapping samples (31 individual studies) contributed to this meta-analysis. These studies were published between 1984 and 2012 ($Mdn = 1993$). Across the 27

samples, the sample size for biological incest offenders ranged from 11-1,862 (*Mdn* = 33, Total *N* = 4,192) and the sample size for sociolegal incest offenders ranged from 10-896 (*Mdn* = 33, Total *N* = 2,322). Only one study included female offenders (4%), with 12.5% of the sample in that study being female. Seven samples were from incarcerated offenders (26%), ten were from offenders in the community (37%), five included a combination of incarcerated and community offenders (18.5%), and in five samples the location of the offenders was unknown (18.5%). It was unknown whether participants were in treatment in 37% of the samples (*k* = 10). When this information was available, in 53% of the samples (*k* = 9) they were in treatment, in 41% (*k* = 7) they were not in treatment, and in 6% (*k* = 1) some were in treatment while others were not in treatment.

In half of the samples (52%, *k* = 14), it was unknown whether the biological incest offender group also included offenders who had unrelated victims. When this information was presented (*k* = 13), in only 23% of the samples (*k* = 3) did the biological incest offender group include individuals who also had at least one unrelated victim as well. Similarly, in 48% of the samples (*k* = 13) it was unknown whether the sociolegal incest offender group also included offenders who had unrelated victims. When this information was presented (*k* = 14), in only 21% of the samples (*k* = 3) did the sociolegal incest offender group include individuals who had at least one unrelated victim as well. In one sample (4%), biological incest offenders included some offenders who also had sociolegal incest victims, and in one sample (4%), sociolegal incest offenders included some offenders who also had biological incest victims. This occurred because in one study, mixed offenders (those who had both biological and sociolegal incest victims) were placed in the category of biological incest offenders, and in another study, biological uncles were grouped as sociolegal instead of biological incest offenders.

Table 2. *Descriptive Summary of the Samples*

Study #	Authors	Country	Biological Incest N	Sociolegal Incest N	Group Classification Method ¹	Age of Victims ²	Gender of Victims ³	Adversarial Degree
1	Akca (1986).	United States	16	26	Arrests/charges & convictions	Prepubescent	Female	Moderate
2	Bagley & Pritchard (2000).	United Kingdom	68	37	Arrests/charges & convictions	Unknown	Mixed	Low
3	Bennett (1985).	United States	17	14	Arrests/charges & convictions	Unknown	Unknown	Low
4	Blanchard et al. (2006).	Canada	59	33	Arrests/charges, convictions, self-report & other	Prepubescent	Female	Unknown
5	Buhk (1990).	United States	44	44	Arrests/charges & convictions	Unknown	Female	High
6	Dadds, Smith, Webber, & Robinson (1991).	Australia	23	23	Arrests/charges	Pubescent	Female	High
7	Dennison, Stough, & Birgden (2001).	Australia	17	11	Arrests/charges & convictions	Unknown	Unknown	Moderate
8	Ducro (2009).	Belgium	12	10	Arrests/charges & convictions	Unknown	Unknown	Moderate
9	Eher, Rettenberger, & Schilling (2010).	Austria	138	90	Arrests/charges & convictions	Unknown	Unknown	Moderate
10	Erickson, Walbeck, & Seely (1987).	United States	70	59	Arrests/charges & convictions	Mixed	Mixed	High
11	Gordon (1989).	United States	1862	896	Other	Mixed	Female	Unknown
12	Gordon & Creighton (1988).	United Kingdom	107	53	Other	Mixed	Female	Low
13.1	Greenberg, Firestone, Nunes, Bradford, & Curry (2005).	Canada	149	78	Arrests/charges & convictions	Prepubescent	Female	High
13.2	Greenberg, Bradford, Firestone, & Curry (2000).							
14	Groff & Hubble (1984).	United States	16	26	Arrests/charges & convictions	Mixed	Female	Unknown
15	Gullickson (1993).	United States	33	26	Arrests/charges & convictions	Unknown	Female	Unknown

Table 2 continued.

Study #	Authors	Country	Biological Incest N	Sociolegal Incest N	Group Classification Method ¹	Age of Victims ²	Gender of Victims ³	Adversarial Degree
16	Hills (2002).	Canada	18	25	Arrests/charges & convictions	Prepubescent	Unknown	Moderate
17	Kennedy (1995).	United Kingdom	11	19	Arrests/charges & convictions	Unknown	Mixed	Low
18.1	Langevin & Watson (1991).	Canada	143	87	Arrests/charges & convictions	Prepubescent	Mixed	High
18.2	Seto, Lalumiere, & Kuban (1999).							
18.3	Langevin, Wortzman, Dickey, Wright, & Handy (1988).							
19	Marban (1998).	United States	22	34	Arrests/charges & convictions	Unknown	Unknown	Low
20	Margolin & Craft (1989).	United States	1056	384	Other	Prepubescent	Unknown	Low
21	Rice & Harris (2002).	Canada	28	17	Arrests/charges, convictions, self-report, & other	Prepubescent	Mixed	High
22	Schaefer (1990).	United States	24	21	Arrests/charges & convictions	Prepubescent	Mixed	Low
23	Scott & Stone (1986).	United States	33	29	Arrests/charges & convictions	Prepubescent	Female	Moderate
24.1	Studer, Aylwin, Clelland, Reddon, & Frenzel (2002).	Canada	60	90	Arrests/charges & convictions	Unknown	Unknown	Moderate
24.2	Studer, Clelland, Aylwin, Reddon, & Monro (2000).							
25	Tetreault (2005).	Canada	40	42	Arrests/charges, convictions, self-report & other	Prepubescent	Unknown	High
26	Titcomb, Goodman-Delahunty, & De Puisseau (2012).	Australia	96	118	Arrests/charges	Prepubescent	Mixed	High
27	Vaccaro (1992).	United States	30	30	Arrests/charges & convictions	Prepubescent	Female	Low

¹ This variable describes how offender groups were identified. The "other" category refers to credible accusations and child protection agency files.

² Prepubescent included victim under age 12, pubescent included victims between ages 12 to 15, and teenagers included victims aged 15 to the legal age of consent where the study took place. The "mixed" category refers to the sample of offenders having victims across multiple categories.

³ Among all samples categorized as "mixed" ($k = 7$), the percentage of the sample with any male victims ranged from 4% to 23%

The majority of samples (63%, $k = 17$) defined biological incest as offenders who were genetic fathers to their victims. However, in 33% of the samples ($k = 9$), biological incest included other biological relationships as well (e.g., uncles, grandparents) and in 4% of the samples ($k = 1$) it was unknown how biological incest was defined. In the majority of the samples (85%, $k = 23$), sociolegal incest was defined as offenders who were in a parental relationship with their victims. In 7% of the samples ($k = 2$), however, sociolegal incest also included other sociolegal relatives (e.g., step-uncles, step-siblings) and in 7% of the samples ($k = 2$) it was unknown how sociolegal incest was defined. See Table 2³ for additional characteristics of the samples.

Demographic Characteristics

Table 3⁴ presents the results of the comparison between biological and sociolegal incest offenders on demographic characteristics. Biological incest offenders were older ($d = 0.11$, 95% CI [0.04, 0.19], $N = 3,102$, $k = 18$), had a lower income ($d = -0.21$ [-0.42, -0.001], $N = 1,786$, $k = 4$), and had more access to children ($d = -0.29$ [-0.44, -0.14], $N = 2,933$, $k = 4$), compared to sociolegal incest offenders. There was evidence of variability in these findings (I^2 ranged from 51.4% to 59.0%). Higher access to children was defined as having more contact with children through work, use of leisure time, or at home, and could include primary caregiving responsibilities. Biological incest offenders were also found to be less likely to have ever been married compared to sociolegal incest offenders ($d = -0.36$ [-0.69, -0.03], $N = 461$, $k = 5$); however, this is unsurprising as most sociolegal incest offenders need to be married (or equivalent) to the mother of their victim in order to be considered a sociolegal incest offender (e.g., stepfathers). This finding was consistent across studies ($I^2 = 0.0\%$).

³ In original manuscript, this was Table 1

⁴ In original manuscript, this was Table 2

Childhood Difficulties

Table 3 presents the results of the comparison between biological and sociolegal incest offenders on childhood difficulties. There were no differences between biological and sociolegal incest offenders on abuse in the family of origin, problems in the family of origin, physical abuse in childhood, or sexual abuse in childhood (d 's ranged from -0.02 to 0.10; I^2 ranged from 0.0% to 66.0%).

Atypical Sexuality

Table 4⁵ presents the results of the comparison between biological and sociolegal incest offenders on indicators of atypical sexuality. Sociolegal incest offenders were found to experience greater sexual self-regulation difficulties compared to biological incest offenders ($d = 0.31$, 95% CI [0.03, 0.59], $N = 203$, $k = 3$); this finding was consistent across the studies ($I^2 = 10.7\%$). This variable represents the inability to direct sexual urges and behaviors towards forms that are socially and personally acceptable, and includes excessive sexual preoccupation (frequency of sexual thoughts/behaviors) as well as sexualized coping (the use of sex as a coping response to stress). Contrary to our predictions, there were no differences between biological and sociolegal incest offenders in paraphilias (e.g., pedohebephilia, pedophilia, other paraphilias; d 's ranged from -0.09 to 0.11; I^2 ranged from 0.0% to 51.4%), or other types of sexual difficulties (e.g., problems in the sexual sphere; d 's ranged from 0.08 to 0.09; I^2 ranged from 0.0% to 45.4%).

Antisocial Tendencies

Table 5⁶ presents the results of the comparison between biological and sociolegal incest offenders on antisocial tendencies. Sociolegal incest offenders had more alcohol ($d = 0.25$, 95%

⁵ In original manuscript, this was Table 3

⁶ In original manuscript, this was Table 4

CI [0.05, 0.44], $N = 490$, $k = 5$) and drug ($d = 0.52$ [0.18, 0.86], $N = 358$, $k = 3$) problems compared to biological incest offenders. These findings were consistent across studies ($I^2 = 0.0\%$). Additionally, sociolegal incest offenders tended to score higher on psychopathy (PCL-R: $d = 0.23$ [-0.09, 0.55], $N = 153$, $k = 3$) than biological incest offenders, however, this comparison did not reach statistical significance. There was evidence of some variability in this finding ($I^2 = 54.4\%$). For the remaining antisocial tendency variables, d 's ranged from -0.01 to 0.18 (I^2 ranged from 0.0% to 68.9%).

Interpersonal Deficits and Psychopathology

Table 6⁷ presents the results of the comparison between biological and sociolegal incest offenders in the domains of interpersonal deficits and psychopathology. It was found that biological incest offenders were more likely to repress uncomfortable thoughts and feelings (as measured by the Repression scale of the Minnesota Multiphasic Personality Inventory; Welsh, 1956) compared to sociolegal incest offenders ($d = -0.44$, 95% CI [-0.75, -0.14], $N = 174$, $k = 3$); there was evidence of variability in this finding ($I^2 = 68.4\%$). For the remaining psychopathology variables, d 's ranged from -0.19 to 0.16 (I^2 ranged from 0.0% to 72.7%). Additionally, biological incest offenders were also more likely to experience social deficits (e.g., problems relating to people and social adjustment difficulties) compared to sociolegal incest offenders ($d = -0.21$ [-0.59, 0.17], $N = 109$, $k = 3$), although this comparison did not reach statistical significance. This finding was consistent across studies ($I^2 = 0.0\%$).

Moderator Analyses. We examined a few theoretically meaningful moderators that may impact the differences found between biological and sociolegal incest offenders; victim gender, the composition of the biological incest offender group, and treatment. Given the small number of studies included in many of the aggregated effects and the sample size requirements

⁷ In original manuscript, this was Table 5

Table 3. Comparison Between Biological and Sociolegal Incest Offenders Against Children on Demographic Characteristics and Childhood Difficulties

	Fixed-effect		Random-effects		Q	I^2	$N(k)$
	d	[95% CI]	d	[95% CI]			
Demographic Characteristics							
Young age ¹	0.11	[0.04, 0.19]	0.19	[0.05, 0.32]	35.00**	51.4%	3,102 (18)
Racial minority	-0.01	[-0.30, 0.27]	-0.03	[-0.35, 0.30]	4.70	14.8%	381 (5)
Never married	-0.36	[-0.69, -0.03]	-0.36	[-0.69, -0.03]	3.27	0.0%	461 (5)
No current relationship	-0.26	[-0.50, -0.02]	-0.39	[-0.88, 0.11]	13.65**	70.7%	683 (5)
No current relationship outlier removed	-0.18	[-0.42, 0.07]	-0.20	[-0.59, 0.20]	6.34	52.7%	453 (4)
Unemployed	0.12	[-0.14, 0.38]	0.12	[-0.14, 0.38]	2.34	0.0%	353 (5)
Low income	-0.21	[-0.42, -0.001]	-0.02	[-0.44, 0.41]	7.32	59.0%	1,786 (4)
Low educational attainment	-0.01	[-0.15, 0.12]	-0.01	[-0.15, 0.12]	7.72	0.0%	910 (11)
Low intelligence	-0.01	[-0.25, 0.24]	0.01	[-0.30, 0.32]	4.09	26.7%	314 (4)
High access to children	-0.20	[-0.34, -0.06]	-0.03	[-0.43, 0.36]	18.70***	78.6%	3,079 (5)
High access to children outlier removed	-0.29	[-0.44, -0.14]	-0.19	[-0.50, 0.12]	6.61	54.6%	2,933 (4)
High number of children	-0.11	[-0.36, 0.14]	-0.12	[-0.39, 0.16]	3.64	17.7%	335 (4)
Childhood Difficulties							
Abuse in the family of origin	-0.02	[-0.33, 0.29]	-0.02	[-0.33, 0.29]	1.59	0.0%	219 (3)
Problems in the family of origin	0.10	[-0.19, 0.38]	0.15	[-0.34, 0.65]	5.88	66.0%	253 (3)
Sexual abuse history	0.10	[-0.12, 0.32]	0.11	[-0.13, 0.34]	5.43	8.0%	553 (6)
Physical abuse history	0.07	[-0.20, 0.33]	0.07	[-0.20, 0.33]	1.79	0.0%	392 (4)

Note. A positive d indicates that sociolegal incest offenders exhibited characteristics that were inherently problematic (e.g., unemployment) or statistically rare (e.g., childhood sexual abuse) relative to biological incest offenders. Bolded values indicate that the group differences were statistically significant, $p < .05$.

¹ Trim-and-fill adjusted results: $d_{\text{fixed}} = 0.04$, 95% CI [-0.03, 0.12]; $d_{\text{random}} = 0.06$, 95% CI [-0.09, 0.21]

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

Table 4. *Comparison Between Biological and Sociolegal Incest Offenders Against Children on Atypical Sexuality*

	Fixed-effect		Random-effects		Q	I^2	$N(k)$
	d	[95% CI]	d	[95% CI]			
<i>Atypical Sexual Interests</i>							
Any paraphilia ¹	0.03	[-0.13, 0.20]	0.03	[-0.13, 0.20]	2.51	0.0%	862 (9)
Pedohebephilia-any assessment method	0.07	[-0.11, 0.25]	0.07	[-0.11, 0.25]	5.09	0.0%	821 (7)
Pedohebephilia – assessed via PPG	0.11	[-0.09, 0.32]	0.11	[-0.09, 0.31]	4.36	0.0%	600 (6)
Pedophilia - any assessment method	0.04	[-0.18, 0.26]	0.04	[-0.28, 0.37]	6.17	51.4%	630 (4)
Other paraphilias	0.31	[0.11, 0.52]	0.18	[-0.31, 0.66]	12.89**	76.7%	469 (4)
Other paraphilias outlier removed	-0.09	[-0.39, 0.22]	-0.09	[-0.39, 0.22]	0.40	0.0%	248 (3)
<i>Sexual Difficulties</i>							
Any prior sexual offenses	0.09	[-0.10, 0.28]	0.07	[-0.20, 0.34]	16.49	45.4%	969 (10)
Sexual self-regulation problems	0.31	[0.03, 0.59]	0.32	[0.01, 0.62]	2.24	10.7%	203 (3)
Problems in the sexual sphere	0.08	[-0.08, 0.24]	0.08	[-0.08, 0.24]	3.46	0.0%	767 (9)

Note. A positive *d* indicates that sociolegal incest offenders exhibited characteristics that were inherently problematic (e.g., pedophilia) relative to biological incest offenders. Bolded values indicate that the group differences were statistically significant, $p < .05$.

¹ Trim-and-fill adjusted results: $d_{\text{fixed}} = -0.02$, 95% CI [-0.17, 0.13]; $d_{\text{random}} = -0.02$, 95% CI [-0.17, 0.13]

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

Table 5. *Comparison Between Biological and Sociolegal Incest Offenders Against Children on Antisocial Tendencies*

	Fixed-effect		Random-effects		<i>Q</i>	<i>I</i> ²	<i>N</i> (<i>k</i>)
	<i>d</i>	[95% CI]	<i>d</i>	[95% CI]			
Any prior offenses	0.11	[-0.05, 0.26]	0.11	[-0.05, 0.26]	8.46	0.0%	942 (11)
Any prior violent offenses	0.18	[-0.16, 0.53]	0.22	[-0.21, 0.65]	4.53	33.7%	354 (4)
Self-regulation problems ¹	0.06	[-0.14, 0.26]	-0.01	[-0.30, 0.28]	18.10*	50.3%	665 (10)
Impulsivity ²	0.08	[-0.13, 0.28]	-0.01	[-0.34, 0.32]	18.20*	56.0%	619 (9)
Hostility	0.09	[-0.08, 0.25]	0.05	[-0.23, 0.33]	27.90**	64.1%	831 (11)
Any substance misuse	-0.01	[-0.11, 0.10]	0.09	[-0.13, 0.31]	28.90***	68.9%	2,536 (10)
Substance misuse during offense	0.12	[-0.12, 0.37]	0.12	[-0.12, 0.37]	0.70	0.0%	590 (5)
Alcohol misuse	0.25	[0.05, 0.44]	0.25	[0.05, 0.44]	3.67	0.0%	490 (5)
Drug misuse	0.52	[0.18, 0.86]	0.52	[0.18, 0.86]	1.71	0.0%	358 (3)
Antisociality	0.15	[-0.01, 0.31]	0.17	[-0.10, 0.43]	23.94**	58.2%	773 (11)
PCL-R	0.23	[-0.09, 0.55]	0.25	[-0.27, 0.77]	4.39	54.4%	153 (3)

Note. A positive *d* indicates that sociolegal incest offenders exhibited characteristics that were inherently problematic (e.g., substance use) relative to biological incest offenders. Bolded values indicate that the group differences were statistically significant, $p < .05$.

¹ Trim-and-fill adjusted results: $d_{\text{fixed}} = \mathbf{0.28}$, 95% CI [0.11, 0.45]; $d_{\text{random}} = 0.24$, 95% CI [-0.06, 0.55]

² Trim-and-fill adjusted results: $d_{\text{fixed}} = \mathbf{0.34}$, 95% CI [0.16, 0.52]; $d_{\text{random}} = 0.31$, 95% CI [-0.05, 0.66]

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

Table 6. *Comparison Between Biological and Sociolegal Incest Offenders Against Children on Interpersonal Problems and Psychopathology*

	Fixed-effect		Random-effects		Q	I ²	N (k)
	d	[95% CI]	d	[95% CI]			
Interpersonal Problems							
Any problems in the social sphere	-0.10	[-0.26, 0.06]	-0.10	[-0.26, 0.06]	0.99	0.0%	1,834 (5)
Social deficits	-0.21	[-0.59, 0.17]	-0.21	[-0.59, 0.17]	0.50	0.0%	109 (3)
Detached relationship style	-0.07	[-0.27, 0.13]	-0.07	[-0.27, 0.13]	3.71	0.0%	648 (9)
Psychopathology							
Mental health difficulties ¹	-0.17	[-0.36, 0.02]	-0.07	[-0.44, 0.29]	29.31***	72.7%	2,071 (9)
Anxiety	0.02	[-0.15, 0.19]	0.02	[-0.21, 0.24]	14.24	36.8%	703 (10)
Depression	-0.01	[-0.21, 0.20]	-0.03	[-0.37, 0.32]	18.78**	62.7%	597 (8)
Depression outlier removed	-0.19	[-0.41, 0.03]	-0.19	[-0.41, 0.03]	2.22	0.0%	535 (7)
Repression	-0.44	[-0.75, -0.14]	-0.35	[-0.92, 0.21]	6.33*	68.4%	174 (3)
Socially desirable responding	0.16	[-0.10, 0.42]	0.17	[-0.12, 0.45]	6.02	17.0%	283 (6)
Severe mental disorder	0.04	[-0.18, 0.26]	-0.02	[-0.37, 0.34]	12.55*	60.2%	341 (6)
Personality disorder	0.05	[-0.17, 0.27]	0.05	[-0.17, 0.27]	1.33	0.0%	395 (4)

Note. A positive *d* indicates that sociolegal incest offenders exhibited characteristics that were inherently problematic (e.g., social deficits) relative to biological incest offenders. Bolded values indicate that the group differences were statistically significant, $p < .05$.

¹Trim-and-Fill adjusted results: $d_{\text{fixed}} = \mathbf{-0.28}$, 95% CI [-0.46, -0.11]; $d_{\text{random}} = -0.24$, 95% CI [-0.60, 0.12]

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

associated with moderator analysis, investigation of moderators was limited to prior sexual offenses, substance abuse, and anxiety.

Prior sexual offenses. Group differences on prior sexual offenses were not moderated by the percentage of biological incest offenders who had any male victims ($Z = -0.93$, $p = .353$, $k = 7$), or the percentage of sociolegal incest offenders who had any male victims ($Z = -0.81$, $p = .419$, $k = 7$).

Whether the biological incest offender group was composed entirely of biological fathers, or whether it included biological fathers as well as other biological relatives, moderated group difference on prior sexual offenses (between-level $Q = 4.88$, $p = .027$, $k = 10$). When the biological incest offender group was composed entirely of biological fathers, sociolegal incest offenders had more prior sexual offenses ($d = 0.23$, 95% CI [0.01, 0.46], $N = 607$, $k = 7$, $I^2 = 42.3\%$). Conversely, when the biological incest offender group included fathers as well as other biological relatives (e.g., uncles, grandparents), biological incest offenders had more prior sexual offenses ($d = -0.24$ [-0.59, 0.11], $N = 362$, $k = 3$, $I^2 = 0.0\%$).

Substance abuse. The composition of the biological incest offenders group also moderated group differences on substance abuse (between-level $Q = 11.95$, $p = .001$, $k = 9$). When the sample was composed entirely of biological fathers, biological incest offenders had more substance abuse problems ($d = -0.16$ [-0.28, -0.03], $N = 2,043$, $k = 6$, $I^2 = 21.7\%$). Conversely, when the sample was composed of biological fathers and other biological relatives, sociolegal incest offenders had more substance abuse problems ($d = 0.26$ [0.06, 0.46], $N = 405$, $k = 3$, $I^2 = 65.3\%$).

Anxiety. Whether the participants were in treatment at the time of the study did not moderate the group difference in anxiety (between-level $Q = 0.30$, $p = .587$, $k = 6$).

Publication Bias

A series of Egger's regressions were conducted to assess whether there was evidence of publication bias for all variables that included at least 6 studies in the aggregated effect ($n = 20$). Positive statistically significant ($p < .10$) Egger's regressions were found for young age (intercept = 1.33, $p = .027$, $k = 18$), any paraphilias (intercept = 0.97, $p = .073$, $k = 9$), and mental health difficulties (intercept = 4.88, $p = .098$, $k = 9$). Negative, statistically significant Egger's regressions were found for self-regulation problems (intercept = -3.80, $p = .044$, $k = 10$), and impulsivity (intercept = -3.73, $p = .070$, $k = 9$). In order to correct for this bias, the Trim-and-Fill method (Duval & Tweedie, 2000) was used. The fixed-effect results are presented below.

For young age, this method adjusted for six studies to the left of the mean effect size, resulting in an effect size smaller than that reported in Table 3 (Original results: $d = 0.11$, 95% CI [0.04, 0.19]; Trim-and-Fill results: $d = 0.04$, 95% CI [-0.03, 0.12]). For any paraphilias, this method adjusted for three missing studies to the left of the mean effect size. However, this resulted in a very similar effect size to that originally reported in Table 4 (Original results: $d = 0.03$ [-0.13, 0.20]; Trim-and-Fill results: $d = -0.02$ [-0.17, 0.13]). For mental health difficulties, this method adjusted for two missing to the left of the mean effect size and resulted in an adjusted effect size that was larger than that originally reported in Table 6 (Original results: $d = -0.17$ [-0.36, 0.02] ; Trim-and-Fill results: $d = -0.28$ [-0.46, -0.11]).

For general self-regulation problems, this method adjusted for four missing studies to the right of the mean effect, and resulted in an effect size larger than that originally reported in Table 5 (Original results: $d = 0.06$ [-0.14, 0.26]; Trim-and-Fill results: $d = 0.28$ [0.11, 0.45]). Lastly, for impulsivity, this method adjusted for four missing studies to the right of the mean effect size, and resulted in an effect size larger than that originally reported in Table 5 (Original results: $d = 0.08$

[-0.13, 0.28]; Trim-and-Fill results: $d = 0.34$ [0.16, 0.52]).

Discussion

Summary

Sociolegal incest offenders were found to have more general and sexual self-regulation problems (Trim-and-Fill $d = 0.28$ and $d = 0.31$, respectively), impulsivity problems (Trim-and-Fill $d = 0.34$), as well as alcohol ($d = 0.25$) and drug ($d = 0.52$) problems compared to biological incest offenders. While not statistically significant, the comparison between biological and sociolegal incest offenders for psychopathy as measured by the Psychopathy Checklist – Revised (Hare, 2003) produced a similar effect size ($d = 0.23$), with sociolegal incest offenders tending to exhibit more psychopathic traits than biological incest offenders. The magnitude of this effect was similar to the other antisociality variables with significant group differences, but the aggregated effect size for this variable only included three studies and, as such, had low statistical power. These findings are consistent with our hypothesis that sociolegal incest offenders are more antisocial than biological incest offenders.

Biological incest offenders were found to have more access to children ($d = -0.29$) and to hold a lower income ($d = -0.21$) compared to sociolegal incest offenders. Furthermore, biological incest offenders were found to have more mental health difficulties, defined as global psychological symptoms in adulthood (e.g., distress, neuroticism, use of mental health services; Trim-and-Fill adjusted $d = -0.28$), and were more likely to repress uncomfortable thoughts and feelings ($d = -0.44$) compared to sociolegal incest offenders. Lastly, while not statistically significant, biological incest offenders were also more likely to experience social deficits compared to sociolegal incest offenders ($d = -0.21$). This comparison only included three studies and thus had low statistical power.

Moderators

A few candidate moderator variables were investigated. This investigation was limited by the small number of studies included in many of the aggregated effects, but it did produce some intriguing results for sample composition.

Paternal versus non-paternal biological incest offenders. The composition of the biological incest offender group proved to be an important moderator for both of the variables where it could be examined. For prior sexual offenses, when the sample was composed entirely of biological fathers, sociolegal incest offenders had significantly more prior sexual offenses ($d = 0.23$). Conversely, when the sample included biological fathers as well as other non-paternal biological relatives, biological incest offenders had more prior sexual offenses ($d = -0.24$; although this difference was not statistically significant). These results suggest that non-paternal biological relatives may be more problematic in sexual criminality than biological fathers.

Furthermore, when the sample was composed exclusively of biological fathers, biological incest offenders had more substance abuse problems ($d = -0.16$), while sociolegal had more substance abuse problems when the sample included biological fathers and other biological relatives ($d = 0.26$). These results indicate that biological fathers may be more problematic than non-paternal biological relatives on this particular indicator of antisociality.

There are plausible theoretical reasons why the composition of the biological incest offender group would be an important moderator. The fitness consequences associated with incest vary by the degree of the genetic relationship. It follows that the fitness consequences associated with incest are greater in cases of father-child incest than in cases of uncle-niece/nephew or grandfather-grandchild incest.

Although theoretically important, the composition of the biological incest group could

not be assessed for the majority of the variables in this meta-analysis. Other authors have found this to be an important variable to consider when examining group differences in sexual offenders. For example, Greenberg et al. (2000) found that non-paternal biological relatives had higher rates of prior sexual offenses ($d = 0.75$), as well as higher rates of sexual recidivism ($d = 0.50$) and any recidivism ($d = 0.62$) compared to biological fathers. However, it was biological fathers who had higher rates of non-violent prior offenses ($d = -0.41$) compared to non-paternal biological relatives. Seto et al. (1999) found that non-paternal biological relatives were more likely to be diagnosed as sexually deviant based on phallometry results ($d = 0.50$) compared to biological fathers. Blanchard et al. (2006) found no statistically significant difference between biological father incest offenders and non-paternal biological relatives in the diagnosis of pedophilia ($d = 0.13$). More comparison studies specifying sample composition are needed.

Limitations

Meta-analyses and systematic reviews are inherently limited by the studies that are included and the extent to which relevant studies are randomly versus systematically excluded. Two of the most common biases in meta-analysis are search bias and publication bias (Walker, Hernandez, & Kattan, 2008). Search bias refers to relevant studies not being found during the literature search due to how the search was performed, which can result in the non-random exclusion of some studies. While a comprehensive search strategy was employed in this meta-analysis, using a number of diverse online databases, it is possible that some studies were missed.

As previously discussed, publication bias can also greatly influence the results of a meta-analysis because studies that find statistically significant results are more likely to be published and therefore found and included in the meta-analysis. Publication bias was statistically

investigated in the current meta-analysis and we did find evidence of publication bias for five of the variables reviewed. However, this bias was corrected using the Trim-and-Fill method (Duval & Tweedie, 2000). It is important to note that the direction of the publication bias was mixed; some variables showed positive publication bias and others showed negative publication bias, suggesting any effect of publication bias was not systematic.

Another limitation of the current meta-analysis is that studies could operationalize group membership in different ways. For example, in some studies, the group of biological incest offenders only included genetic fathers, while in other studies the biological incest group included non-paternal biological relatives (e.g., uncles/grandfathers) in addition to genetic fathers. Similarly, in some studies the group of sociolegal incest offenders only included stepfathers, while in other studies this group also included extended sociolegal relatives (e.g., step-uncles). While an attempt was made to account for these different operational definitions of group membership by conducting moderator analyses, this investigation was limited to only a few variables. Importantly, in this meta-analysis, sociolegal incest offenders were more likely to be in a parental relationship with their victims ($k = 85\%$ of samples) compared to biological incest offenders ($k = 63\%$ of samples). The question of whether biological fathers and non-paternal biological relatives differ in important ways will need to be addressed in future studies.

Finally, the constructs of interest in this meta-analysis could be operationalized in a variety of ways. For example, evidence of substance abuse in one study could have been measured using the Michigan Alcohol Screening Test (Selzer, 1971), while in another study could have been the reported frequency of alcohol use per week. These different operationalizations would introduce heterogeneity in the aggregated meta-analysis results.

Conclusions

Consistent with our hypothesis, sociolegal incest offenders were found to be more problematic on some indicators of antisocial tendencies, although there were many indicators where they were similar. Additionally, biological incest offenders were found to suffer more from mental health difficulties. A surprising finding of this meta-analysis is the lack of difference between biological and sociolegal incest offenders in atypical sexual interests. There was very little heterogeneity in these effect sizes (i.e., the studies were consistent). While groups did not differ in the presence of atypical sexual interests, sociolegal incest offenders exhibited more problems in regard to general and sexual self-regulation. Consequently, the current meta-analysis suggest that sociolegal incest offenders may be more likely to act on their sexual urges when an atypical sexual interest is present, relative to biological incest offenders. Firm conclusions about this finding do require replication, however, as general self-regulation problems showed evidence of a publication bias.

Another important finding of this meta-analysis is the inability to compare groups on any variables related to family dynamics (e.g., spousal relationship quality, family conflict, involvement in child's upbringing). Despite these variables being included in our coding manual due to their theoretical importance, there were not enough primary studies to investigate them. Many psychological and clinical theories have suggested that dysfunctional family relationships may play a role in incestuous offending (e.g., Herman, 2012; Maddock & Larson, 1995; Russell, 1986). Additionally, a prominent evolutionary theory of incest suggests that early propinquity in a child's life is vital in order to develop incest avoidance. If early propinquity does not occur, incest may be more likely to occur (Westermarck, 1891/1921). Variables related to either of these theories could not be investigated.

The results of this meta-analysis suggest there are small to moderate magnitude differences between biological and sociolegal incest offenders in domains that are relevant to the expansion of the theoretical literature concerning incest. The findings presented here are one more step in the continued effort to understand the puzzle of incest sexual offending.

Study 1 – General Conclusions

The results of this meta-analysis highlight a few important findings. The first is that there are very few studies that differentiate between biological and sociolegal incest offenders. This limited number of studies inhibited the ability to draw firm conclusions. However, the results obtained suggest that biological and sociolegal incest offenders are different on some factors known to be important for the initiation and maintenance of sexual offending; primarily indicators of antisociality. These results may suggest that traditional theories of sexual offending against children, which highlight both antisociality and atypical sexual interests as etiological factors for sexual offending against children (e.g., MFM), may be more applicable to sociolegal incest offenders than biological incest offenders. This further highlights the need to examine factors that explain why some individuals commit sexual offences against biological relatives, as traditional theories of sexual offending continue to seem less applicable to explaining the crimes committed by biological incest offenders.

While these results are not necessarily generalizable to non-forensic populations of individuals who engage in sexual behaviour with a biological or sociolegal relative, they do provide evidence toward the rationale for considering these two forms of incest to potentially have distinct etiological origins. Despite these findings, however, it is possible that evolutionary driven mechanisms could still be applicable to sociolegal incest offenders (although likely to a lesser degree than biological incest offenders) because some kinship cues, like physical proximity, are not derived from the actual degree of genetic relatedness.

Based on these results, Studies 2 and 3 of this dissertation will examine the effect that the type of incest (biological or sociolegal) has on the relationship between physical proximity and the likelihood of incestuous behaviour. Additionally, antisociality will be examined and

controlled for in these studies, as this meta-analysis has demonstrated that antisociality may contribute to explaining the behaviour of individuals who engage in incest with a sociolegal relative more so than a biological relative.

CHAPTER 3 – Study 2

An Examination of the Westermarck Hypothesis and the Role of Disgust in Incest

Avoidance among Fathers

Stoltenborgh et al. (2011) conducted an international meta-analysis and found that the prevalence of child sexual abuse was 18% for girls and 8% for boys (see also Stoltenborgh et al., 2013). Approximately one third of these cases are perpetrated by family members (Ogrodnik, 2010). The consequences associated with child sexual abuse include poorer psychological well-being, higher rates of mental illness, and decreased life satisfaction (e.g., Fergusson et al., 2013; Ratican, 1992; Roberts et al., 2004). Research also suggests that the negative consequences associated with incestuous abuse by a relative is even greater than the negative consequences experienced by victims of child abuse committed by non-relatives (Stroebe et al., 2012).

Despite its prevalence, incestuous sexual behaviour is puzzling from an evolutionary perspective. Due to the effects of inbreeding depression (e.g., Seemanová, 1971), offspring born between close genetic relatives reduces reproductive fitness for both parents. This selection pressure has promoted selection against incestuous behaviour. Since genetic relatedness is not an observable trait, kin detection systems rely on cues that were reliable in ancestral environments to estimate relatedness between individuals (Lieberman et al., 2007). Westermarck (1891/1921) postulated that physical proximity is one such kinship cue.

Individuals who have close physical proximity during childhood are expected to experience sexual indifference toward one another. Prior researchers have found evidence for a “critical window” in which the effect of physical proximity is most influential for incest avoidance, and is often defined as the first 6 years of life (Shepher, 1971), although some authors specify younger (before age 3; Wolf, 1995) or older (before age 10; Bevc & Silverman, 2000)

critical ranges. If early physical proximity does not occur, Westermarck (1891/1921) proposes that the likelihood of incestuous behaviour will increase, because incest avoidance has not been activated. This theory has found support for sibling incest avoidance. Multiple studies have found that genetically unrelated children who are raised together from birth are unlikely to develop sexual relationships (e.g., Shepher, 1971; Spiro, 1958; Talmon, 1964). Additionally, Bevc and Silverman (1993/2000) found that siblings who were separated during the first few years of life were more likely to engage in incestuous behaviour that could lead to reproduction (vaginal intercourse) compared to siblings who were not separated. This relationship was not found for incestuous behaviours that could not result in reproduction (e.g., kissing, fondling). In light of the evidence found for the Westermarck hypothesis in sibling relationships, this theory may also hold promise in understanding incest avoidance in the context of father-daughter relationships as well.

If a father is not present in his child's life during the child's early developmental years, then the Westermarck hypothesis (1891/1921) suggests that the incest avoidance mechanism will not be activated or will be weakened, making it more likely that they will commit a sexual offence against their child. Very little research, however, has been conducted to assess this theory in father-daughter relationships. Parker and Parker (1995) found that biological and step-fathers who had committed a sexual offence against their daughter were less likely to be present in the home during their daughters' early childhood compared to non-offending biological and step-fathers (34% versus 70%). Williams and Finkelhor (1995), conversely, did not replicate this finding; although they did find that incestuous biological fathers spent less time in a caregiver role with their daughters (e.g., diapering, playing) compared to non-incestuous biological fathers.

Disgust

While support has been found for the Westermarck hypothesis (1891/1921) for sibling incest, this support still does not address the nature of the incest avoidance mechanism. How does close physical proximity facilitate the development of incest avoidance? Westermarck originally postulated that physical proximity produces feelings of sexual indifference. Indeed, relatives typically have no interest in sexual relationships with each other. When asked to explicitly think about such a relationship, however, a stronger emotion is often reported: Disgust. Indeed, prior research has shown that disgust is a response that triggers the avoidance of sexual behaviours that are harmful to fitness (see Tybur, Lieberman, and Griskevicius, 2009 for a review). It is therefore theoretically plausible that disgust is the proximate mechanism that ensures humans avoid incest. Physical proximity during early childhood acts as a cue of genetic relatedness. Once kin recognition has been activated, a disgust response toward the idea of sex with that relative develops. Disgust toward incest is also culturally influenced - there are very strong cultural incest taboos in all societies, although the degree of relatedness included in the taboo does vary (see Wolf & Durham, 2004, for a review). Disgust toward incest, however, is stronger in individuals who have a potential incestuous partner (e.g., an opposite-sex sibling; Fessler & Navarrete, 2004).

Specifically addressing the relationship between physical proximity and disgust toward incest, Lieberman et al. (2003) found that early physical proximity with an opposite-sex sibling was significantly and positively correlated with disgust toward incest. This trend was not found for the relationship between physical proximity with a same-sex sibling and disgust toward incest. Additionally, the authors found that disgust towards sibling incest was significantly lower for participants who had opposite-sex siblings with whom they did not coreside during childhood compared to participants who had opposite-sex siblings with whom they did coreside during

childhood. Lastly, these authors found that physical proximity is a stronger predictor of disgust toward incest than the actual degree of genetic relatedness between siblings, and once controlling for physical proximity, degree of genetic relatedness no longer predicts disgust toward incest. These results have been replicated by the same set of authors in a subsequent study (Lieberman et al., 2007). The relationship between physical proximity and disgust has, however, never been examined with fathers and their daughters. This study is the first to examine disgust as a first order proximate mechanism involved in incest avoidance among fathers.

Measuring Incest and Disgust

The most direct method for measuring incestuous behaviour is to ask participants to self-report whether they have ever engaged in sexual behaviour with their child. In non-forensic samples, though, this will likely evoke socially desirable responding, especially if such behaviour is illegal. Similarly, asking fathers how disgusting they find the idea of sex with their daughter may also evoke socially desirable responding, and generate ceiling effects (i.e., most respondents rate their disgust very high, with little variability). One method for minimizing this bias and reducing ceiling effects is to ask participants to read a description (i.e., vignette) of third-party incestuous behaviour, where the described characters are not themselves or their own child. Participants are then asked a series of questions about each vignette, aimed at measuring their propensity for the behaviour described, as well as their level of disgust toward the behaviour. This method is based on the premise of egocentric empathy, which is the propensity to experience another person's behaviour as if it were one's own (Fessler & Navarrete, 2004), and has been successfully used in previous research with siblings to measure disgust toward incest (Antfolk et al., 2012; Lespiau and Kaminski, 2016).

Furthermore, research suggests that there is a connection between the emotion of disgust

and moral judgements. When people make judgements about an object or situation, they rely on their affect (Schwarz & Clore, 1983). If a person feels disgust, they will judge a situation more severely than if they do not feel disgust. Asking an individual to rate how morally wrong they view a particular situation, therefore, should involve a moral judgement which uses the feeling of disgust as diagnostic information (e.g., Schnall et al., 2008). Judgements of moral wrongness toward third-party incest have been successfully used in previous research of sibling incest to operationalize disgust toward incest (Lieberman et al., 2003/2007).

Hypotheses

Very few studies have examined the Westermarck hypothesis (1891/1921) in father-daughter relationships, and no study has examined the mediating role of disgust in the relationship between physical proximity and incest propensity among fathers. The aim of this study is to examine the tenability of the Westermarck hypothesis in the context of father-daughter relationships, and assess the mediating role that disgust toward incest has in the relationship between physical proximity and incest avoidance.

The primary hypothesis for this study is that the relationship between physical proximity and incest propensity will be mediated by disgust toward incest. Less physical proximity with a child is expected to be associated with less disgust toward incest, which in turn is associated with increased incest propensity. Predictions were also made about conditions that may influence the strength of this indirect relationship (i.e., moderators). For example, while it is expected that sociolegal fathers will have a higher level of incest propensity than biological fathers (due to the nature of non-nuclear families and how this would impact physical proximity with a child), because humans rely on kinship cues like physical proximity to provide information to our incest avoidance mechanisms as opposed to relying on actual genetic relatedness, relationship type is

not expected to influence the strength of indirect relationship. Additionally, given that the Westermarck hypothesis (1891/1921) is based on the possibility of inbreeding depression, the strength of the indirect effect is expected to be larger when modeling incest propensity for reproductive sexual behaviour, than non-reproductive sexual behaviour.

A previous meta-analysis (Pullman, Sawatsky, Babchishin, McPhail, & Seto, 2017) found that sociolegal incest offenders were more problematic than biological incest offenders on some indicators of antisociality. Thus, differences between biological and sociolegal fathers in antisociality characteristics were examined. It is not necessarily expected that sociolegal fathers will be more antisocial than biological fathers. The results of the Pullman et al. (2017) meta-analysis do suggest, however, that among participants who have a high degree of incest propensity, biological fathers may be less antisocial on some indicators than sociolegal fathers. Additionally, antisociality is an important confounding factor; antisocial fathers may choose to be away from their children (i.e., have less physical proximity) and may also be more likely to engage in incest. Therefore, it is prudent to include antisociality as a covariate in all of the models being examined, as there may be some variability in the relationships between physical proximity, disgust toward incest, and incest propensity that can be accounted for by antisociality.

Method

Participants

Inclusion criteria for this study specified that all participants had to be 18 years old or older, be proficient in English, and be a father with at least one daughter (biological, step, common-law, adopted). The final sample size for analysis was 632 participants (see the Procedure section for validity screening criteria). Participants for this study were recruited by Qualtrics (<https://www.qualtrics.com/uk/online-sample/>) – a survey platform and project

management company – using their survey panels. Among participants included in the final sample, 74% lived in the United States, and 26% lived in Canada. On average, they were over 40 years old ($M=42.74$, $SD=11.60$), and had completed at least some college or university training (71%). These participants had, on average, 3.27 children, ($M_{daughter}=2.08$, $SD= 1.36$). The proportion of the sample that were biological or sociolegal fathers were close to equal (biological 45%; sociolegal 55%). Please see Table 7 for more descriptive characteristics of this sample.

Materials

Measures. The complete survey can be found in Appendix B. The median length of the survey was 20 minutes. While the survey was extensive and asked questions about a wide range of topics for the purpose of a larger program of research, only those measures that are pertinent to the current study will be described herein.

Demographic characteristics. Participants were asked to report a number of demographic characteristics about themselves (e.g., age, sex, education), as well as characteristics about their children (e.g., age, sex, degree of relatedness). These variables were taken directly from participant responses on the survey.

Antisociality. Both childhood and adult antisociality were measured. For childhood antisociality, participants were asked whether, before the age of 15, they engaged in 12 activities indicative of conduct disordered behaviour in childhood (e.g., skipping school (often), initiating physical fights (often), vandalism). The positive (yes) responses were counted as 1-point, and summed to create a total score. Scores could therefore range from 0-12, with higher scores indicating more childhood antisociality. These 12 items had a high degree of internal consistency (Cronbach's Alpha; $\alpha = .83$). For adult antisociality, participants were asked whether they had ever been arrested, charged, or convicted for a 1) non-sexual violent offence (e.g., assault), 2)

Table 7. *Demographic and Descriptive Characteristics of Fathers*

	Mean (SD)/ Frequency
Age (<i>N</i> = 632)	42.74 (11.60)
Education (<i>N</i> = 632)	
Less than elementary school	0.0%
Elementary school	0.2%
Some high school	5.7%
Completed high school	23.6%
Some college/university	30.1%
Completed college/university	31.3%
Graduate school	9.2%
Income (<i>N</i> = 632)	
\$0 to \$10,000	10.0%
\$11,000 to \$20,000	8.8%
\$21,000 to \$30,000	10.4%
\$31,000 to \$40,000	10.6%
\$41,000 to \$50,000	13.3%
\$51,000 to \$60,000	11.2%
\$61,000 to \$70,000	7.9%
\$71,000 to \$80,000	8.5%
\$81,000 or more	19.3%
Country of residence (<i>N</i> = 632)	
Canada	25.6%
USA	74.4%
Current marital status (<i>N</i> = 629)	
Married	65.3%
Not married	34.7%
Number of children ¹ (<i>N</i> = 632)	3.27 (2.03)
Number of female children ¹ (<i>N</i> = 632)	2.08 (1.26)
Type of father (<i>N</i> = 631)	
Biological father	44.7%
Sociolegal father	55.3%
Incest propensity ¹ (Range =12-120; <i>N</i> = 610)	31.73 (12.06)
Disgust toward incest ¹ (Range =8-80; <i>N</i> = 623)	70.83 (12.77)
Physical proximity ¹ (Range =0-27; <i>N</i> = 624)	7.23 (5.75)

Notes: ¹Outliers were identified by visual inspection of histograms, followed by review of Z-scores ($Z > 3.29$). Outliers were reduced, but maintain their rank order.

non-sexual non-violent offence (e.g., theft), and 3) a contact sexual offence (e.g., forcing

someone to engage in sexual activity). All three of these questions had yes/no response options.

The original intent was to create a total score for adult antisociality by summing the positive

(yes) responses. However, the degree of internal consistency was very low (Cronbach's Alpha; α

= .41). Therefore, each of the criminal history items was considered separately in the analyses.

Physical proximity. Participants were asked a number of questions about their living arrangements with their daughter, including 1) their child's current age, 2) if they had ever lived in the same residence with their child, 3) how old the child was when they started living with them (from birth to 20 years old or older), and 4) how old the child was when they stopped living with them (still living with child *or* less than one year old to 20 years old or older). Based on these questions, the total length of time that the participant had lived with their child (in years) was calculated. Participants who have never lived in the same household as their child had a score of zero.

Incest propensity. Based on the premise of egocentric empathy (Fessler & Navarrete, 2004), participants were asked to read four vignettes (adapted from Albrecht et al., 2014) describing third-party sexual activity between a father and his daughter, and asked questions that would indicate a propensity for the behaviour described. For biological fathers, the vignettes indicated a sexual encounter between a father and his "young daughter", whereas for sociolegal fathers (step/common-law/adopted) the vignettes indicated a sexual encounter between a father and his "young step-daughter". All other aspects of the vignettes were the same regardless of participant characteristics. Two of the vignettes described non-reproductive sexual behaviour (genital fondling), whereas two of the vignettes described reproductive sexual behaviour (intercourse; Bevc & Silverman, 1993/2000). Participants were asked "*How likely do you think it is that the man in this story will encourage continued sexual contact with his daughter?*" and "*If you were in a similar situation, how likely would you be to encourage continued sexual contact with your daughter?*" These items were rated on a 1 (not at all likely) to 10 (extremely likely) scale. Similar to the third-party vignettes themselves, the first question was based on the premise

of egocentric empathy (Fessler & Navarrete, 2004), in which a participant experiences someone else's behaviour as if it were their own. Furthermore, participants were also asked "*How arousing do you find this story?*" and indicated their response on a 1 (not at all arousing) to 10 (extremely arousing) scale. These 12 items (three items for each of the four vignettes) were summed to create a total incest propensity score. Scores could range from 12-120, and higher scores indicated a higher level of incest propensity. These questions were always presented in the same order as presented above. These 12 items had an acceptable level of reliability (Cronbach's Alpha; $\alpha = .79$).

Disgust toward incest. Responding to the same four vignettes as described above, participants were also asked "*How disgusting do you find this story?*" with responses provided on a 1 (not at all disgusting) to 10 (extremely disgusting) scale, and "*How morally wrong do you find the man's behaviour in this story?*" which was measured on a 1 (not at all wrong) to 10 (extremely wrong) scale. These 8 items (two items for each of the four vignettes) were summed to create a total disgust toward incest score. Scores could range from 8-80, and higher scores indicated a higher level of disgust toward incest. These questions were always presented in the same order as presented above. These 8 items had an acceptable level of reliability (Cronbach's Alpha; $\alpha = .83$).

Procedure

Ethical approval for this study was granted by the University of Ottawa Research Ethics Board (Appendix C) and the Royal Ottawa Mental Health Centre Research Ethics Board (Appendix D). The survey was designed and implemented on the Qualtrics platform. Using Qualtrics to recruit participants meant that while identifying information about participants was not recorded in the subsequent dataset, the Qualtrics server that stored the electronic data did

record participant IP addresses. Therefore, because of the potential for a participant's responses to be connected to their identities, questions concerning undetected criminal behaviour, where a specific victim could be identified (e.g., a child), were not asked.

Qualtrics has developed an online community of individuals interested in participating in survey research. These online communities are referred to as "panels". Individuals interested in being a panel member sign-up online, fill out a comprehensive demographic questionnaire, and are sent invitation emails when a new survey is available that they are eligible to participate in. Panel members are paid by Qualtrics for participating in a survey, based on an amount agreed upon between Qualtrics and the participant. Prior research has demonstrated that Qualtrics panel members have similar demographic, geographic, and political characteristics to the U.S. population (Heen, Lieberman, & Miethe, 2014), and that in general, research panels can be considered a close approximation of the general population (Goodman, Cryder, & Cheema, 2013; Paolacci, Chandler, & Ipeirotis, 2010).

Qualtrics recruited participants for this study from their online research panel. Invitations to participate were sent to potential participants who met the basic inclusion criteria of the study (male, over 18 years old, had a child). Data collection for this survey was conducted in two waves. In the first wave of data collection, Qualtrics was paid \$6USD per participant who completed the survey. Due to the small number of sociolegal fathers recruited in the first wave of data collection (7%), the second wave restricted the sample to sociolegal fathers. Furthermore, 21 participants from Wave 1 of the survey were subsequently excluded because despite instructions, they answered the questions in the survey about their son, not their daughter. In Wave 2 of the survey, participants who did not follow instructions (i.e., indicated they were answering the questions about a sociolegal son as opposed to a sociolegal daughter) were

redirected out of the survey. In the second wave of data collection, Qualtrics was paid \$4USD per participant (an end of year sale price) who completed the survey. In both waves of the survey, Qualtrics compensated participants based on an agreed upon amount between Qualtrics and the participant. These two datasets were subsequently merged ($N=983$).

A total of 148 participants withdrew at some point during the survey. Thus, there was complete data for 835 participants. Two participants were subsequently excluded for rushing through the survey, defined as completing the survey in less than 1/3 of the median duration from the pilot survey. The median length for Wave 1 and 2 was 20 minutes, thus, 1/3 of the median length equated to spending less than 7 minutes on the survey. Participants were also asked three questions to ensure they were paying attention, and three other questions to ensure they were responding consistently. First, participants were given “True” and “False” response options, and asked “Does five plus five equal ten?” Participants were also given a 0-50 dropdown scale, and asked to select a number between 30 and 35 from the list. Additionally, as previously described, one of the measures used in this study was a series of vignettes describing an interaction between a father and his daughter. Participants were asked to select the name of the daughter from one of these vignettes, from a list of names.

In regard to consistency, participants were asked how old they were, what country they currently live in, and their level of education, twice. Age was allowed to vary by ± 1 from their original answer and still be considered valid. Their response to the questions about the country they currently live in and their level of education, however, had to match their original answer. This validity screening resulted in 181 participants being excluded from all analyses, because they failed one or more of the validity questions. This rate of careless responding (22%) is higher than the rate typically found in other studies (5-15%, Meade & Craig, 2012; 7%, Fonseca-

Pedrero et al., 2009).

An examination of missing data was conducted. All of the questions in the survey were forced choice questions (participants had to provide a response). However, all but the eligibility criteria questions provided participants with an “I prefer not to answer” option (PNA). Therefore, analyses were conducted to examine the rate and pattern of PNA responding among participants. Twenty participants used the PNA response for more than 10% of their responses in the survey. These individuals were excluded from all analyses to ensure data quality. Therefore, the final sample size for this study was 632.

Planned Analyses

For univariate analyses, frequencies between categorical variables were examined with Pearson’s chi-squared test (χ^2 ; Pearson, 1900). The difference between two groups on a continuous dependent variable was assessed with Kruskal Wallis non-parametric ranked ANOVAs (H ; Kruskal, 1952), whereas the relationship between continuous variables was assessed with Kendall’s non-parametric ranked correlations (τ ; Kendall, 1938). These statistics were chosen because many of these variables are expected to be skewed in the population, and indeed, were skewed in this sample, thus violating the statistical assumptions of typical parametric ANOVAs/correlations. To accompany these univariate analyses, Cohen’s d was calculated as a measure of effect size. For 2x2 frequency tables, the following formula was used:

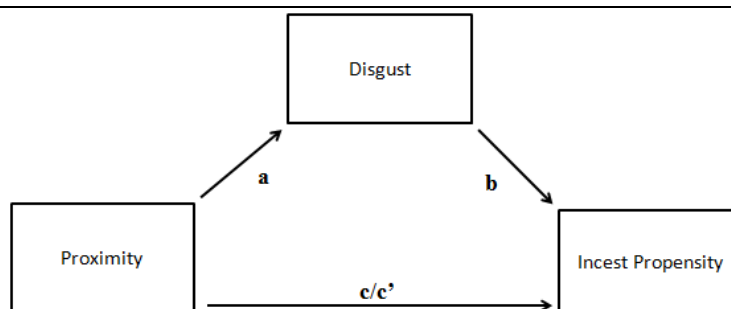
$$d = \frac{1}{1.65} \left[\ln \left(\frac{\{a+.5\}\{d+.5\}}{\{b+.5\}\{c+.5\}} \right) \right] \text{ (Fleiss, 1994; Sánchez-Meca, et al., 2003).}$$

The distribution of the Kruskal Wallis H statistic approximates a chi-squared distribution. Therefore, Cohen’s d was calculated using the Kruskal Wallis H statistic, with the following formula: $d = 2 \sqrt{\chi^2/(N-\chi^2)}$, where $X^2 = H$. The direction of Cohen’s d (positive or negative) was determined based on the specified prediction. Cohen’s d values were positive if the relationship was in the expected direction,

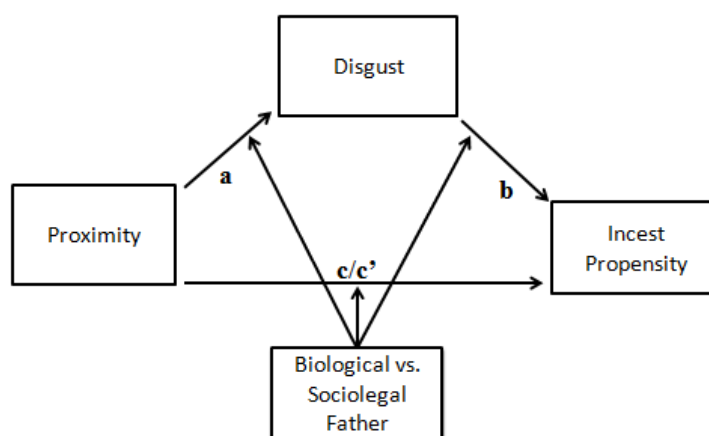
whereas Cohen's d values were negative if the relationship was not in the expected direction. Cohen (1988) suggested that a d of 0.20 is small, 0.50 is moderate, and 0.80 is large. To provide some context for this study, the previously mentioned Pullman et al., (2017) meta-analysis found that sociolegal incest offenders were more problematic than biological incest offenders on some indicators of antisociality, and the magnitude of these effects ranged from what could conventionally be considered small (e.g., $d = 0.25$) to moderate (e.g., $d = 0.52$) in size. Furthermore, Parker and Parker (1995) found that fathers who had committed a sexual offence against their daughter were less likely to be present in the home during their daughters' early childhood compared to non-offending fathers, $d = 0.91$, 95% CI [0.43, 1.39].

The primary hypothesis for this study is that the relationship between physical proximity and incest propensity will be mediated by disgust toward incest (Figure 3a). This hypothesis was analyzed using mediation analysis via ordinary least squares regression (PROCESS macro; Hayes, 2013). Based on the recommendations of Hayes (2009), the product-of-coefficients method with bootstrapping (re-sampling the sample with replacement thousands of times) was used to quantify the indirect effect. In addition to this simple mediation model, the effect that different characteristics of the sample had on the strength of this association was examined, using moderated-mediation analyses (Figure 3b). Moderated-mediation or conditional process analysis performs the same bootstrapping mediation analysis as the simple mediation model, but at each level of the moderator. The index statistic, a measure of the difference in the strength of the indirect effect at different levels of the moderator, is also derived using a bootstrapping approach. Lastly, sensitivity analyses (Figure 3c) were conducted, to examine differences in the strength of the indirect effect when predicting reproductive vs. non-reproductive incest propensity, using disgust toward reproductive and non-reproductive incest, respectively. Based

a) Simple Mediation Model



b) Moderated-Mediation Model



c) Sensitivity Analyses

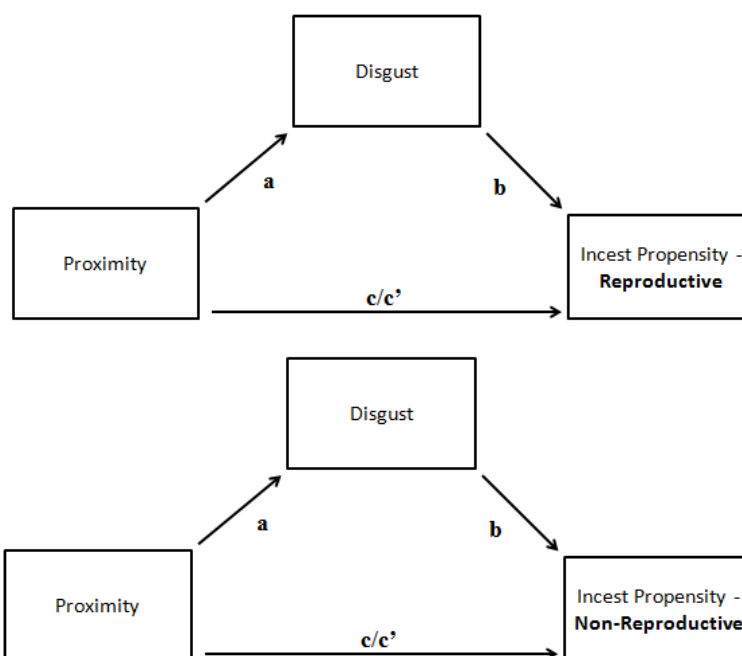


Figure 3. *Mediation Models Examining Incest Propensity Among Fathers*

Note: Paths a, b, and c are standardized regression coefficients, while path c' (indirect effect) is the product of paths a and b.

on the recommendations of Payton, Greenstone, and Schenker (2003), an 85% confidence interval for each indirect effect was calculated, using the formula: $\beta \pm t(n-2, 1-\alpha/2) \text{ se}(\beta)$, where β is the regression coefficient, t is the critical value from the t-distribution, having $n-2$ degrees of freedom and a cumulative probability equal to the critical probability $(1-\alpha/2)$, and $\text{se}(\beta)$ is the standard error of the regression coefficient (Draper & Smith, 2014). Non-overlap in these 85% confidence intervals suggests statistically significant differences in the magnitude of the indirect effects, at a 95% confidence level.

Statistical assumptions. Bootstrapping mediation analysis using the PROCESS macro is based on ordinary least squares regression, when the dependent variable is continuous. It is important to note that in path a, disgust toward incest is the dependent variable, whereas in path b and c, incest propensity is the dependent variable. The statistical assumptions of linear regression should be tested separately for each path of the model. A simple linear regression assumes 1) a linear relationship between the independent and dependent variable, 2) multivariate normality of residuals, 3) homoscedasticity of residuals, and 4) independence of errors (Tabachnick & Fidell, 2007). In addition to these assumptions, it is also prudent to ensure the absence of multivariate outliers between the independent and dependent variable, and the absence of outliers in the residuals of the solution. The linear relationship between each continuous independent variable and the dependent variable was assessed using scatter plots. Multivariate normality of residuals was assessed by saving the standardized residuals from the regression, and examining the skew and kurtosis statistics of the residual distribution ($\text{skew}/\text{SE skew} < 3.29$; $\text{kurtosis}/\text{SE kurtosis} < 3.29$). Homoscedasticity of residuals was assessed by plotting the standardized residuals against the standardized predicted values, and examining the shape of the scatter (a funnel shape indicates heteroscedasticity). Lastly, independence of errors

was assessed via the Durbin-Watson test, which detects autocorrelation among residuals (Tabachnick & Fidell, 2007). After these analyses were completed, the presence of multivariate outliers between the independent and dependent variable was explored using Mahalanobis' distance ($p < .001$, $df=2$, critical $X^2=13.82$), as was the possibility of outliers in the solution by examining the histogram and Z scores associated with saved standardized residuals from the regression ($Z < 3.29$).

Data Preparation

Missing data. Analyses were undertaken to examine the rate and pattern of PNA responding for each variable included in this study. All variables used in this study had less than 5.0% PNA responding (0% to 3.5%). Analyses were undertaken to examine if the pattern of PNA responding on all of the variables included in this study was different by levels of incest propensity; there were no statistically significant associations ($p < .05$). Furthermore, there were no differences in levels of childhood antisociality across those with missing and non-missing data on physical proximity, incest propensity, or disgust toward incest. Therefore, listwise deletion within analyses (e.g., within a single regression model) and pairwise deletion between different analyses were utilized⁸.

Ceiling and floor effects. The primary variables of interest in this study – physical proximity, disgust toward incest, and incest propensity – could be influenced by either ceiling or floor effects. If present, these effects would reduce variability and influence the relationships examined below, since regression assesses the amount of variability in one variable, explained by another variable. Therefore, these variables were assessed in-depth for evidence of such effects.

⁸ With less than 5% missing data, there are unlikely to be any differences in statistical findings between deletion and imputation methods of dealing with missing data (Tabachnick & Fidell, 2007).

Physical proximity represents the number of years the participant lived with their daughter. Scores on physical proximity ranged from 0 to 27 years. The mean score for physical proximity was 7.23, and there was evidence of variability in this distribution ($SD=5.75$). For biological fathers, 25% of scores were below 3 years, whereas 25% of scores were above 14 years. For sociolegal fathers, 25% of scores were below 2 years, whereas 25% of scores were above 9 years. There was more variability in physical proximity for biological than sociolegal fathers.

Scores on disgust toward incest could range from 8 to 80. In this sample, the actual range was 20 to 80. The mean disgust score was high ($M= 70.83$), but there was variability ($SD= 12.77$). Approximately 49% of participants had the highest disgust score possible (a score of 80), but 25% of the sample had scores below 62.

Scores on incest propensity could range from 12 to 120 (the actual range in this sample was 12 to 84). The mean incest propensity score was moderate ($M= 31.73$), and there was evidence of variability in this distribution ($SD= 12.06$). Approximately 9% of the sample had the lowest incest propensity score possible (a score of 12), but 25% of the sample had scores above 34. These analyses suggest that the relationships examined below are unlikely to be influenced by ceiling or floor effects, or insufficient variability, although this possibility cannot be definitively ruled out.

Results

Degree of Genetic Relatedness

A series of univariate analyses were undertaken to examine potential differences between biological and sociolegal fathers. Biological and sociolegal fathers did not differ in rates of incest propensity, disgust toward incest, or childhood antisociality (Table 8). Sociolegal fathers did,

Table 8. *Differences Between Biological and Sociolegal Fathers*

Full Sample						
	Biological Fathers	Sociolegal Fathers				
	Mean Rank/ Mean (SD)	Mean Rank/ Mean (SD)	N	H	p	d (95% CI)
Incest propensity	301.58 31.43 (12.15)	307.73 31.98 (12.01)	609	0.19	.660	0.04 (-0.12, 0.19)
Disgust toward incest	326.06 72.05 (11.85)	299.89 69.82 (13.40)	622	3.68	.055	0.15 (-.003, 0.31)
Physical proximity	364.39 9.05 (6.29)	269.51 5.78 (4.81)	623	42.99	<.001	0.54 (0.38, 0.71)
Childhood antisociality	298.98 1.72 (2.49)	317.00 1.92 (2.50)	617	1.75	.187	0.11 (-0.05, 0.26)
	Frequency	Frequency	N	X ²	p	d (95% CI)
Violent offence	10.3%	14.7%	629	2.63	.105	0.24 (-0.05, 0.53)
Non-violent offence	19.5%	26.8%	629	4.61	.032	0.25 (0.02, 0.48)
Contact sexual offence	0.4%	1.7%	631	2.65	.138	0.77 (-0.31, 1.85)
High Incest Propensity – Top 10 th percentile						
	Biological Fathers	Sociolegal Fathers				
	Mean Rank/ Mean (SD)	Mean Rank/ Mean (SD)	N	H	p	d (95% CI)
Childhood antisociality	27.47 1.28 (2.83)	36.67 2.51 (3.34)	64	4.65	.031	0.56 (0.05, 1.07)
	Frequency	Frequency	N	X ²	p	d (95% CI)
Violent offence	3.4%	11.1%	65	1.33	.370 ¹	0.59 (-0.57, 1.75)
Non-violent offence	6.9%	19.4%	65	2.12	.172 ¹	0.62 (-0.30, 1.55)
Contact sexual offence	0.0%	5.9%	65	1.66	.498 ¹	0.88 (-0.98, 2.74)

Note: H = Kruskal Wallis ranked ANOVA. Mean (SD) reported for descriptive purposes. Kruskal Wallis ranked ANOVA calculated from the mean rank. Bolded values indicate statistical significance. ¹ Fishers exact *p*-value reported due to cells with expected counts less than 5.

however, have less physical proximity with their daughters than biological fathers, $H=42.99$, $p < .001$, $d= 0.54$, 95% CI [0.38, 0.71]. Furthermore, biological and sociolegal fathers did not differ in the frequency of non-sexual violent and contact sexual offence histories (Table 8), although sociolegal fathers were more likely to have non-violent offence histories compared to biological

fathers, $X^2 = 4.61$, $p = .032$, $d = 0.25$, 95% CI [0.02, 0.48].

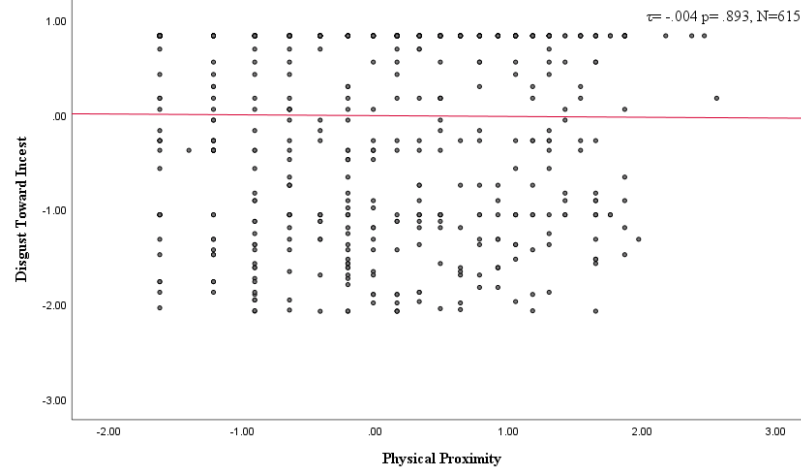
When restricting the sample to participants who scored in the top 10th percentile on incest propensity, as a group of fathers who are most likely to commit incest (scores above 43, $N = 65$), sociolegal fathers had higher scores on childhood antisociality than biological fathers, $H = 4.65$, $p = .031$, $d = 0.56$, 95% CI [0.05, 1.07]. However, the groups did not differ in the rate of violent, $X^2 = 1.33$, $p = .370$, $d = 0.59$, 95% CI [-0.57, 1.75], non-violent, $X^2 = 2.12$, $p = .172$, $d = 0.62$, 95% CI [-0.30, 1.55], or sexual, $X^2 = 1.66$, $p = .498$, $d = 0.88$, 95% CI [0.98, 2.74], offence histories (Table 8).

Physical Proximity, Disgust Toward Incest, And Incest Propensity

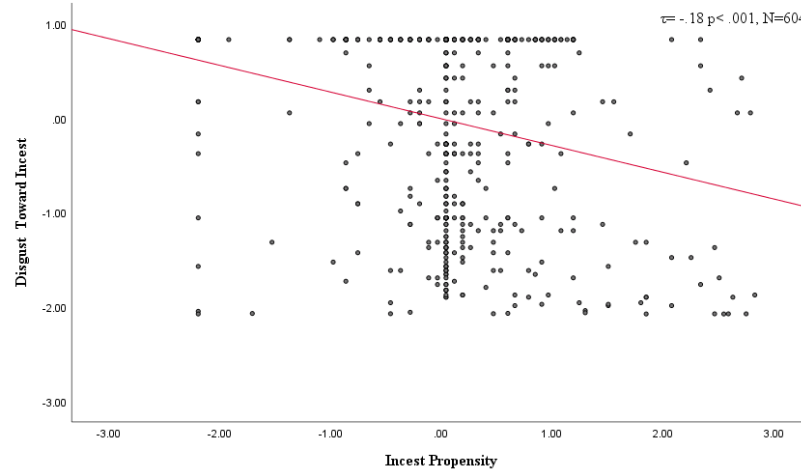
After examination of the statistical assumptions associated with linear regression for each path of the model, multivariate normality and homoscedasticity of residuals was found to be violated. Thus, a Box-Cox transformation (Box & Cox, 1964) was performed on all variables in the regression model (physical proximity $\lambda = 0.50$; disgust toward incest $\lambda = 3.00$; incest propensity $\lambda = 0.50$). To increase interpretation, these transformed variables were subsequently standardized (z-scores). Using these newly transformed variables, there was no evidence of multivariate outliers between the independent and dependent variables for each path of the model, or the residuals of the solution. See Figure 4 for an illustration of the bivariate relationships between physical proximity, disgust, and incest propensity.

Contrary to expectations, physical proximity was not associated with incest propensity, $b = -0.01$, $SE = 0.04$, 95% CI [-0.09, 0.07]. Furthermore, physical proximity was also not associated with disgust toward incest, $b = -0.02$, $SE = 0.04$, 95% CI [-0.11, 0.06]. However, lower levels of disgust toward incest were associated with an increased propensity for incest

a)



b)



c)

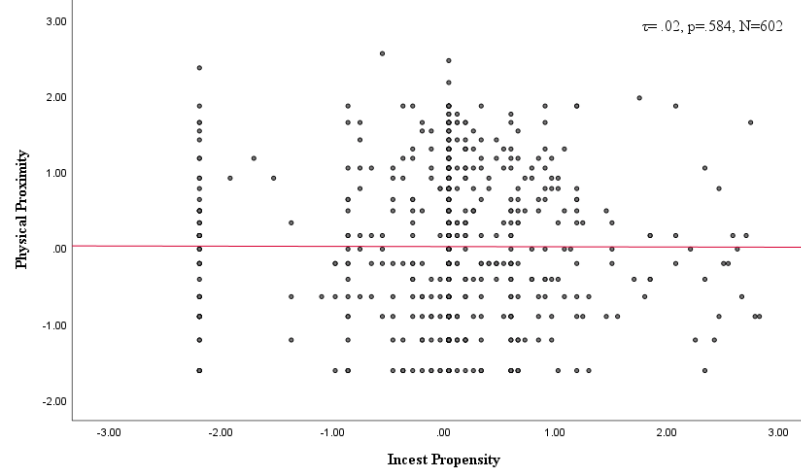


Figure 4. *Bivariate Relationships between Physical Proximity, Disgust, and Incest Propensity*

Note: Variables have been transformed with a box-cox transformation and standardized. τ = Kendall's non-parametric ranked correlation.

among fathers, $b = -0.24$, $SE = 0.04$, 95% CI $[-0.32, -0.17]$. The indirect effect was tested using a bootstrap estimation approach with 5000 samples. These results indicated that disgust toward incest did not mediate the relationship between physical proximity and incest propensity, $b = -0.01$, $SE = 0.01$, 95% CI $[-0.01, 0.03]$.

To account for the possibility that it is only physical proximity during the theorized critical window that influences incest avoidance, a second physical proximity variable was computed and analyzed. Participant who had never lived with their daughters were given a score of zero. Participants who had lived with their daughters, but began living with them after the age of 6, were given scores of 1. Participant who began living with their daughters before the age of 6 but after the daughter was born, were given a score of 2. Finally participants who began living with their daughters at the time of the daughter's birth were given a score of 3. Using this new physical proximity variable, physical proximity was not associated with incest propensity, $b = -0.03$, $SE = 0.04$, 95% CI $[-0.11, 0.04]$. Furthermore, physical proximity was also not associated with disgust toward incest, $b = 0.02$, $SE = 0.04$, 95% CI $[-0.06, 0.11]$, although lower levels of disgust toward incest were associated with an increased propensity for incest among fathers, $b = -0.24$, $SE = 0.04$, 95% CI $[-0.31, -0.17]$. The indirect effect was tested using a bootstrap estimation approach with 5000 samples. The results indicated that disgust toward incest did not mediate the relationship between physical proximity and incest propensity, $b = -0.01$, $SE = 0.01$, 95% CI $[-0.03, 0.01]$. Based on the similar results found for both variations of physical proximity, all further analyses were conducted using the original physical proximity variable that accounts for the total number of years a father lived with his daughter.

The relationship between physical proximity, disgust toward incest, and incest propensity was further examined among biological and sociolegal fathers separately, using moderated-

mediation. Disgust toward incest did not mediate the relationship between physical proximity and incest propensity for biological, $b = -0.01$, $SE = 0.01$, 95% CI $[-0.03, 0.01]$, or sociolegal, $b = 0.01$, $SE = 0.01$, 95% CI $[-0.01, 0.04]$, fathers. There was not a meaningful difference in the magnitude of the difference between these indirect effects, Index = 0.02, $SE = 0.02$, 95% CI $[-0.01, 0.05]$. Lastly, sensitivity analyses were conducted to examine differences in the magnitude of the indirect effect, when predicting non-reproductive vs. reproductive incest. After an examination of statistical assumptions, these variables were also transformed with a Box-Cox transformation (Box & Cox, 1964; disgust toward non-reproductive incest $\lambda = 2.00$; disgust toward reproductive incest $\lambda = 3.00$; propensity for non-reproductive incest $\lambda = -0.50$; propensity for reproductive incest $\lambda = 1.00$), and then standardized (z-scores). Disgust toward non-reproductive incest did not mediate the relationship between physical proximity and non-reproductive incest propensity, $b = 0.001$, $SE = 0.002$, 95% CI $[-0.001, 0.01]$, 85% CI = $[-0.002, 0.004]$. This model accounted for approximately 1% of the variance in non-reproductive incest propensity, $r^2 = .01$. Furthermore, disgust toward reproductive incest did not mediate the relationship between physical proximity and reproductive incest propensity, $b = -0.003$, $SE = 0.01$, 95% CI $[-0.02, 0.01]$, 85% CI = $[-0.013, 0.007]$. This model accounted for 7% of the variance in reproductive incest propensity, $r^2 = .07$. Examining the 85% confidence intervals for these two indirect effects reveals that they do overlap; hence there was not a difference in the magnitude of the indirect effect between predicting non-reproductive vs. reproductive incest.

Discussion

The results obtained in this study do not support the Westermarck hypothesis (1891/1921) as a mechanism that facilitates incest avoidance for fathers. Physical proximity was not found to be associated with incest propensity. These results are contrary to some of the prior

research examining physical proximity as a risk factor for incest among fathers. Parker and Parker (1986) found that non-incestuous fathers were more likely to be present in the home during their daughters' early childhood compared to incestuous fathers. This was, however, a forensic sample of fathers who had been convicted of sexual abuse against their daughters, and did not control for the effect of antisociality. Antisocial fathers may voluntarily choose to spend less time with their children, and may also be more likely to engage in incest. Williams and Finkelhor (1995) examined physical proximity between fathers and their daughters in a sample of men in the Navy. As Navy personnel are often deployed, participants spent significant amounts of time away from their children, but not voluntarily. In this study, there was not a difference in the proportion of time fathers spent away from their daughters in the first four years of their daughter's life, between incestuous and non-incestuous fathers.

In the current study, physical proximity was also not found to be associated with disgust toward incest, although lower levels of disgust toward incest were associated with higher levels of incest propensity. These results suggest that while physical proximity may not be a reliable kinship cue used to inform incest avoidance for fathers, disgust toward incest may still be the proximate mechanism that facilitates incest avoidance. For example, multiple studies have found that physical resemblance (i.e., phenotypic similarity) and perceived partner fidelity are kinship cues used by putative fathers, regulating paternal investment/solicitude toward their children (e.g., Anderson, Kaplan, & Lancaster, 2007; Apicella & Marlowe, 2004; Burch & Gallup, 2000; Fox & Bruce, 2001). In a direct test of these kinship cues on incest avoidance, Billingsley et al., (2018) found that increased certainty of partner fidelity was associated with decreased levels of sexual arousal toward daughters, as well as increased disgust toward sexual activity with daughters. With regard to physical resemblance, however, Billingsley et al. did not find a

meaningful association between physical resemblance and sexual arousal or disgust toward sexual activity with a daughter. Based on these results, it is possible that disgust toward incest mediates the relationship between other theoretically relevant kinship cues and incest propensity, even if physical proximity does not. This is the first test of the Westermarck hypothesis and the mediating role of disgust in a sample of fathers, however, so these null results should be replicated prior to firm conclusions being drawn about the tenability of this kinship cue.

An alternative explanation for the null findings in this study is that the theorized incest avoidance mechanism only exists in the daughter, not the father (Rice & Harris, 2002). The costs associated with incest (inbreeding depression) are much greater for daughters than their fathers (Haig, 1999) due to parental investment vs. mating effort reproductive strategies. Additionally, if there is a critical window in early childhood for the development of incest avoidance, then a father would be well outside this critical window (e.g., under the age of 6) by the time he had a child, but his daughter would not. Among other species (e.g., Dugatkin & Godin, 1998) it is the female that chooses their preferred mate. Therefore, incest avoidance mechanisms may have specifically evolved in human females to ensure that they avoid incest. Due to the power dynamics associated with father-daughter relationships, daughters may be unable to resist sexual advances by fathers, despite the avoidance they experience. Indeed, among gorillas, adolescent females leave their harems early in life, arguably a mechanism designed to ensure inbreeding does not occur with fathers or brothers (Ghiglieri, 1999). Furthermore, among spotted hyenas, it is the males that migrate to other packs to search for mates, due to female mate choices that avoid inbreeding (Höner et al., 2007).

Another surprising finding of this study was that sociolegal fathers did not exhibit a higher propensity for incest with their daughters than biological fathers. Even if physical

proximity is not a valid kinship cue for fathers, we would still expect sociolegal fathers to have a higher propensity for incest, based on other kinship cues (e.g., physical resemblance, maternal fidelity— sociolegal fathers know a child is not their own). The reason for this finding is unclear. It is possible that the effects of socially desirable responding are more prominent for sociolegal than for biological fathers for this topic – possibly because of increased suspicion of sociolegal fathers with regard to child welfare (e.g., societal perceptions of the “cinderella effect”; Daly & Wilson, 1998).

Partially in support of the stated hypothesis and partially consistent with results from a previous meta-analysis (Pullman et al., 2017), among participants with scores within the top 10th percentile on incest propensity, sociolegal fathers reported more childhood antisociality than biological fathers. However, these groups did not differ with regard to the presence of violent, non-violent, and sexual offence history. These analyses were based on a small proportion of the overall sample ($N=65$), and thus it is possible that there was not enough statistical power to detect these effects. Another possibility for these null results, however, is that antisocial individuals are less likely to use the Qualtrics platform, which requires signing up for an account in order to participate in research.

Limitations

All of the measures used were self-reported, which may result in socially desirable responding, especially with sensitive and taboo topics. Despite attempts to reduce these effects by utilizing third-party descriptions and indirect questions, this could still be influencing the relationships examined. Using methods not reliant on self-report would add incremental validity to any study examining incest avoidance mechanisms. For example, De Smet, Van Speybroeck, and Verplaetse (2014) used facial electromyography to measure disgust toward descriptions of

sibling incest. In a similar vein, penile plethysmography (an indicator of sexual arousal) could be used to measure arousal toward descriptions of incestuous behaviour. Another limitation associated with all cross-sectional studies is that the direction of the relationships reported are not known. While evidence of covariation (e.g., between disgust toward incest and incest propensity) was found, conclusions about cause and effect cannot be made.

Another limitation associated with this study is the vignettes used to measure disgust and arousal toward incest specified a sexual encounter with a “young” biological or step-daughter. This wording was chosen to facilitate participants “being in the shoes” of the actor in the vignette, to provide an estimate of the degree of disgust and arousal they feel toward the idea of sex with their own child (i.e., egocentric empathy; Fessler & Navarrete, 2004). However, this wording means that it is not possible to disentangle the amount of disgust/arousal experienced from the idea of sex with a biological or sociolegal daughter from the amount experienced toward the idea of sex with a young girl in general. Future research using vignettes to measure incest propensity should employ a factorial design (i.e., vignettes involving sexual activity with a related child, sexual activity with a related adult, sexual activity with an unrelated child, and sexual activity with an unrelated adult) to disentangle these findings.

Despite these limitations, this study builds upon the current literature about incest avoidance in fathers. The next study of this dissertation extends the Westermarck paradigm and the mediating role of disgust to investigate incest avoidance mechanisms among siblings, using very similar methods, but relies on self-reported incidents of sexual behaviour involving a sibling, as opposed to incest propensity.

CHAPTER 4 – Study 3

An Examination of the Westermarck Hypothesis and the Role of Disgust in Incest

Avoidance among Siblings

The prevalence of sexual behaviour between siblings is between 7%-24%, and when reported, approximately 80% of these encounters are characterized as non-coercive (Bevc & Silverman, 1993; Greenwald & Leitenberg, 1989; Hardy, 2001). The consequences associated with coercive sibling incest include an increased incidence of mental illness (e.g., depression, post-traumatic stress disorder, eating disorders), increased suicidal ideation, and adult intimacy problems (e.g., Rudd & Herzberger, 1999). Consequences associated with non-coercive incest are less well-defined, as most studies utilize convenience samples of individuals who have experienced coercive sibling incest, such as victims of adjudicated sexual offenders or victims from sexual assault support groups. In a notable exception, Stroebel et al. (2013) examined outcomes associated with sibling incest in a relatively unselected (university) sample, and found that women reporting incest with their brother (coercive or non-coercive) were more likely to be estranged from family members, to have suffered psychological injury, to have intimacy problems, to have engaged in prostitution, and to have greater life conflicts compared to women who did not experience incest. Unfortunately, Stroebel and colleagues (2013) did not differentiate between coercive and non-coercive sibling incest, though the majority of participants reported non-coercive sibling incest (78%). These findings suggest that even non-coercive sibling incest between brothers and sisters may be accompanied by harmful outcomes.

From a biological perspective, sexual behaviour between siblings is puzzling. Due the effects of inbreeding depression – reduced biological fitness caused by increased morbidity and mortality of offspring born from incestuous unions (Seemanová, 1971) – selection pressures

should have promoted the evolution of mechanisms to 1) allow us to identify kin because genetic relatedness is an unobservable trait and 2) ensure humans avoid incest. Westermarck (1891/1921) suggested that close physical proximity during childhood is a kinship cue that provides information to our kin-detection system about the likelihood of being genetically related to another individual. This kin-detection system, in turn, provides information to our incest avoidance mechanism. Family members who do not have close physical proximity with one another are therefore theorized to be at an increased risk of incestuous behaviour, because this incest avoidance mechanism has not been activated by (or receives a weaker signal from) an associated kinship cue. Evidence consistent with this theory has been observed in sibling samples. For example, multiple studies have found that opposite-sex siblings who are separated during childhood are more likely to engage in behaviour that could lead to reproduction (i.e., vaginal intercourse) compared to opposite-sex siblings not separated in childhood (Bevc & Silverman, 1993/2000), genetically unrelated opposite-sex children who are raised together are unlikely to develop romantic and sexual relationships with each other (e.g., Shepher, 1971; Spiro, 1958; Talmon, 1964), and when genetically unrelated opposite-sex children who are raised together are compelled to marry, they have fewer children and are more likely to get divorced (Wolf, 1995).

These are not necessarily conscious decisions; the idea of sex with a close relative typically evokes a strong emotional response, primarily disgust, which has been shown to encourage the avoidance of behaviours that are harmful to evolutionary fitness (Tybur et al., 2009; Tybur, Lieberman, Kurzban, & Descioli, 2013). Once the kin-detection system has identified a particular individual as kin, a disgust response develops toward the idea of sex with that person. Indeed, in the absence of other cues of genetic relatedness, childhood physical

proximity with an opposite-sex sibling has been found to predict multiple measures of disgust toward incest: The more physical proximity between siblings, the more disgust they felt toward sibling incest (Lieberman et al., 2007).

Hypotheses

The primary hypothesis for this study is that the relationship between physical proximity and the likelihood of incest will be mediated by disgust toward incest. Less physical proximity in childhood is expected to be associated with less disgust toward incest, which in turn is associated with an increased likelihood that incest will occur. In addition to this primary hypothesis, evolutionary theory provides a framework for generating other hypotheses about sibling characteristics that should make incestuous behaviour more or less likely to occur. For example, this relationship is expected to be stronger among female participants than male participants, because the fitness costs of incest are greater for females than males. Additionally, while it is expected that non-full siblings will be more likely to engage in incest compared to full siblings due to the availability of fewer kinship cues (e.g., less physical proximity, less likely to observe MPA), because humans rely on kinship cues like physical proximity to provide information to our incest avoidance mechanisms as opposed to relying on the actual degree of genetic relatedness, sibling type is not expected to influence the strength of the indirect relationship. Furthermore, some authors (e.g., Lieberman et al., 2007) have speculated that the effect of physical proximity on the likelihood of incestuous behaviour is particularly important for younger siblings detecting older siblings. The reason for this is that older siblings have additional kinship cues that younger siblings do not (i.e., Maternal Perinatal Association (MPA) – observing your mother taking care of your younger sibling). However, younger siblings do not have access to MPA cues when detecting an older sibling. Younger siblings must rely more

heavily on other kinship cues such as physical proximity. Therefore, it is expected that the indirect relationship will be stronger when the participant is younger than their sibling.

Among participants who have engaged in sexual behaviour with a sibling, there are also likely characteristics associated with the nature of this behaviour that may influence the strength of the indirect relationship between physical proximity and sexual behaviour with a sibling. For example, given that the Westermarck hypothesis (1891/1921) is based on the possibility of inbreeding depression, it is expected that the indirect effect will be stronger when predicting the likelihood of reproductive sexual behaviour between siblings, than non-reproductive sexual behaviour between siblings. Furthermore, males are expected to be more likely to initiate incest than females, because the fitness costs associated with incest are lower for males than for females (due to mating effort vs. parental investment strategies). Moreover, the postulation that more physical proximity in childhood is associated with a higher degree of disgust toward incest also leads to the prediction that more physical proximity in childhood would also be associated with a lower degree of intrusiveness among siblings who have engaged in sexual behaviour.

Lastly, based on the results of a previous meta-analysis (Pullman et al., 2017) finding that sociolegal incest offenders were more problematic on some indicators of antisociality than biological incest offenders, non-full siblings who engage in incest are expected to exhibit more indicators of antisocial behaviour in childhood than full siblings who engage in incest. Finally, it is also prudent to include childhood antisociality as a covariate in all of the models being examined, as there may be some variability in the relationship between physical proximity and incest that can be accounted for by childhood antisociality.

The aim of this study is to examine these hypotheses in two non-forensic samples of opposite-sex siblings. The first is a university sample of opposite-sex siblings. Due to the low

base rate of incestuous behaviour in this sample, this hypothesis was also examined among a community sample of opposite-sex siblings. By investigating the proximate mechanisms that may inform incest avoidance, a foundation for understanding the scientific puzzle that is incestuous sexual behaviour can start to be built.

Method

Participants

Inclusion criteria for this study specified that participants had to be 18 years old or older, proficient in English, and have at least one opposite-sex sibling (full, half, step, or adopted). The same survey was deployed across a university sample ($N=748$) and community sample ($N=946$) of participants. Details of these recruitment procedures can be found in the Procedures section. University participants were younger than community participants, $t=21.61$, $df=1,692$, $p<.001$, $d=1.06$, 95% CI [0.96, 1.16], and the university sample included fewer males ($X^2=108.00$, $p<.001$, $d=0.72$, 95% CI [0.58, 0.86]). Both samples reported having approximately 2 siblings ($M_{University} = 2.16$, $M_{Community} = 2.19$), and participants in both samples reported full-siblings as the most common type of sibling (university= 93%, community= 84%). In the university sample, the frequency of self-reported sexual behaviour with a sibling was 3%, whereas the frequency of self-reported sexual behaviour with a sibling in the community sample was 12%. It was unknown why the prevalence of sibling incest was so low in the university sample. The frequency reported in the community sample is more consistent with past research on sibling incest (Bevc & Silverman, 1993; Finkelhor, 1980; Greenwald & Leitenberg, 1989; Griffe et al., 2014; Hardy, 2001). Due to the possibility of there being systematic differences between these two samples of participants, the samples were analyzed separately⁹. More descriptive characteristics of both the university and community samples can be found in Table 9.

⁹ See Appendix E for a summary of the results for the combined sample.

Table 9. *Demographic Characteristics of University & Community Siblings*

	University Sample	Community Sample
Age ¹	19.37 (2.56)	25.95 (8.01)
Sex		
Male	17.0%	40.3%
Female	83.0%	59.7%
Childhood SES		
Lower	2.0%	7.9%
Lower-middle	13.1%	26.6%
Middle	48.7%	37.6%
Upper-middle	33.6%	25.8%
Higher	2.7%	2.0%
Total number of siblings ¹	2.16 (1.35)	2.19 (1.58)
Number of opposite-sex siblings ²	1.42 (0.75)	1.49 (0.81)
Sibling Type		
Opposite-sex full sibling	93.2%	83.6%
Opposite-sex half sibling	3.3%	12.6%
Opposite-sex step sibling	2.9%	2.6%
Opposite-sex adopted sibling	0.5%	1.2%
Incestuous behaviour with a sibling		
No	96.9%	87.8%
Yes	3.1%	12.2%

Note: Percentages may not equal 100% due to rounding

¹ Outliers were identified by visual inspection of histograms, followed by review of Z-scores. Outliers (defined as $Z > 3.29$) were reduced, but maintain their rank order.

² Likert scales ranged from 0 (none) to 5 (5 or more)

Materials

Measures. The complete survey can be found in Appendix F. The median length of the survey was 17 minutes for the university sample, and 16 minutes for the community sample. While the survey was extensive and asked questions about a wide range of topics as part of a larger program of research, only those measures that are pertinent to the current study will be described herein.

Demographic and sibling characteristics. Participants were asked to report a number of demographic characteristics about themselves (e.g., age, sex, education), as well as characteristics about the sibling they were answering the survey questions about (e.g., sibling age). These variables are taken directly from participant responses. For sibling type, while

multiple non-full sibling types were initially coded (e.g., half, step, adopted siblings), small frequencies resulted in the sibling type variable being collapsed (full vs. non-full siblings).

Childhood antisociality. Participants were asked to report a variety of childhood characteristics related to antisocial behaviour. On a 1 (never) to 5 (very often) scale, participants were asked 1) how often in their childhood they shouted at other people, 2) how often in their childhood they hit or physically hurt other people, 3) whether they enjoyed taking risks in their childhood, and 4) if they had to make a decision when they were a child, how long they considered the pros and cons. Although the original intent was to examine these items together as a composite scale, examining the reliability of these items together (item 4 reverse scored) resulted in a poor degree of internal consistency (university Cronbach's Alpha; $\alpha = .54$; community Cronbach's Alpha; $\alpha = .44$). Therefore, these variables were examined as individual indicators of childhood antisociality.

Sexual behaviour between siblings. Participants were asked whether they had ever experienced sexual behaviour (e.g., kissing, touching, intercourse) with any of their siblings. Response options included "no", "yes, one sibling", "yes, two siblings", or "yes, three or more siblings". Very few participants had experienced sexual behaviour with more than one sibling. Therefore, this variable was dichotomized into "yes" and "no". For participants who reported incest with more than one sibling, their responses to the opposite-sex sibling closest in age to them, whom they had engaged in incest with, was used.

Characteristics of sexual behaviour between siblings. Participants who had experienced sexual behaviour with at least one sibling were given an additional set of questions pertaining to the nature of this sexual behaviour. Participants were asked about the specific sexual behaviours they had engaged in (behaviours ranged from "French" kissing to intercourse), the reasons why

they had engaged in the behaviour (e.g., curiosity, forced), whether they and/or their sibling consented to the behaviour, and how old both siblings were when the behaviour started. Using these variables, sexual behaviour between siblings was considered coercive if 1) the participant reported that their sibling or themselves did not consent, or 2) the age gap between the siblings was five years or greater, or 3) the participant reported force was used. Sexual behaviour between siblings was considered non-coercive if 1) the participant reported that both their sibling and themselves consented to the behaviour, and 2) the age gap between the siblings was less than five years, and 3) the participant reported that force was not used. An uncategorizable incest category was also included, which was necessary due to missing information (i.e., PNA responses). Additionally, participants were asked how often they initiated the sexual behaviour with their sibling (always myself, mostly myself, sometimes myself, never myself). This was turned into a dichotomous variable (any initiation/never initiated) for these analyses.

Childhood proximity. Participants were asked if they have ever lived in the same household as their sibling. If they answered yes, they were subsequently asked what age they were when they started living with their sibling. These questions were used to create a scale where higher scores were associated with more physical proximity in childhood. If a participant had never lived in the same household with their sibling, they received a score of 0. If they had lived in the same household with their sibling, but started living together after the age of 6, they received a score of 1. If they had lived in the same household with their sibling, and started living together before the age of 6 (but after their own/their sibling's birth), they received a score of 2. Finally, if they had lived in the same household with their sibling, and started living with their sibling from their own or their sibling's birth, they were given a score of 3.

Disgust toward incest. This scale was adapted from Lieberman et al., (2007) and was

designed to measure the degree of disgust a participant experienced toward the thought of sexual behaviour with their own sibling. Both first and third-party questions about disgust toward incest (e.g., you engaged in an activity with your sibling vs. a hypothetical pair of siblings engaged in an activity) were used. This third-party method reveals feelings of disgust toward the idea of incest with one's own kin, but reduces the possibility of generating a ceiling effect (Antfolk et al., 2012; Fessler & Navarrete, 2004). First, participants were asked to imagine participating in eight different sexual behaviours (e.g., kissing, fondling, sexual intercourse) with *their own sibling*, and to rate their level of disgust toward the idea of this sexual behaviour on a 0 (not disgusting at all) to 6 (extremely disgusting) scale (university Cronbach's Alpha; $\alpha = .79$, community Cronbach's Alpha; $\alpha = .88$). Participants were also asked to rate the degree of disgust they experienced toward the thought of sexual behaviour between *a hypothetical pair of siblings*, participating in eight sexual behaviours. Again, each item was measured on a 0 (not disgusting at all) to 6 (extremely disgusting) scale (university Cronbach's Alpha; $\alpha = .81$, community Cronbach's Alpha; $\alpha = .92$). Examining the reliability of the items from these two scales together resulted in an even higher degree of internal consistency (university Cronbach's Alpha; $\alpha = .89$, community Cronbach's Alpha; $\alpha = .93$), indicating that all items were measuring the same construct. Therefore, the mean of each subscale was calculated, and then the sum of the two subscale means was taken as the total score. Total scores could therefore range from 0-12.

Procedure

Ethical approval for this study was granted by the University of Ottawa Research Ethics Board (Appendix G) and the Royal Ottawa Mental Health Centre Research Ethics Board (Appendix H). This was an anonymous online survey (internet protocol (IP) addresses were not recorded) that was created using the program Checkbox, and data was collected by and stored on

a server that is owned and physically located at the Royal Mental Health Centre. Therefore, no other parties (e.g., software company, cloud servers), had access to the collected data. At the end of the survey, participants were redirected to a second survey that was not connected to their responses on the primary survey. Here, participants entered their applicable contact information. This was used to provide compensation for participating in the study. This procedure ensured that participant responses to the survey remained anonymous at all times. The same survey was deployed across 1) a university sample, and 2) a community sample of siblings.

University sample. Participants for this study were recruited from the Integrated System of Participation in Research (ISPR) at the University of Ottawa. Participants were, therefore, all undergraduate students at the University of Ottawa, and were granted one credit for participating in the survey. At the end of the primary survey, participants were redirected to a secondary survey and asked to provide their ISPR participant number and their University of Ottawa email address in order to get their course credit. Using the ISPR portal, 952 participants accessed the survey. Twenty participants withdrew from the survey at some point before the end of the survey (2%). Moreover, 109 participants started the survey, but stopped answering questions at some point before the end of the survey (12%). Therefore, complete data was obtained for 823 participants.

While participants who had never experienced sexual behaviour with a sibling had to answer the questions about one of their opposite-sex siblings (the sibling closest in age), participants who had experienced sexual behaviour with a sibling were asked to answer questions about the sibling they had experienced the sexual behaviour with, regardless of age difference or whether this was a same-sex or opposite-sex sibling. When sexual behaviour occurred with more than one sibling, participants were asked to answer questions for up to two

siblings they had experienced sexual behaviour with, and when the sexual behaviour occurred with more than two siblings, participants were told to prioritize opposite-sex siblings over same-sex siblings. Because this study is assessing an evolutionary prediction that is contingent on the possibility of inbreeding depression, the sample was restricted to participants who answered the questions in the survey about an opposite-sex sibling ($N = 8$ same-sex sibling (1%) and $N=32$ “prefer not to respond” excluded (4%)). Although this hypothesis is contingent on the possibility of inbreeding depression, sociolegal siblings (step/common-law/adopted siblings) were included in the sample because physical proximity is the hypothesized kinship cue that triggers the incest avoidance mechanism, not the actual degree of genetic relatedness.

Participants were asked two questions to make sure they were paying attention to the survey questions, and another two questions to ensure they were responding consistently. First, participants were given a 0-6 Likert scale and asked to select option two. Participants were also given “Yes” and “No” response options, and asked to select the “No” response. Additionally, participants were asked how old they were and what country they currently live in, twice. Age was allowed to vary by ± 1 from their original answer and still be considered valid. Their response to the question about the country they currently live in, however, had to match their original answer. This validity screening resulted in 32 participants being excluded from all analyses, because they failed one or more of the validity questions (4%); a rate of careless responding that is lower than the rate typically found in other studies (5-15%, Meade & Craig, 2012; 7%, Fonseca-Pedrero et al., 2009). This is likely due to the conscientiousness of the sample. These participants were primarily psychology students, who may place more value on the importance of survey research than the general population.

Additionally, an examination of missing data was conducted. All of the questions in the

survey were forced choice questions, meaning that participants had to provide a response. However, all but the eligibility criteria questions provided participants with an “I prefer not to answer” option (PNA). Therefore, analyses were undertaken to examine the rate and pattern of PNA responding among participants. Eleven participants used the PNA response for more than 10% of their responses in the survey. These individuals were excluded from all analyses to ensure data quality. These screening procedures resulted in a final sample size of 748 participants who were retained for the analyses (some overlap between participants excluded for different reasons).

Community sample. Participants for this study were recruited via a variety of online platforms in both Canada and the United States (e.g., Facebook, Reddit, Kijiji). At the end of the primary survey, participants were redirected to a secondary survey and asked to provide their email address in order to be entered in a draw to win 1 of 200 \$25 Amazon gift cards. Although this survey was still actively recruiting participants as part of a larger program of research, data for this study were extracted in February 2018.

A total of 1,965 participants consented to participate in the study. Seventy-four of these participants withdrew at some point during the survey (4%). Additionally, 665 participants who initially consented did not finish the survey (34%). This resulted in a sample size of 1,226 participants who had complete data. With regard to data validity, a very large influx of participants was noticed during one day in March 2017. After a manual review of this data, it was found that the responses across this influx of participants were all exactly the same. Given the suspicious nature of this data, these 89 participants (7%) were excluded. Furthermore, 19 participants who answered the questions about a same-sex sibling were also excluded (2%).

The same set of four validity questions that was used in the university sample described

above were also used here. These validity checks resulted in 142 participants being excluded from the analyses. This rate of careless responding (13%) is higher than that found among the university sample, and is more similar to rates found in previous research (5-15%, Meade & Craig, 2012; 7%, Fonseca-Pedrero et al., 2009). Given the higher rate of careless responding among this sample of siblings, it was also prudent to ensure that participants were taking enough time to consider each question. Therefore, the amount of time that it took participants to complete the survey was examined. A decision was made that participants had to spend at least 5 seconds, on average, on each question in the survey to consider their responses valid. This corresponded to needing to spend at least 8 minutes on the survey. Applying this additional validity check resulted in 59 participants being excluded. Adding all three of these variables together (opposite-sex siblings, passed all validity checks, and passed time criterion) resulted in 181 participants being excluded ($N = 956$).

As mentioned, all questions in the survey were mandatory, and all questions except the inclusion criteria included a “I prefer not to answer” response option (PNA). Ten participants who used the PNA option for more than 10% of their responses were excluded, to ensure data quality. The final sample size was 946 participants who were retained for analysis.

Planned Analyses

University sample. The prevalence of sibling incest (3%) was lower than expected based on previous studies (e.g., 7%-24%; Bevc & Silverman, 1993; Greenwald & Leitenberg, 1989; Hardy, 2001). Despite a large overall sample size ($N = 748$), this base rate of sibling incest resulted in a small sample size for the outcome of interest ($N = 23$). Therefore, the planned mediation analysis examining whether disgust toward incest mediates the relationship between physical proximity and the likelihood of incest could not be conducted. Nonetheless, based on

the tenets of the Westermarck hypothesis (1891/1921) and the suspected mediating role of disgust, less physical proximity in childhood is expected to be associated with an increased likelihood of sexual behaviour between siblings, as are lower levels of disgust toward incest.

Alternative analyses utilizing statistical methods designed for low base rate events or restricted value ranges were implemented for this study. Receiver Operator Characteristic (ROC) analyses (Swets, 1988) have been traditionally used for diagnostic evaluations because they plot the true positive rate against the false positive rate, to examine whether classification accuracy is greater than what would be expected by chance. Thus, ROC analysis allows the evaluation of the ability of a variable to predict a binary outcome. A useful effect size measure called the Area under the Curve (AUC) is produced by the ROC analysis. AUCs range from 0 to 1, where a score of 0.5 indicates a chance level of prediction and 1 (or 0, depending on the direction of coding) indicates perfect prediction. AUCs are commonly used in forensic psychology literature to examine recidivism, and are suitable for low base rate/restricted range data (Babchishin & Helmus, 2016).

ROC analysis and AUCs are non-parametric statistics, meaning that they make no assumptions about the distribution or shape of the data. This characteristic of ROC analysis is particularly useful when examining constructs that are likely to be naturally skewed in the population. Although the distribution of the variable is not a concern for ROC analyses, the detection and correction of outliers is still necessary (Klym, 2007). Therefore, outliers for continuous variables were identified by visual inspection of histograms, followed by a review of Z-scores ($Z > 3.29$). Outlying values were reduced in magnitude, but maintained their rank order.

By convention, AUCs of 0.56 are considered a small effect, 0.64 a medium effect, and 0.71 a large effect (Rice & Harris, 2005). In the context of predicting the likelihood of sibling

incest, for example, an AUC of 0.70 indicates that a randomly selected participant who had experienced sibling incest would have a higher score on the predictor variable than a randomly selected participant who had not experienced sibling incest 70% of the time. The direction of an AUC is specified prior to the analysis for each predictor. For example, lower scores on disgust are expected to increase the risk of incest. However, higher scores on sibling type (full siblings=0, non-full siblings=1) are expected to increase the risk of incest. These directions are specified prior to the analysis, so the AUC value is above 0.50 if the observed relationship is in the expected direction. If the AUC value is below 0.50, then the results are not in the expected direction.

A series of 'N - 1' chi-squared tests (Pearson, 1947), Kruskal Wallis non-parametric ranked ANOVAs (H ; Kruskal, 1952), and Kendall's non-parametric ranked correlations (τ ; Kendall, 1938) were also performed to test other evolutionarily germane predictions among participants who had engaged in incestuous behaviour. The 'N - 1' chi-squared test (Pearson, 1947) introduced by Egon Pearson is very similar to the traditional Pearson's chi-squared test (Pearson, 1900) created by Karl Pearson, except a correction is made that results in more accurate inferential statistics when the sample size is small (Campbell, 2007). The 'N - 1' chi-squared test is mathematically equivalent to the Mantel-Haenszel chi-squared statistic (Mantel & Haenszel, 1959) available in SPSS, when used for 2 x 2 frequency tables (Busing, Weaver, & Dubois, 2015). As a measure of effect size, the Mantel-Haenszel chi-squared statistic was converted to a Cohen's d , using the following formula: $d = 2 \sqrt{\chi^2 / (N - \chi^2)}$. The Cohen's d was calculated on the X^2 statistic as opposed to the original frequencies because the Mantel-Haenszel X^2 value has already been bias corrected for the small sample size.

Non-parametric Kruskal Wallis ranked ANOVAs (H) and Kendall's non-parametric

ranked correlations (τ) were chosen to examine continuous variables because many of these variables are expected to be skewed in the population (and were indeed skewed in this sample), thus violating the statistical assumptions of typical parametric ANOVAs and correlations. The distribution of the non-parametric Kruskal Wallis H statistic approximates a chi-squared distribution, and thus the H statistic is compared to this distribution to determine statistical significance. Because of this, Cohen's d was calculated based on the Kruskal Wallis H statistic, using the same X^2 formula as specified above.

Community sample. A similar series of univariate analyses were used to examine the tenability of evolutionarily germane predictions about participants who have engaged in incestuous behaviour. Frequencies between categorical variables were examined with Pearson's chi-squared test (χ^2 , Pearson, 1900). The difference between two groups on a continuous dependent variable was assessed via Kruskal Wallis non-parametric ranked ANOVAs (H ; Kruskal, 1952), whereas the relationship between continuous variables was assessed with Kendall's non-parametric ranked correlations (τ ; Kendall, 1938). As a measure of effect size, Cohen's d was calculated for 2x2 frequency tables with the following formula:

$$d = \frac{1}{1.65} \left[\ln \left(\frac{\{a + .5\}\{d + .5\}}{\{b + .5\}\{c + .5\}} \right) \right] \text{ (Fleiss, 1994; Sánchez-Meca et al., 2003). To calculate Cohen's } d \text{ for}$$

mean differences between groups, Cohen's d was calculated based on the Kruskal Wallis H statistic, using the same formula as specified for the student sample.

The direction of Cohen's d (positive or negative) was determined based on the specified prediction. Cohen's d values were positive if the relationship was in the expected direction, whereas Cohen's d values were negative if the relationship was not in the expected direction. Cohen (1988) suggested that a d of 0.20 is small, 0.50 is moderate, and 0.80 is large. To provide some context for this study, the previously mentioned Pullman et al., (2017) meta-analysis found

that sociolegal incest offenders were more problematic than biological incest offenders on some indicators of antisociality, and the magnitude of these effects ranged from what could conventionally be considered small (e.g., $d = 0.25$) to moderate (e.g., $d = 0.52$) in size. Furthermore, Bevc & Silverman (2000) found that opposite-sex siblings who had engaged in vaginal intercourse were more likely to have been separated for at least a year, in the first 10 years of their life, compared to opposite-sex siblings who did not engage in sexual behaviour with one another, $d = 1.42$, 95% CI [0.69, 2.16].

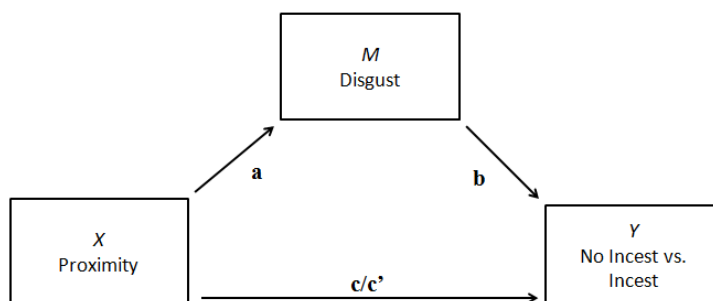
The base rate of incestuous behaviour between siblings in this sample (12%, $N = 115$) does allow a direct test of the mediation hypothesis: The primary hypothesis is that the relationship between physical proximity and the likelihood of sexual behaviour between siblings is mediated by disgust toward incest (Figure 5a). This hypothesis was analyzed using mediation analysis for dichotomous outcomes, utilizing the PROCESS macro developed for SPSS (Hayes, 2013). Mediation analysis tests whether the effect of physical proximity (X) on the likelihood of sexual behaviour with a sibling (Y) is mediated by disgust toward incest (M). Traditional methods of mediation (e.g., Baron & Kenny, 1986) infer the existence of an indirect effect, but do not actually quantify the indirect effect. Based on the recommendations of Hayes (2009), the product-of-coefficients method (the product of paths a and b) with bootstrapping has been used in this study to quantify the indirect effect. Bootstrapping is an estimation method that takes the overall sample size, and then re-samples the sample with replacement thousands of times. The indirect effect is calculated within each mini-sample. This creates a distribution of indirect effects, from which a confidence interval is calculated in order to assess the statistical significance of the indirect effect.

In addition to examining this simple mediation model, the effect that different

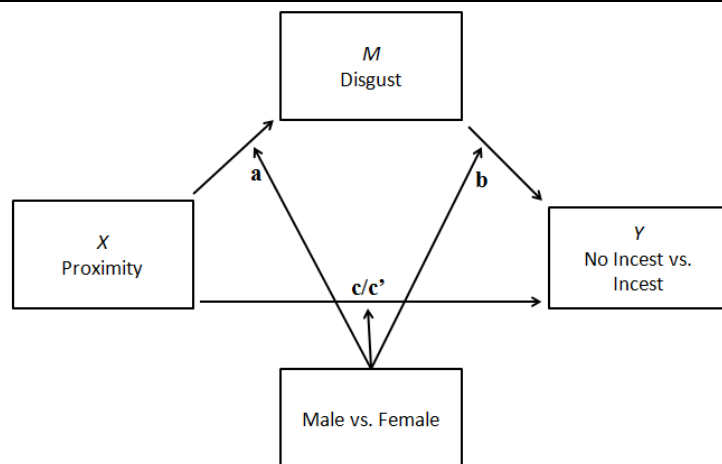
characteristics of the sample had on the strength of this association was also examined, using moderated-mediation analyses (Figure 5b). Moderated-mediation (also referred to as conditional process analysis) conducts the same mediation analysis as described above, but at each level of the moderator (e.g., males and females). The index statistic, a measure of the difference in the strength of the indirect effect at different levels of the moderator, is also derived using a bootstrapping approach from the distribution of the difference in the strength of the indirect effect at each level of the moderator. A bootstrapped confidence interval is calculated around this difference score to facilitate statistical inference. Lastly, sensitivity analysis were conducted (Figure 5c), to examine differences in the strength of the indirect effect, when examining different characteristics of the incestuous behaviours that occurred between siblings. Based on the recommendations of Payton et al., (2003), an 85% confidence interval for each indirect effect was calculated, based on the following formula: $\beta \pm t(n-2, 1-\alpha/2) \text{ se}(\beta)$, where β is the regression coefficient, t is the critical value from the t-distribution, having $n-2$ degrees of freedom and a cumulative probability equal to the critical probability $(1-\alpha/2)$, and $\text{se}(\beta)$ is the standard error of the regression coefficient (Draper & Smith, 2014). Non-overlap in these 85% confidence intervals suggests statistically significant differences in the magnitude of the indirect effects, at a 95% confidence level.

Statistical assumptions. The primary hypothesis was assessed using mediation analysis. Specifically, the relationship between physical proximity and disgust was assessed via linear regression, while the relationship between disgust and the likelihood of incest, as well as the relationship between physical proximity and the likelihood of incest was assessed via logistic regression. Therefore, the statistical assumptions associated with linear and logistic regression must be met for the results to be valid. A simple linear regression assumes 1) a linear relationship

a) Simple Mediation Model



b) Moderated-Mediation Model



c) Sensitivity Analyses

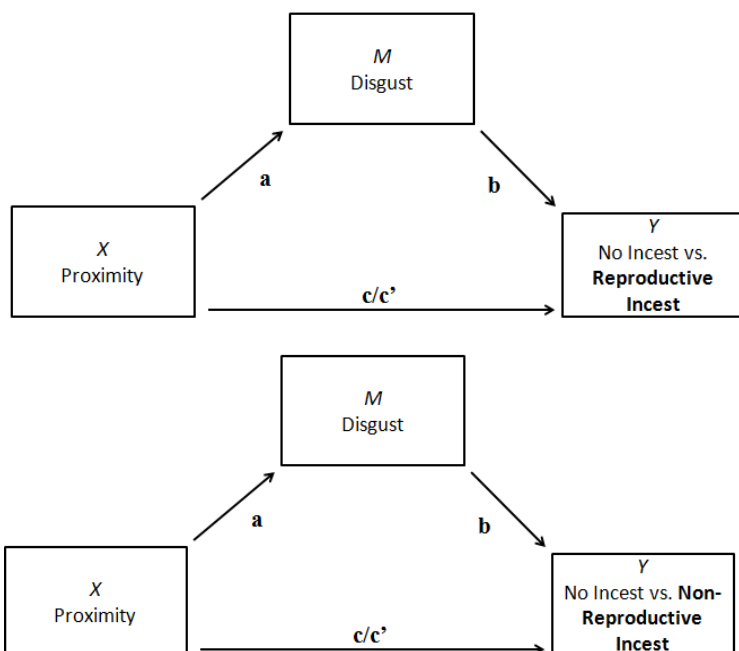


Figure 5. *Mediation Models Examining Incestuous Behaviour Among Siblings*

Note: Paths a, b, and c are standardized regression coefficients, while path c' (indirect effect) is the product of paths a and b.

between the independent and dependent variable, 2) multivariate normality of residuals, 3) homoscedasticity of residuals, and 4) independence of errors (Tabachnick & Fidell, 2007). In addition to these assumptions, it is also prudent to ensure the absence of multivariate outliers between the independent and dependent variable, and the absence of outliers in the residuals of the solution. The linear relationship between physical proximity and disgust was assessed using a scatter plot. Multivariate normality of residuals was assessed by saving the standardized residuals from the regression, and examining the skew and kurtosis statistics of the residual distribution ($\text{skew}/\text{SE skew} < 3.29$ / $\text{kurtosis}/\text{SE kurtosis} < 3.29$). Homoscedasticity of residuals was assessed by plotting the standardized residuals against the standardized predicted values, and examining the shape of the scatter (a funnel shape indicates *heteroscedasticity*). Lastly, independence of errors was assessed via the Durbin-Watson test, which detects autocorrelation among residuals (Tabachnick & Fidell, 2007). After these analyses were completed, the presence of multivariate outliers between the independent and dependent variable was explored using Mahalanobis distance ($p < .001$, $df=2$, critical $X^2=13.82$), and the possibility of outliers in the solution was examined by reviewing the histogram and Z scores associated with saved standardized residuals from the regression ($Z < 3.29$).

A simple logistic regression assumes 1) a linear relationship between the independent variable and the logit transformation of the dependent variable (known as linearity in the logit), and 2) independence of errors. Furthermore, the detection of outliers in the residuals of the solution is also necessary (Tabachnick & Fidell, 2007). Linearity in the logit was assessed by creating an interaction between the independent variable and its' log transformation. This interaction is added to the logistic regression with the original predictor. If this interaction term is statistically significant in the prediction of the dependent variable, then this assumption is

violated. Independence of errors in logistic regression refers to the fact that each response comes from a different, unrelated case. As this was a between-subjects design, this assumption is met. Lastly, residuals in the solution were assessed by examining the histogram and Z-scores of the saved standardized residuals ($Z > 3.29$).

Data Preparation

Ceiling effects. Two of the primary variables of interest in this study –physical proximity and disgust toward incest – could be influenced by ceiling effects or floor effects. If present, these effects would reduce variability and could influence the relationships examined below, since both regression and AUCs assesses the amount of variability in one variable, explained by another variable. Therefore, a detailed examination of these variables was conducted to assess evidence of such effects.

Physical proximity was an ordinal scale, where scores could range from 0 to 3. In the university sample, the mean score was high ($M=2.77$), with little variability ($SD=0.76$). The vast majority (91%) of participants had the highest amount of physical proximity possible, and only 6% had the lowest score possible. In the community sample, the mean score was also high ($M=2.63$), but there was more variability than in the university sample ($SD=0.95$). Furthermore, while the majority of participants (86%) also had the highest score possible, more participants did have the lowest score possible as well (10%).

Scores on disgust toward incest could range from 0 to 12. In the university sample, the actual range was 2.75 to 12.00 (scores of zero were found to be outliers, and thus the magnitude was reduced but they maintain rank order). The mean disgust score was high ($M= 9.92$), with little variability ($SD= 1.75$). Approximately 19% of participants had the highest disgust score possible, 25% of the sample had scores below 9.00, and 25% had scores above 11.50. In the

community sample, the actual range of disgust scores was 0 to 12. The mean disgust scores was high ($M=8.22$), but with more variability than the university sample ($SD=2.76$). While 8% of participants had the highest disgust score possible, 25% had scores below 7.00, and 25% had scores above 10.00. There was more variability in physical proximity and disgust toward incest among the community sample than the university sample. These analyses suggest that there is evidence of ceiling effects for both samples, which may influence the results, but that this effect is more pronounced in the university sample of participants.

Missing data. In addition to examining the rate of PNA responding for each participant, an examination of the rate and pattern of PNA responding for each variable included in this study was also conducted. In both samples, all variables had less than 1% PNA responding. The primary outcome variable for this study (sexual contact with a sibling) did not predict the pattern of PNA responding among any variable in either sample (excluding variables that were only given to participants who had experienced sexual contact with a sibling). Based on these results, listwise deletion within analyses (e.g., within a single regression model) and pairwise deletion between different analyses were utilized¹⁰

Results

University Sample

The prevalence and characteristics of sexual behaviour between siblings. As previously mentioned, 3% of participants in this study experienced sexual behaviour with at least one opposite-sex sibling ($N = 23$). This rate of sexual behaviour between siblings is lower than prevalence rates found in past studies of university samples (7%-24%; Bevc & Silverman, 1993; Greenwald & Leitenberg, 1989; Hardy, 2001). Among the 23 participants who experienced

¹⁰ With less than 5% missing data, there are unlikely to be any differences in statistical findings between deletion and imputation methods of dealing with missing data (Tabachnick & Fidell, 2007).

sexual behaviour with a sibling, the majority reported sexual behaviour with a full sibling (83%). A large portion of participants (39%) reported the experience as non-coercive, 30% reported that they coerced their sibling, 13% reported that their sibling coerced them, and 18% of cases were uncategorizable due to missing data (i.e., selected PNA for one or more of the questions used to create these distinctions). In regard to the type of sexual behaviour experienced, no participants experienced vaginal or anal intercourse with a sibling. The most common types of sexual behaviour experienced was touching of sexual organs (64%) and kissing (46%). The most commonly endorsed motivations for engaging in sexual behaviour with a sibling was curiosity (91%) and the behaviour was part of a game (65%). More details can be found in Table 11.

Predictors of sibling incest. Contrary to expectations, childhood proximity did not predict sibling incest, $AUC=0.56$, 95% CI [0.44, 0.69], $N=741$, nor did disgust toward incest, $AUC=0.59$, 95% CI [0.46, 0.73], $N=733$, or type of sibling, $AUC=0.56$, 95% CI [0.43, 0.68], $N=745$. Furthermore, male participants were not found to be more likely to initiate sexual behaviour with their sisters, Mantel-Haenszel $X^2=0.56$, $df=1$, $p=.454$, $N=14$, $d=0.41$, 95% CI [-0.66, 1.48]. In regard to the intrusiveness of the sexual behaviour, there was a trend for less physical proximity to be associated with a higher degree of intrusiveness, $\tau=-.37$, $p=.060$, $N=22$, a medium effect, although as mentioned, there were no participants who had experienced reproductive sexual behaviours. Lastly, there were no statistically significant differences between full and non-full siblings on indicators of childhood antisociality including hitting others, shouting, risk taking, and weighting the pros and cons of a decision (Table 10).

Community Sample

The prevalence and characteristics of sexual behaviour between siblings. As previously mentioned, approximately 12% of participants in this study experienced sexual

Table 10. *University Sample- Antisociality Indicators for Full and Non-full Siblings Who Engage in Incest*

<i>University Sample</i>						
	Full Siblings	Non-full Siblings				
	Mean Rank/ Mean (SD)	Mean Rank/ Mean (SD)	H	N	p	d (95% CI)
Hitting others	12.76 <i>1.89 (0.99)</i>	8.38 <i>1.25 (0.50)</i>	1.63	23	.202	-0.55 (-0.30, 1.40)
Shouting	11.53 <i>2.37 (1.21)</i>	14.25 <i>2.75 (0.50)</i>	0.58	23	.445	0.32 (-0.51, 1.15)
Risk taking	11.71 <i>3.05 (1.03)</i>	13.38 <i>3.25 (0.96)</i>	0.22	23	.641	0.20 (-0.62, 1.02)
Decision making	10.92 <i>1.95 (0.71)</i>	17.12 <i>1.25 (0.50)</i>	3.27	23	.070	-0.81 (-1.70, 0.07)

Note: H = Kruskal Wallis ranked ANOVA. Mean (SD) reported for descriptive purposes. Kruskal Wallis ranked ANOVA calculated from the mean rank. Comparisons should not be made between the mean ranks of the University and Community Samples as ranks are calculated within each sample. Bolded values indicate statistical significance ($p < .05$).

behaviour with at least one opposite-sex sibling ($N = 115$). This rate of sibling incest is similar to other studies (7%-24%; Bevc & Silverman, 1993; Greenwald & Leitenberg, 1989; Hardy, 2001). Among the participants who experienced sexual behaviour with a sibling, the majority reported sexual behaviour with a full sibling (64%). The majority of participants (45%) reported the experience as non-coercive, 10% reported that they coerced their sibling, 22% reported that their sibling coerced them, and 23% of cases were uncategorizable due to missing information. In regard to the type of sexual behaviour experienced, the most common types of sexual behaviour experienced was touching of sexual organs (75%) and kissing (52%). A substantial proportion of participants did, however, report more intrusive sexual behaviours ranging from masturbation of/by their sibling (44%/41%) to anal intercourse (20%). The most commonly endorsed motivations for engaging in sexual behaviour with a sibling was curiosity (85%) and the behaviour was part of a game (66%). More details regarding these characteristics can be found in Table 11, for both the university and community sample.

Table 11. *Characteristics of Sexual Behaviour Between Siblings*

	University Sample	Community Sample
Sibling Type		
Full sibling	82.6%	64.3%
Non-full sibling	17.4%	35.7%
Coercion		
Non-coercive	39.0%	45.2%
Participant coercive	30.0%	10.4%
Sibling coercive	13.0%	21.7%
Uncategorizable	18.0%	22.6%
Type of Sexual Behaviour ¹		
Kissing	45.5%	52.2%
Touching sexual organs	63.3%	75.4%
Masturbate sibling	18.2%	43.9%
Masturbated by sibling	9.1%	41.2%
Receive oral sex	0.0%	36.3%
Perform oral sex	9.1%	42.0%
Vaginal intercourse	0.0%	31.3%
Anal intercourse	0.0%	20.2%
Reasons for Sexual Behaviour ¹		
Curiosity	91.3%	85.0%
Game	65.2%	66.4%
Desire	17.4%	53.0%
Romance	0.0%	23.5%
Urged	8.7%	20.4%
Influenced	17.4%	29.5%
Forced	8.7%	16.8%
Other	13.6%	16.0%

¹ Each item was presented as a *yes* or *no* question. The results reported are the percent of the sample that indicated *yes*.

Non-full siblings were more likely to engage in incest than full siblings, $X^2 = 36.01$, $df = 1$, $p < .001$, $d = 0.76$, 95% CI [0.50, 1.02]. Furthermore, among siblings who had engaged in sexual behaviour, males were more likely to initiate this behaviour than females, $X^2 = 11.20$, $df = 1$, $p = .001$, $d = 1.14$ 95% CI [0.40, 1.88]. Furthermore, a lower degree of physical proximity was found to be associated with more intrusive sexual behaviour between siblings, $\tau = -.26$, $p = .004$, $N = 97$. Lastly, while non-full siblings were more likely to shout at other people in childhood, there were no differences between full and non-full siblings on other indicators of childhood antisocial behaviour (Table 12).

Table 12. *Community Sample- Antisociality Indicators for Full and Non-full Siblings Who Engage in Incest*

<i>Community Sample</i>						
	Full Siblings	Non-full Siblings				
	Mean Rank/ Mean (SD)	Mean Rank/ Mean (SD)	H	N	p	d (95% CI)
Hitting others	54.36 1.74 (0.74)	64.57 2.10 (1.04)	2.82	115	.093	0.32 (-0.05, 0.69)
Shouting	53.29 2.24 (1.10)	66.50 2.66 (1.11)	4.50	115	.034	0.40 (0.03, 0.78)
Risk taking	54.47 2.95 (1.17)	64.37 3.32 (1.27)	2.49	115	.115	0.03 (-0.07, 0.67)
Decision making	54.64 2.20 (1.07)	64.06 2.54 (1.19)	2.27	115	.132	0.28 (-0.09, 0.65)

Note: H = Kruskal Wallis ranked ANOVA. Mean (SD) reported for descriptive purposes. Kruskal Wallis ranked ANOVA calculated from the mean rank. Comparisons should not be made between the mean ranks of the University and Community Samples as ranks are calculated within each sample. Bolded values indicate statistical significance ($p < .05$).

The relationship between physical proximity, disgust, and incest. After examination of the statistical assumptions associated with both linear and logistic regression, multivariate normality of residuals in the linear regression and linearity in the logit in the logistic regression were found to be violated. Thus, physical proximity and disgust toward incest were log transformed to address these issues of non-normality. In both the linear and logistic regression models using these transformed variables, there was no evidence of multivariate outliers or outliers in the residual solution. To increase the interpretability of the results, especially in light of these transformations, all continuous variables were standardized prior to modeling.

As expected, lower levels of physical proximity were associated with an increased likelihood of sexual behaviour between siblings, $b = -0.34$, $SE = 0.09$, 95% CI [-0.51, -0.17]. Furthermore, lower levels of physical proximity were associated with lower levels of disgust toward incest, $b = 0.09$, $SE = 0.03$, 95% CI [0.02, 0.16], and lower levels of disgust toward incest were associated with an increased likelihood of sexual behaviour between siblings, $b = -0.63$, SE

= 0.12, 95% CI [-0.86, -0.40]. The indirect effect was tested using a bootstrap estimation approach with 5000 samples. These results indicated that disgust toward incest mediated the relationship between physical proximity and the likelihood of incest, $b = -0.06$, $SE = 0.02$, 95% CI [-0.12, -0.01].

A few candidate moderators were assessed to ascertain whether the strength of this indirect effect differed across different sample characteristics. Disgust toward incest mediated the relationship between physical proximity and the likelihood of incest for both males, $b = -0.14$, $SE = 0.08$, 95% CI [-0.32, -0.02], and females, $b = -0.05$, $SE = 0.03$, 95% CI [-0.14, -0.01]. Unexpectedly, the magnitude of these indirect effects did not differ, Index = -0.09, $SE = 0.08$, 95% CI [-0.27, 0.05]. Furthermore, disgust toward incest mediated the relationship between physical proximity and the likelihood of incest for full-siblings, $b = -0.05$, $SE = 0.03$, 95% CI [-0.12, -0.001], but not for non-full siblings, $b = -0.10$, $SE = 0.07$, 95% CI [-0.26, 0.01]. Given the substantially smaller sample size for non-full siblings, however, this result is unsurprising due to a lack of statistical power. Importantly, the magnitude of these indirect effects did not differ, Index = -0.05, $SE = 0.08$, 95% CI [-0.2, 0.08]. Finally, disgust toward incest mediated the relationship between physical proximity and the likelihood of incest for participants who were older than their sibling, $b = -0.08$, $SE = 0.05$, 95% CI [-0.19, -0.01], but not for participants who were younger than their sibling, $b = -0.04$, $SE = 0.03$, 95% CI [-0.15, 0.01]. However, there was not a difference in the magnitude of these indirect effects, Index = -0.04, $SE = 0.06$, 95% CI [-0.16, 0.07].

Sensitivity analysis was also conducted to examine the magnitude of the indirect effect when examining different characteristics of incestuous behaviour between siblings. When predicting the likelihood of engaging in non-reproductive incest with a sibling (versus no incest

with a sibling), disgust toward incest mediated the relationship between physical proximity and the likelihood of incest, $b = -0.04$, $SE = 0.02$, 95% CI $[-0.10, -0.004]$; 85% CI $[-0.07, -0.004]$. This model accounted for 6% of the variance in the likelihood of sibling incest (Nagelkerke $r^2 = .06$). When predicting the likelihood of engaging in reproductive incest with a sibling (versus no incest with a sibling), disgust toward incest mediated the relationship between physical proximity and the likelihood of incest, $b = -0.09$, $SE = 0.06$, 95% CI $[-0.24, -0.001]$; 85% CI $[-0.18, -0.002]$. This model accounted for 36% of the variance in the likelihood of sibling incest (Nagelkerke $r^2 = .36$). An examination of the 85% confidence intervals for these two indirect effects suggested that the confidence intervals do overlap, and therefore the magnitude of these indirect effects did not differ from one another.

Discussion

The results obtained from the university sample of participants were not consistent with the Westermarck hypothesis (1891/1921), or the various evolutionary predictions specified about the nature of the incestuous behaviour that occurred between siblings. While in the expected direction, childhood proximity, disgust toward incest, and sibling type were not found to be predictors of the likelihood of sexual behaviour between siblings. Additionally, while again in the expected direction, brothers were not more likely to initiate sexual behaviour with their sisters. Finally, there was a moderate sized trend for less physical proximity to be associated with a higher degree of intrusiveness ($r = -.37$), although this was not statistically significant.

In the community sample of participants, the relationship between physical proximity and the likelihood of incest was mediated by disgust toward incest. Less physical proximity in childhood was associated with less disgust toward incest, and less disgust toward incest was associated with an increased likelihood that incest would occur between siblings. This

relationship was not influenced by the sex of the participant or whether the participant was older or younger than their sibling, contrary to hypotheses. As expected, however, whether the siblings were full or non-full siblings also did not influence the strength of this indirect effect. Sensitivity analysis was conducted to examine whether the strength of the indirect effect was stronger for certain types of incestuous behaviour. The magnitude of the indirect effect did not differ between non-reproductive and reproductive sexual behaviours. Interestingly, although the magnitude of the indirect effects were not statistically different from one another, the model for reproductive incest accounted for 30% more of the variance in the likelihood of incest, compared to the non-reproductive incest model (36% vs. 6%, respectively). If taken as a measure of effect size, a difference of 30% of the variance accounted for between models could be considered a large effect.

Univariate analyses were consistent with the evolutionary perspective of incest. Non-full siblings were more likely to engage in incest than full-siblings ($d = 0.76$), and male participants were more likely to initiate a sexual encounter with a female sibling ($d = 1.14$). Additionally, less physical proximity was found to be associated with more intrusive sexual behaviour between siblings ($\tau = -.26$). These results are consistent with the Westermarck hypothesis (1891/1921) and the mediating role of disgust in this incest avoidance mechanism. Furthermore, these results suggest that there may be certain conditions in which the Westermarck hypothesis and disgust are more or less likely to be applicable.

In both samples, there was not strong evidence to suggest that non-full siblings who engaged in incest were more antisocial than full-siblings who engaged in incest. These results are inconsistent with the results from a previous meta-analysis (Pullman et al., 2017) of biological and sociolegal incest offenders. There are a couple of potential explanations for this. Due to

small frequencies, the non-full sibling variable included half, step, and adopted siblings, whereas the meta-analysis sampled purely sociolegal (genetically unrelated) relatives. These sample compositions could be influencing the results observed. Furthermore, the samples included in the meta-analysis were primarily non-sibling cases (i.e., fathers) and were of convicted sexual offenders. Therefore, it is possible that the factors that distinguish between biological and sociolegal incest offenders are different than the factors that distinguish between full and non-full siblings who engage in incest in non-adjudicated samples.

Limitations

There were a number of limitations associated with the university sample of participants. First, university students are not a representative population, and the characteristics of that non-representativeness could have influenced the variables of interest in this study. Indeed, participants in the university sample were younger, better educated and from a higher socioeconomic stratum than participants in the community sample (see Table 9), as well as in the general population (Statistics Canada, 2016). Additionally, divorce and family conflict have been found to have a negative effect on educational attainment (Purdie, 2010), suggesting that university students (who, by definition, have a high degree of educational attainment) are more likely to have traditional family structures than the general population, which in turn will reduce the amount of variability in childhood physical proximity among this population. Indeed, the university sample had higher physical proximity and disgust toward incest scores, with less variability, than the community sample. It is possible that the lack of variability in these variables contributed to the null results obtained.

Furthermore, the rate of incestuous behaviour between siblings in the university sample was substantially lower (3%) than rates found in previous surveys (7%-24%; Bevc & Silverman,

1993; Greenwald & Leitenberg, 1989; Hardy, 2001), as well as the rate found in the community sample (12%) of siblings. This unexpectedly low base rate could also be related to the non-representativeness of this sample. University students are more prosocial than the general population (Weymans, 2010). It is also possible that they are more influenced by the effects of socially desirable responding. Although the procedure for this study ensured that participant responses were anonymous, credits for participating in the study were granted by collecting identifying information (ISPR participant number, university email address). The knowledge that this identifying information was being collected could have influenced the truthfulness of responding.

Another limitation of this low base rate of incestuous behaviour is that it resulted in the inability to directly test the predicted mediation model in the university sample. Additionally, the analyses performed among participants who had experienced sexual behaviour with a sibling ($N = 23$) had a very low level of statistical power ($power = .08 - .30$; G*Power, Faul, Erdfelder, Lang, & Buchner, 2007; Faul, Erdfelder, Buchner, & Lang, 2009). Indeed, these power analyses suggest that with this sample size, the probability of failing to detecting a significant effect, if a significant effect does exist, will occur 70% to 92% of the time.

A final limitation associated with the university sample is that none of the participants who had engaged in sexual behaviour with a sibling engaged in vaginal intercourse. The Westermarck hypothesis (1891/1921) specifies the existence of an incest avoidance mechanism that has evolved because of the fitness consequences associated with inbreeding depression. Inbreeding depression is, strictly speaking, only a possibility if the sexual behaviour could result in reproduction. Therefore, while it is likely that the expected relationship between physical proximity and the likelihood of non-reproductive incest would be found, as well as disgust

toward incest and the likelihood of non-reproductive incest, these relationships are expected to be stronger when predicting the likelihood of reproductive incest. Indeed, Bevc and Silverman (1993/2000) also examined a university sample of siblings, and found that siblings who experienced a separation of a year or longer in the first 10 years of life were more likely to engage in penile-vaginal intercourse compared to siblings who were not separated in childhood, but this relationship was not found for non-reproductive behaviours such as kissing or masturbation.

The community sample minimized many of the limitations found in the university sample, including a higher base rate of incestuous behaviour between siblings (3% vs. 12%), and more variability in the sexual activities participants experienced with a sibling. Indeed, while no participants had engaged in reproductive incest among the university sample, over 30% of participants in the community sample had. Nonetheless, there are still a few limitations that should be addressed. The most important limitation is that both of these samples are from a cross-sectional study. This means that the direction of the effects reported here are unknown, and thus conclusions about cause and effect cannot be made. Indeed, it is possible that, instead of lower levels of disgust leading to an increased likelihood of sexual behaviour with a sibling, the direction is actually reversed - if you've experienced sexual behaviour with a sibling, you report less disgust toward incest. While evidence was found that these relationships do exist in the community sample, and a theoretically postulated direction for these effects was suggested, this limitation hinders the ability to empirically draw conclusions about the direction of these relationships.

Despite these limitations, this study provides partial support for the Westermarck hypothesis (1891/1921) and the mediating role of disgust, building upon the current literature

about incest avoidance mechanisms in siblings. Specifically, in the community sample of siblings, less physical proximity was associated with less disgust toward incest, less disgust toward incest was associated with an increased likelihood of sexual behaviour with a sibling, and disgust toward incest mediated the relationship between physical proximity and the likelihood of incest.

CHAPTER 5 – Discussion

Summary

The aim of this dissertation was to evaluate proximate mechanisms that facilitate incest avoidance, as well as elucidate under what circumstances these mechanisms may fail, gaining important theoretical insight from the evolutionary psychology literature. Study 1 was a meta-analysis that examined differences between adult biological and sociolegal incest offenders. The samples included in this meta-analysis were composed primarily of fathers. Study 2 further examined factors associated with incest among fathers, addressing the Westermarck hypothesis (1891/1921) and the mediating role of disgust. Lastly, Study 3 extended this paradigm to sibling relationships, also assessing the validity of the Westermarck hypothesis and the mediating role of disgust in this population.

Study 1 found that sociolegal incest offenders were more problematic on some indicators of antisocial tendencies (general self-regulation, sexual self-regulation, impulsivity, substance abuse), but contrary to expectations, these groups did not differ in atypical sexual interests. While groups were similar in the presence of atypical sexual interests, sociolegal incest offenders had more problems with general and sexual self-regulation, suggesting that if an atypical interest was present, they may be more likely to act on these interests. The results of this meta-analysis suggest that traditional theories of sexual offending against children that highlight both antisociality and atypical sexual interests as potential etiological factors (e.g., Motivation-Facilitation Model; Seto, 2017), may explain more cases of sociolegal incest than biological incest. Even if traditional theories are applicable to explaining sociolegal incest, however, evolutionary driven mechanisms may still be important because some kinship cues, like physical proximity, are not derived from the actual degree of genetic relatedness.

Study 2 was an examination of the Westermarck hypothesis (1891/1921) and the mediating role of disgust in father-daughter relationships. Partially consistent with the findings from Study 1, among participants with scores in the top 10th percentile on incest propensity, sociolegal fathers reported more childhood antisociality than biological fathers. Biological and sociolegal fathers did not differ, however, on the presence of violent, non-violent, and sexual offence histories in adulthood. These analyses did suffer from a low degree of statistical power because of the reduced sample size ($N=65$), and thus may explain the statistically insignificant results. Another possibility for these null results, however, is that antisocial individuals are less likely to use the Qualtrics platform, which requires signing up for an account in order to participate in research. Given these results, and the confounding effect that antisociality may have on the relationship between physical proximity and incest propensity, antisociality was statistically controlled for in all of the mediation analyses that were performed.

While there have been a few studies that have examined the Westermarck hypothesis (1891/1921) in a sample of fathers (Parker & Parker, 1995; Williams & Finkelhor, 1995), this was the first to examine the mediating role of disgust in the incest avoidance mechanism. The results from this study do not support the viability of the Westermarck hypothesis as a mechanism that facilitates incest avoidance for fathers. Physical proximity was not associated with incest propensity or disgust toward incest, although lower levels of disgust toward incest were associated with higher levels of incest propensity. Disgust toward incest did not mediate the relationship between physical proximity and incest propensity. While physical proximity may not be a reliable kinship cue used to regulate incest avoidance for fathers, as these results suggest, disgust toward incest may still be the proximate mechanism that facilitates incest avoidance. Putative fathers may rely on other kinship cues, such as physical resemblance or

partner fidelity (e.g., Anderson et al., 2007; Apicella & Marlowe, 2004; Burch & Gallup, 2000; Fox & Bruce, 2001) as signals for incest avoidance, as opposed to physical proximity.

Alternatively, it is also possible that the theorized incest avoidance mechanism resides in the daughter, as opposed to the father, given the differential fitness consequences associated with inbreeding being greater for females than males (Rice & Harris, 2002), and the hypothesis that there is a critical window for the development of incest avoidance (e.g., Shepher, 1971; Wolf, 1995) that would preclude fathers given their age.

Lastly, Study 3 was also an examination of the Westermarck hypothesis (1891/1921) and the mediating role of disgust, but in two samples (university and community sample) of siblings. Surprisingly, in both the university and the community sample, very little evidence was found to suggest that sociolegal siblings who engage in incest were more antisocial than biological siblings who engage in incest. Nonetheless, antisociality was statistically controlled for in all of the mediation analyses, given known differences between adjudicated biological and sociolegal incest offenders (Pullman et al., 2017).

This was the first study to examine the mediating role of disgust in the relationship between physical proximity and incest, relying on actual sexual behaviour between siblings (as opposed to propensity, as in past vignette studies). In the university sample, childhood proximity, disgust toward incest, and sibling type were not found to be predictors of the likelihood of sexual behaviour between siblings. These results are inconsistent with the tenets of the Westermarck hypothesis. Limitations associated with this sample, including non-representativeness (Purdie, 2010), an unexpectedly low base-rate of incestuous behaviour between siblings (3%; Bevc & Silverman, 1993; Greenwald & Leitenberg, 1989; Hardy, 2001), and very little variability in the types of sexual behaviours participants engaged in (i.e., no instances of intercourse; Bevc &

Silverman, 1993/2000) could all help to explain these null results.

In the community sample of siblings, the relationship between physical proximity and the likelihood of incest was mediated by disgust toward incest. Less physical proximity in childhood was associated with less disgust toward incest, and less disgust toward incest was associated with an increased likelihood that incest would occur between siblings. While there was not a statistically significant difference in the magnitude of the indirect effect between predicting reproductive and non-reproductive incest, the model predicting reproductive incest accounted for 30% more of the variance in the likelihood of incest, compared to the non-reproductive incest model (36% vs. 6%, respectively), arguably a large difference. As expected, sibling type (full vs. non-full) was not a meaningful moderator; the mediating effect of disgust toward incest in the relationship between physical proximity and the likelihood of incest was not dependent the actual degree of genetic relatedness between siblings. These results are consistent with the Westermarck hypothesis (1891/1921) and the mediating role of disgust among siblings, and further suggest that there may be certain conditions in which the Westermarck hypothesis and disgust are more or less likely to be applicable (e.g., reproductive incest).

Implications

Sexual behaviour between relatives is not only deleterious from a fitness perspective, but the psychological consequences associated with incest can be extremely harmful (Fergusson et al., 2013; Ratican, 1992; Roberts et al., 2004), possibly even in the case of non-coercive incest (Stroebe et al., 2013). Understanding how incest avoidance mechanisms function and under what conditions they may be weakened can provide insight into factors that increase the likelihood of incestuous behaviour.

In a criminal justice context, incest offenders are typically considered to be low risk

offenders (e.g., Hanson & Bussière, 1998). However, the results of Study 1 (Pullman et al., 2017) and possibly Study 2 (incest avoidance mechanisms among fathers) suggest that this conclusion may be less applicable in the case of sociolegal incest offenders, who are more problematic on some indicators known to be predictors of recidivism. Additionally, violence between siblings, including sexual violence, has been described as the most common and least researched form of family violence (Eriksen & Jensen, 2006, 2008). Criminal justice research has already acknowledged the importance of family level risk factors for juvenile delinquency (Savignac, 2009). It is possible that the absence of kinship cues could be a reliable risk factor for sibling incest, incorporated into adolescent sex offender risk assessment procedures (see Hempel, Buck, Cima, & Marle, 2013 for a review of risk assessment tools for adolescent sex offenders).

The results of this dissertation advance theoretical knowledge about how incest avoidance mechanisms function. Among siblings, physical proximity as a second order proximate mechanism and disgust toward incest as a first order proximate mechanism appear to be viable as a theoretical model to explain incest avoidance among siblings. This is consistent with prior research in this area (e.g., Lieberman et al., 2003/2007), but these results also extend prior research by examining these relationships among participants who have engaged in incestuous behaviour with a sibling. Among fathers, however, the Westermarck hypothesis (1891/1921) is a less promising theoretical explanation. Physical proximity was not found to be associated with incest propensity, nor was physical proximity found to influence levels of disgust toward incest. Interestingly, less disgust toward incest was associated with more incest propensity. This suggests that, while physical proximity may not be a kinship cue used to signal kinship estimation for the purpose of incest avoidance among fathers, disgust toward incest may still be a first order proximate mechanism responsible for producing incest avoidance. Although

not investigated in this dissertation, other kinship cues such as physical resemblance and partner fidelity (e.g., Anderson et al., 2007; Apicella & Marlowe, 2004; Billingsley et al., 2018) may be more reliable kinship cues for fathers. Alternatively, it is possible that incest avoidance mechanisms have evolved among females, but not males, due to differential fitness consequences (Rice & Harris, 2002). In this case, kinship cues may still be necessary so that fathers can accurately identify their kin, but these kinship cues are used for other evolved functions (e.g., differential solicitude), as opposed to incest avoidance.

Limitations

Research investigating incest avoidance typically suffers from a number of limitations. The studies in this dissertation are no exception, although as described, they do provide meaningful improvements over previous research. While specific limitations have been discussed in each study, this section will focus on limitations common to examining incest avoidance mechanisms in general. The most prominent limitations associated with these studies are the cross-sectional nature of the data. Although the ultimate aim is to elucidate the causes of incest, this research design does not allow drawing causal conclusions. Indeed, while lower levels of disgust toward incest were associated with an increased incest propensity among fathers, it is possible that having a propensity for incest decreases disgust toward incest. Similarly, although lower levels of disgust significantly predicted an increased likelihood of sexual behaviour with a sibling, it is possible that instead, if you've experienced sexual behaviour with a sibling, you report less disgust toward incest. While a theoretically postulated direction for these effects has been specified, as well as a sequence for their development, firm conclusions cannot be drawn. The most that can be claimed is whether the results are consistent or inconsistent with the Westermarck hypothesis (1891/1921) and the mediating role of disgust

as an incest avoidance mechanism.

Another limitation associated with these studies is the reliance on self-report. Because of the taboo nature of the topic, asking an individual to self-report incestuous behaviour with a relative is likely to be influenced by socially desirable responding, even for a confidential online survey. Even if methods assessing propensity are used as opposed to behaviour, socially desirable responding can still result in floor or ceiling effects. A number of strategies were employed to reduce such effects, including the use of third-party vignettes of incestuous behaviour as well as the addition of questions that do not directly ask about incest propensity (e.g., *How likely do you think it is that the man in this story will encourage continued sexual contact with his daughter*) or disgust toward incest (e.g., *How morally wrong do you find the man's behaviour in this story*). Nonetheless, it is not known the extent to which the current results have been influenced by socially desirable responding.

Another limitation associated with these studies is the non-representative nature of some of the samples. University students are commonly used in psychological research. University students are not, however, representative of the general population (Hanel & Vione, 2016). More importantly, they may be different in ways that influence the results presented here. For example, family dysfunction (e.g., divorce, conflict) has a negative effect on educational attainment (Purdie, 2010). University students, by definition, have a high degree of educational attainment, and thus are more likely to have traditional family structures than the general population. It is possible that this, in turn, reduces the amount of variability in childhood physical proximity. Additionally, university students are more liberal than the general population (Pew Research Center, 2016), and are likely less antisocial than the general population, because high educational attainment is a protective factor against delinquency (Howell, 2003). These factors could

potentially influence the variables measured in this study. This highlights the importance of sample representativeness when investigating incest avoidance mechanisms, as these mechanisms are theoretically universal, and thus results should be generalizable to the population. Furthermore, an attempt was made to collect a reasonably representative sample of fathers using the Qualtrics platform. The nature of the Qualtrics platform – requiring participants to sign-up for an account for the specific purpose of participating in research – likely resulted in a less antisocial sample than would be expected from a truly representative population of fathers.

Future Research Directions

There are a number of avenues that future research on this topic should investigate. First, the results from the university sample of siblings highlight the importance of using reasonably representative populations, or at least populations whose non-representativeness does not directly influence the variables being studied. Additionally, given that incest avoidance is theorized to be a universal mechanism, this literature would also benefit from cross-cultural comparisons. In relation to sample characteristics, it would also be helpful to examine the various evolutionary predictions set forth here in both adjudicated and non-adjudicated samples, using the same survey instruments, so that results can be directly comparable. The results of Study 1 (meta-analysis comparing biological and sociolegal incest offenders) found that some indicators of antisociality were distinguishing factors between biological and sociolegal offenders who commit sexual crimes against their kin. These results were partially confirmed in the sample of fathers, but not in either sample of siblings. It is important to note that while the meta-analysis included all types of biological and sociolegal relatives, the samples were predominantly composed of biological and sociolegal fathers. Therefore, it is possible that the finding that

sociolegal incest offenders were more problematic on some indicators of antisociality than biological incest offenders was driven by the fathers in the samples. This would explain why the results were not replicated in the sibling samples. Another possibility is the self-selection effect of survey research. Participants in Study 2 and 3 chose to participate in an online study. Furthermore, the Qualtrics platform required fathers to sign-up for a Qualtrics account for the purpose of participating in research, and these fathers, as well as the university students, are likely to be less antisocial than the general population (Howell, 2003). These sample characteristics likely resulted in a less antisocial sample than the general population.

Another future research direction would be to assess incestuous behaviours, as opposed to incestuous propensities. Due to the influence of socially desirable responding and, in some instances, the illegality of the behaviour, this can be difficult to implement. Online anonymous surveys can help to facilitate this, however, if large enough samples can be collected, the base rate of incestuous behaviour may be sufficient for analyses. If measuring incestuous behaviour is not possible, indirect measures of incest propensity can be used. For example, in men, penile plethysmography (PPG) is used to measure the amount of blood flow to the penis, as a proxy measure for arousal (i.e., degree of erection). Using audio descriptions of incestuous activity and measuring arousal with PPG may reduce the degree of socially desirable responding that can occur with self-report measures. Relatedly, assessing disgust as a first order proximate mechanism that facilitates incest avoidance could also be challenging using self-report methods, as the possibility of generating ceiling effects is high. Using indirect measures, such as facial electromyography (De Smet et al., 2014), to assess disgust toward incest would add validity to this area of research.

A comprehensive understanding of the causes of incest requires acknowledging the

multifaceted aspects of incest avoidance. Future research should, therefore, not only examine both first and second order proximate mechanisms that facilitate incest avoidance, but also examine multiple factors within the same theoretical model. For example, previous research has found that physical proximity is a valid kinship cue used by siblings (Lieberman et al., 2007), but only in the absence of Maternal Perinatal Association (MPA; observing your mother caring for your sibling). The degree to which a given kinship cue is effective may depend on what other kinship cues are present. Moreover, disgust is not the only first order proximate mechanism that could be responsible for inhibiting incestuous behaviour. Solicitude is defined as the degree of affection, care, and concern an individual experiences toward their relatives. Solicitude encompasses the caring, emotional responses toward a relative, which often translates into the behavioural investment of time and resources. This investment of time and resources, in turn, influences the fitness of both parties. Behavioural investment in a relative (e.g., sister, child) increases indirect fitness because genetic relatives share common genes. Individuals vary their solicitude depending on the degree of shared genes with their relatives (Haig, 1999), because solicitude directed toward a full sister, for example, would increase an individual's indirect fitness more than solicitude directed toward a half-sister. Typically, cues that indicate someone is kin would trigger the activation of solicitude directed toward that kin. If, however, the incest avoidance mechanism fails to activate or is weakened due to a lack of kinship cues, reduced solicitude directed toward the putative relatives would ensure that behavioural investment is not granted to those who share fewer common genes. This lack of solicitude may increase the risk of incest, because less care and concern are given to the putative relative's well-being. Consistent with the hypothesis that solicitude is a first order proximate mechanism that contributes to incest avoidance, Williams and Finkelhor (1995) found that while incestuous and non-incestuous

fathers did not differ in the degree of physical proximity with their daughters, incestuous fathers spent less time engaging in behavioural indicators of solicitude with their daughters, such as feeding and bathing, prior to when the abuse occurred, compared to non-incestuous fathers.

From an evolutionary perspective, incest is puzzling. This dissertation has elucidated an evolutionary mechanism that may be responsible for regulating human incest avoidance in siblings, and under what circumstances this mechanism may not function as expected. Importantly, this dissertation also suggests that this same mechanism is not responsible for regulating incest avoidance in fathers. Incorporating the above suggestions into future research examining mechanisms that facilitate incest avoidance can advance our theoretical understanding and offer robust conclusions about the causes of incest.

Appendix A

Meta-Analysis Coding Manual

Comparing Biological Versus Sociolegal Incest Offenders: A Meta-Analysis

2014-05-04

For additional information, please contact Lesleigh Pullman



Note: Coding manual adapted from Seto et al., 2015

CODING MANUAL

Study Admissibility

To be included in the 2014 meta-analysis on differences between biological and sociolegal incest offenders, the study had to meet the following criteria:

- Include an identifiable sample of predominantly adult (i.e., over 18 years of age) biological incest offenders. The data had to be provided by the offenders themselves (or come from an offenders file information), not their victim or mother of the victim.
 - Biological incest is defined as genetically related individuals up to first cousins. This includes offending against one's child, niece/nephew, grandchild, or a sibling/first cousin under the age of 12.
 - The proportion of fathers versus other genetic relations will be coded as a moderator
 - If a sample includes female offenders, this will be coded
- Include an identifiable sample of predominantly adult (i.e. over 18 years of age) sociolegal incest offenders. The data had to be provided by the offenders themselves (or come from an offenders file information), not their victim or mother of the victim.
 - Sociolegal incest offenders are defined as legally related individuals within a nuclear family. This includes offending against a step-child, adopted child, common-law child (cohabitating for at least one year), as well as step siblings who are under the age of 12.
 - If a sample includes female offenders, this will be coded.
 - While it is expected that sociolegal relationships will be primarily within the nuclear family, if a sample includes extended sociolegal relationships, the proportion of these in the sample will be coded
- Report on the characteristics of incest offenders targeted by this review (the list is available at the end of this manual).
- Sex offender groups with both biological and sociolegal victims (mixed) were excluded
 - If either group of incest offender has any prior offenses against unrelated children, this will be coded for moderator analysis
- Studies had to include at least 10 sex offenders in each comparison group
- Studies had to include sufficient statistical information to calculate effect size d
- Case studies were excluded from this meta-analysis
- Studies can use the following criteria to classify groups
 - Criminal History. Biological incest offenders could include official arrests/charges/convictions against genetic relatives. Sociolegal offenders could include official arrests/charges/convictions against sociolegal victims. Mixed groups were excluded
 - Index offences. In some cases, index offence type was used to separate groups. These studies were included in this meta-analysis, but identified using this classification could minimize difference between groups. This was coded.
 - Self-reports. Self reports include studies where offenders were asked to report their offences. These study were also included in this meta-analysis, but being identified using this classification method could potentially affect group

allocations (at least in cases where there is low confidentiality, resulting in fewer correct self-reported criminal histories, and, consequently, impact group differences). This was coded.

Study Identification

Each study that met the above criteria was given a study number. It was often found that there were some published and unpublished versions of the same study that included partial or complete overlap of subjects. In these cases, the studies were deemed to be part of the same project. Consequently, each 'project' was assigned a number (i.e., 15) with each study within the project being assigned its own number following a decimal point (i.e., 15.1, 15.2). Variables common to more than one study within one project were subject to the rules pertaining to 'multiple indices of a variable'. Variables that were unique to a study were coded as usual and given their study number as an identifier. The study with the greatest number of effect sizes was given the decimal .1, and the next study with the greatest number of effect size was assigned .2. In the case where the studies contributed the same number of effect sizes, the most recent study was given a decimal number of .1, the next most recent assigned .2, and so on in successive years.

Study Descriptive Information

For each study, only one Study Identification form was completed. The Study Identification form included study identifiers as well as study descriptive statistics. An example of the Study Identification form is included at the end of this manual. Study Identification and Description forms included:

- Whether the study is published or unpublished.
 - Published studies include peer reviewed journal articles and book chapters.
 - Unpublished include government reports, websites, thesis/dissertation, conference presentations, and unpublished manuscripts
 - When there were multiple studies that were both published and unpublished, the project was coded as published when there were more published than unpublished material. Likewise, if there were more unpublished than published articles, it was coded as unpublished. If there were only two studies, one published and one unpublished, the study that provided the most effect sizes was used for classification;
- Whether the study was peer reviewed
 - Peer reviewed works include journal articles and student theses
 - Non-peer reviewed works include conference presentations, book chapters, unpublished manuscript or work, government reports, and websites.
- The year the study was published/completed. If there were multiple studies, the year of the study that provided the most effect sizes was used. If two studies provided the same number of effect sizes, then the most recent year was used.
- The name and type of institution or setting the offenders were selected from;

- The country where the study originated;
- The largest final sample size reported in the characteristic section for biological incest offenders and sociolegal incest offenders;
- How each offender group were identified (e.g., corrections, courts);
- Data sources and criteria used to classify offenders as biological or sociolegal incest offenders.
- The proportion of biological incest offenders who were fathers versus other relations
When there were multiple studies within a 'project', with partial but not complete overlap of participants, given the theoretical importance of this variable, this variable was coded for each study individually as opposed to for the 'project' as a whole.
- The proportion of sociolegal incest offenders who were surrogate fathers versus other relations
- Any treatment (sex offender specific); and
- Whether the setting was adversarial

Variable Coding

All variables included in this meta-analysis were included and defined in a variable list that is available at the end of this manual. In studies where many measures assessed the same construct, the better quality (i.e., subject pool was independent from the measure's development pool, better reliability, validity) was coded. When more than one of the measures were equally sound, the weighted effect was used for the general variable. A new variable was created in cases where a particular measure was less psychometrically sound, but had three or more studies reporting data on it. Preference was on continuous vs. frequencies if both variables were based on the same sample size and were psychometrically sound.

Multiple Indices of the Same Variable

In most cases only one finding of a predictor variable was coded per sample. In cases where studies had the same sample and reported findings of the exact same variable, the better quality finding (the largest sample size or fewer inconsistencies) was used. If the sample sizes were similar, the finding with the most complete data was selected (enabling the most comparisons). In order to enable this type of decision making, a table was created with each overlapping study representing a cell. The sample size, date the data were collected (if available), and the complete list of codeable effect size was indicated in the cell. The study with the largest sample size was then coded first, followed by the second largest sample size, and so on. In cases where there are multiple equally good indicators of the same constructs, a weighted average of the effect size was used. If the construct was assessed using the same measure (e.g., PPG), then the effect size was coded from the study with the largest sample size (or better quality measure).

Direction of the Effect Size

Most variables included an obvious negative, or less positive, category. An individual with a deviant sexual preference for boys, for example, was considered to be more problematic than an offender with no such preference. When comparing biological incest offenders to sociolegal incest offenders, the more problematic aspect of the variable was expected to be positively associated to *sociolegal incest* offenders. The expected direction for each variable is reported in the variable list available at the end of this manual. The direction of the relationship (+/-) should be considered to depend on the wording of the variable (e.g., negative relationship with age, but positive relationship with youth). Therefore, it is important to be careful that the direction of the effect when coding is consistent for each variable.

Pre and Post Treatment Data

When both pre-treatment and post-treatment findings were reported, the pre-treatment measure was used. If only post-treatment findings were reported, the post-treatment measure was used.

VARIABLE CODING FORM

Variable Name & Measure

Included at the top of each coding form (available at the end of this manual) are the name of the variable being coded and a brief description of the instrument/item used to assess or measure the variable of interest. We also coded the page number and table from which the information came. This information assisted us when comparing variables and effect sizes, to ensure we were coding from the same information, or alternatively to have a discussion about which data best fits our definition of the variable (if both coders used different measures to calculate the effect size).

Adversarial Setting

The degree of adversarial setting was recorded for all studies. A high adversarial setting would be settings which has real legal consequences to the offenders. For example, assessments explicitly for legal decision making (parole, SVP/DO, supervision, release) would be coded as high adversarial. Moderate adversarial settings would include those in which the offender is under sentence and the assessment could be used for later decision making. For example, participating in an assessment during a treatment program could one day inform decision making and would be defined as a moderate adversarial setting. Low adversarial settings are those with voluntary clients and where there are no foreseeable legal consequences to the offender's participation. For example, anonymous treatment programs or anonymous online survey would be defined as a low adversarial setting.

Significant Digits

When calculating the effect size d , we included 3 digits after the decimal point. Special rounding rules were used. When the 4th digit ended in a 5, the 3rd number was rounded up when it was an odd number and left as it is when it was an even number.

Dependent and Independent Variables

Our independent variable was type of sex offenders (e.g., biological incest offenders, sociolegal incest offender). The Dependent variables included a list of characteristics (list available at the end of this manual) that were hypothesized to be related to the offender groups. The inclusion of these characteristics was dependent on their availability in the literature.

The number of biological incest offenders, sociolegal incest offenders and total number of subjects was recorded on the coding form. When continuous data was presented, the sample size, means and standard deviations were recorded. Additionally, when 2 by 2 table information was provided in the study (e.g., frequency), the numbers were also included on the coding form. Finally, the effect size d was computed (see end of manual for calculation formulas) and recorded on the coding form, as well as the statistic used to calculate d . Each marginal column had total 5 in order to be included in the meta-analysis.

VARIABLES TO BE CONSIDERED

*Asterisks indicate superordinate categories

Empirical-Actuarial risk assessment scales

(For all risk scales, higher likelihood of recidivism was considered to be the problematic direction)

General Recidivism

SIR – The Statistical Index of Recidivism. Score range from - 27 to + 30 and combined into 5 risk categories, ranging from very good risk to very poor risk, *with lower scores indicating greater risk of general recidivism*. More specifically scores from 6 to 30 indicate a very good risk of general recidivism, scores from 1 to 5 indicate a fair risk, scores from -4 to 0 indicate a poor risk, scores from -8 to -5 indicate a good risk, and, lastly, scores from -27 to -9 indicate a very poor risk.

Other risk scales for general recidivism

OTHERR – any other actuarial risk scale intended to be used with sexual offenders.

STUDYRK – unvalidated objective risk assessment scheme for general recidivism. Multiple regression, discriminant function analyses, reported for one sample only, study specific measures.

Other risk scales for violent recidivism

OTHERVR – any other actuarial risk scale intended to be used with sexual offender.

Sexual Recidivism

Below are actuarial risk scale commonly used with sexual offenders. It must include an explicit method of combining the risk factors that is specified in advance. Do not include risk scales tested on the same sample that they were developed on (these would be coded as STUDYRSK). Note for child pornography only offenders, most of these scales would have been modified (with the exception of the SORAG, VRAG, and STABLE-2000/2007). For research purposes note we will code them. If a modification was done on these scale (e.g., removing victim specific items), note it.

S99- The Static-99

S02- The Static-2002

RM2000S- The Risk Matrix 2000- Sexual Score

RM2000SD- The Risk Matrix 2000- Sexual Dichotomous Categories (0 = low, med; 1 = high, very high)

RM2000V- The Risk Matrix 2000- Violence

RM2000C- The Risk Matrix 2000- Combined

VRAG – Violence Risk Appraisal Guide

SORAG – Sex Offender Risk Appraisal Guide.

STAB00- Stable-2000

STAB07- Stable-2007

VASORS – Vermont sex offender risk scale- sex score

Other risk scales for sexual recidivism

OTHERSR – any other actuarial risk scale intended to be used with sexual offender.

STUDYRSK – unvalidated objective risk assessment scheme. Multiple regression, discriminant function analyses, reported for one sample only, study specific measures.

Criminal history

(For all criminal history variables, greater history of crime was considered to be the problematic direction. These criminal history include self-reported and official offences. If both charges and convictions are available, select charges.

ANYPRIOR- prior crime

SEXPRIOR – prior sexual crime.

VIOPRIOR – prior violent crime (as an adult or a juvenile; includes sex crime)

Offender characteristics

AGE – Age at release or testing. Younger age is considered the negative direction

AGEFIRST – age at first offence. Younger age is considered the negative direction

MINRACE – percentage of racial minorities (non-White) in this study. Racial minorities are considered to be the negative direction for comparison purposes

EVERMAR – ever married. Single is considered to be the problematic direction. Common-law is considered married.

CURRREL– Currently in a romantic relationship. Single, separated, and divorced are considered to be the problematic direction

EVERLIV – ever lived with a romantic partner. Those who have not ever lived with a partner are considered to be in the problematic direction

*ACCESS- Access to children (whether through work, use of leisure time, or at home). Can include primary caregiving responsibilities. Greater access to children is considered the problematic direction)

LIVEDWCH –lived with a child (in home, whether step or biological children) at the time of the offence. Those who have lived with a child are considered to be problematic direction

EMPLOY – employment status (employed vs. unemployed). Unemployed is considered to be the problematic direction. Student included as employed.

EMPTYTYPE – employment type (profession vs. manual). Postsecondary students included as professionals. Manual/little authority work is considered to be the negative direction

INCOME – household income. Lower income level is considered to be the negative direction

EDU – education level or categorical (finished high school vs. no high school). Lower education level is considered to be the negative direction

HETERO – sexual orientation. A homosexual/bisexual orientation is considered to be the negative direction for comparison purposes

Sexual deviancy

(For all sexual deviancy measures, greater deviant sexual interest was considered to be the

problematic direction)

General

*SEXREG –sexual self-regulation. Inability to direct sexual urges and behaviours towards forms that are socially and personally acceptable. Includes sexual preoccupation, sexualized coping and ego-dystonic paraphilia.

SEXPOCC – preoccupation with sexual thoughts and behaviours. Frequency of normal and abnormal sexual behaviour, sex drive, rumination on sexual themes, frequent masturbation. Does not include sexual obsession scale of the MSI.

SEXCOPE – use of sex as a coping response

SHORTTERM – short term mating strategies. Include high number of sexual partners, one night stands, and frequent intercourse outside committed relationship. Coded as sexual regulation if sex preoccupation and/or sex coping is unavailable. A greater numbers of mating strategies is considered to be the problematic direction

*DSPKIDS – deviant sexual interest in prepubescent and/or pubescent children (hebepedophilia)– any assessment method.

DSPPEDO – deviant sexual interest in prepubescent children (pedophilia)– any assessment method.

DSPHEB – deviant sexual interest in pubescent children (hebephilia)– any assessment method.

Phallometric assessment

PPGKIDS – sexual interest in prepubescent and pubescent children (hepedophilia) as assessed by phallometrics

PPGBOYS – sexual interest in prepubescent and pubescent boys as assessed by phallometrics

PPGGIRL – sexual interest in prepubescent and pubescent girls as assessed by phallometrics

Other sex related variables

SEXKNOW – low, inadequate sex knowledge. Includes the MSI sexual knowledge and belief

scale (SKB). Low sexual knowledge is considered to be the problematic direction

SEXPROB – unhappy/problem with their sexuality and sex life. Includes Minnesota Multiphasic Personality Inventory masculinity/femininity scale (i.e., Stereotypical masculine or feminine interests/behaviours) – higher scores suggest homoerotic interests and sexual problems. Includes the MSI sexual dysfunction scale (SI). Negative feeling about sexuality is considered to be the problematic direction

OTHERPARA– Any other paraphilia (not including pedohebephilia). Includes the Paraphilias scale (PA), Exhibitionism scale, Rape scale of the MSI. Presence of any paraphilia is considered to be the problematic direction

*GLOBALPARA- Any paraphilia. Includes subordinate category of pedohebephilia or other paraphilia or, in the case that there is a global measure of deviant sexual preferences (e.g., Stable-2007 item deviant preference), it only includes this global measurement (i.e., not other measurement of pedophilia, hebephilia, etc).

DSPS07– Stable-2000 or Stable-2007 deviant sexual preference item.

Attitudes supportive of crime

(For all attitude scales, attitudes supportive of crime/child-adult sex/sexual entitlement/lack of empathy was considered to be the problematic direction)

DSASACSX - attitudes tolerant of adult child sex (e.g., Abel Becker Cognition Scale, Stable – 2000, Bumby MOLEST, MSI justification scale)

ENTITLE – sexual entitlement, belief that sex is a basic need that must be fulfilled

DEVSEXATT – any other deviant attitude concerning sexual matter, e.g., prudishness, “negative sex attitudes,” negative attitudes toward masturbation

DEVATTNS – attitudes tolerant of crime in general – not specific to sexual crime, e.g., procriminal sentiments.

*EMPATHY – lack of empathy towards others (own victims or other victims). Lower empathy levels were considered to be the problematic direction

EMPATHVIC– empathy towards own victim

EMPATHG– empathy towards other victims of child sexual abuse- not specific to their own victims

Intimacy deficits

*GENSOC- Any problems in the social sphere.

SOCIAL – general problems relating to people, poor adult attachment (i.e., not securely attached), lack of concern for others, few friends. Includes Nonsupport PAI scale. Higher frequencies of social problems is considered to be the problematic direction

LONELY – social rejection, loneliness, no friends. This is specific to loneliness and rejection of social networks whereas SOCIAL has to do with problems in the social sphere. Greater loneliness is considered to be the problematic direction

SOCSKILL - social skills deficits, poor dating skills, poor interpersonal presentation. Fewer social skills is considered to be the problematic direction

NEGSOC – negative social influences, delinquent peers, procriminal associates, dysfunctional relationships, and comfort with criminal friends (e.g., MCAA Criminal Friend Index and Part B Associates subscale). Antisocial influences are considered to be the problematic direction

DETACH– prefers emotional distance in relationship (romantic and other). For example, having an avoidant personality, detached coping strategies, emotional avoidance, etc. Also includes the social introversion scale of the MMPI (i.e., People orientation; whether people enjoy and are comfortable being around other people), the PAI Warthm scale, and the NEO-PI-R E2 item. Greater detachment is considered the problematic direction.

INTIMATE – poor adjustment in marriage/intimate relationship, difficulty forming intimate relationships (do not count relationship history by itself, i.e., must be more than “never married”, although marital history can count in an overall assessment). Greater intimacy difficulties are considered to be the problematic direction

LIKEKIDS – emotional identification with children. Greater identification with children is considered to be the problematic direction

CHILDACTIV – involved in child-related activities (e.g., coaching, teaching). Greater involvement in child-related activities is considered to be the problematic direction

HATEGALS – hostility towards women, both attitudes and behavioural. Conflicts with females and sexist attitudes. Greater hostility toward women is considered to be the problematic direction

CALLOUS – lack of concern for others, no in-group, characteristically shallow emotions. Includes the Antisocial Egocentricity and Warmth scale of the PAI and the E1, A3, A6 items of the NEO-PI-R (reversed score). Greater callousness is considered to be the problematic direction

NOCOOP – problems cooperating with supervision officers. Greater supervision problem is considered to be the problematic direction

IQ- Intelligence tests. Lower IQ is considered the problematic direction. Does not include memory tests, but can include any factors included in IQ tests. Developmentally delayed can be used as an indicator low IQ.

MEMORY- Memory quotients or test of memory. Lower memory quotients are considered the problematic direction.

General self-regulation

*SELFREG – general problems with self-regulation, impulsive lifestyle, poor cognitive problem solving, explosive expressions of emotion, unable to form and complete long-term plans. Includes the perfectionism and rule consciousness scales of the Cattell 16PF inventory. Greater self-regulation problems is considered to be the problematic direction

RECKLESS – impulsivity, engaging in behaviour with high probability of negative consequences. High impulsivity tends to be associated with high stimulation seeking behaviour. Also includes the Score on the Minnesota Multiphasic Personality Inventory hypomania scale (i.e., level of excitability), the Hypomanic Activation and Disconstraint scale of the MMPI-2, and the N5 and E5 items of the NEO-PI-R. Higher scores are considered the problematic direction. Greater impulsivity is considered to be the problematic direction

NOPLANS – poor cognitive problem solving abilities. People with high cognitive solving abilities tend to have greater self-discipline, are able to follow through a task despite boredom, and tend to think before acting. Include item C5 and C6 of the NEO-PI. Fewer problem-solving skills is considered to be the problematic direction

EMPLOYPROB– employment problems. If no reckless or noplans, then code as self-reg. Greater employment problems is considered to be the problematic direction

Psychological functioning

*ANXIETY – anxiety disorders. Includes any anxiety-related disorder (e.g., Phobia, OCD) or scales. Also includes MMPI Psychasthenia scale (i.e., Worry, Anxiety, tension, doubts, obsessiveness), Anxiety scale, and hypochondriasis scale (i.e., Concern with bodily symptoms). Also includes the Dysfunctional Negative Emotions scale of the MMPI-2. Also includes the apprehension and tension scale of the Cattell 16PF inventory. High level of anxiety is considered to be the problematic direction

SOCANXIETY – any social anxiety or social phobia disorder or scales. High level of social anxiety is considered to be the problematic direction

DEPRESS – depression. Also includes MMPI depression scale and the PAI Suicide Ideation scale. Also includes the Low Positive Emotions Scale of the MMPI-2. High level of depression is considered to be the problematic direction.

GLOBAL – global psychological symptoms (e.g., low ego strength) in adulthood. Includes general distress, ADD, feeling of rejection, NEO-FFI neuroticism scale, and the Minnesota Multiphasic Personality Inventory hysteria scale (i.e., awareness of problems and vulnerabilities) – higher scores are considered the problematic direction. Can use access to mental health services as an indicator of global psychological issues. Also includes the Demoralization Scale of the MMPI-2. The ES (ego) scale of the MMPI is also included here; however, higher scores are considered *less* problematic. High level of distress is considered to be the problematic direction

NOCOPING – poor coping strategies. People with poor coping strategies are generally susceptible to stress. Includes the Stress scale of the PAI and the N6 item of the NEO-PI-R scale. Also includes the Negative Emotionality/Neuroticism scale of the MMPI-2. Lack of coping strategies or poor coping is considered to be the problematic direction

DANGER – dangerous world as per Ward implicit theories. View children as safer. Viewing the world as a dangerous place is considered to be the problematic direction

ESTEEM – low self-esteem, inferiority. Includes the Low Self Esteem scale of the MMPI-2. Low level of self-esteem is considered to be the problematic direction.

HOSTILE - hostility, resentment, anger, negative emotionality (Stable-2000). Also includes the Minnesota Multiphasic Personality Inventory paranoia scale (i.e., Level of trust, suspiciousness, sensitivity; Measures a person's inability to trust), overcontrolled hostility, and Aggression scale of the PAI – higher scores are considered the problematic direction. Also includes the Cynicism and Aggression scales of the MMPI-2 and the vigilance scale of the Cattell 16PF inventory. High

level of hostility is considered to be the problematic direction

*SUBANY – any substance abuse (alcohol or drugs). Includes the MAC scale of the MMPI and other scales assessing substance abuse problems. Presence of substance abuse problems is considered to be the problematic direction

DRUG – any drug abuse. Presence of drug abuse problems is considered to be the problematic direction

ALCO – any drug abuse. Includes the MAC scale of the MMPI. Presence of drug abuse problems is considered to be the problematic direction

OFFABUSE – abuse of drugs/alcohol during offence. Presence of substance abuse problems is considered to be the problematic direction

LOCUS – locus of control. External locus of control is considered to be the problematic direction

REPRESS – General measures of repression, such as the MMPI Repression scale. Greater repression is considered the problematic direction.

ASSERT – assertiveness. Includes the dominance scale of the PAI. Also Includes the dominance and social boldness scale of the Cattell 16PF. Low assertiveness is considered to be the problematic direction

DIAGPDU – any personality disorder, including antisocial, narcissistic, and borderline (e.g., Axis 2 diagnoses). Also includes the Borderline Features scale of the PAI and the reverse score of item A5 of the NEO-PI-R. Presence of a personality disorder is considered to be the problematic direction

*ANTISOCL – other measure of psychopathy or antisocial personality disorder. Also includes the psychopathic deviate scale of the MMPI (i.e., Conflict, struggle, anger, respect for society's rules) and the Antisocial Features scale of the PAI. Also includes the Antisocial Behavior Scale and the Antisocial Practices Scale of the MMPI-2. High level of antisociality is considered to be the problematic direction

PCL-R – Hare Psychopathy Checklist – Revised. High scores on the PCL-R is considered to be the problematic direction. Coded also as ANTISOCL (the superordinate category).

PCL-RF1 – Factor 1 (interpersonal/affective facet) of the Hare Psychopathy Checklist – Revised. High scores on the PCL-R is considered to be the

problematic direction. Coded also as ANTISOCL (the superordinate category).

PCL-RF2 – Factor 2 (behavioural facet) of the Hare Psychopathy Checklist – Revised. High scores on the PCL-R is considered to be the problematic direction. Coded also as ANTISOCL (the superordinate category).

SEVDO – severe psychotic disorders including psychosis, mania, schizophrenia, and PTSD. This variable only includes “severely disordered” and long-term diagnoses. Diagnoses, however, are not sufficient to score this category. Includes the Minnesota Multiphasic Personality Inventory schizophrenia scale (i.e., Odd thinking and social alienation), mania, and hypomania scales. Also includes the Ideas of Persecution Scale, the Abberant Experiences Scale and the Psychoticism scale of the MMPI-2. Higher scores are considered the problematic direction. Presence of severe psychological dysfunction is considered to be the problematic direction

Clinical presentation

DENIAL – failure to acknowledge guilt for sexual crime. Categorical denial “I was not there” “I didn’t do it”. Greater denial is considered to be the problematic direction

MINIMIZE – minimize culpability through excuses, justifications, while generally acknowledging that sexual offending is wrong. E.g., it wasn’t really a sex offence, I was drunk, I couldn’t help myself. Also includes the Rejection Scale of the PAI and the Cognitive distortions and immaturity scale (CDI) of the MSI. Greater minimization is considered to be the problematic direction

SODESIR – social desirability (e.g., the MMPI Lie scale, BIDR total scores). High social desirability is considered the problematic direction

SELFDECEPT– self-deceptive enhancement (e.g., SDE scale of the BIDR). High self-deceptive enhancement is considered the problematic direction

IMPMAN– positive impression management. High impression management is considered the problematic direction.

Childhood factors

CHILDMAL – history of childhood maladjustment including truancy, runaway, grade failure, but not primarily aggression or criminality. Greater maladjustment is considered to be the problematic direction

JUVDEL – childhood criminality and aggression. Greater childhood criminality/aggression is considered to be the problematic direction

CHILDPROB – history of childhood psychological problems. The focus is on internalizing behaviours and emotional issues. Example includes ADD, depression, and diagnoses of being inept. Greater maladjustment is considered to be the problematic direction

*FAMABUSE – general measures of abuse in family of origin, physical, emotional or neglect, including but not primarily sexual abuse. Higher frequency of childhood abuse is considered to be the problematic direction

FAMNEGLE – emotional or physical neglect during childhood. Higher frequency of childhood neglect is considered to be the problematic direction

FAMPROB – Any disruption in childhood outside of abuse or neglect, including divorcing parents, substance abuse by parents, or foster care. Greater disruption is considered to be the problematic direction

SXABS – sexual abuse during childhood. Higher frequency of childhood sexual abuse is considered to be the problematic direction

PABS – physical abuse during childhood. Higher frequency of childhood physical abuse is considered to be the problematic direction

*ATTACH – Problematic attachment styles towards caregiver in childhood. Coded as securely attached vs. all other attachment styles (reversed scored). Greater problematic attachment styles are considered to be the problematic direction.

ATTACHMOM – Problematic attachment styles towards female caregiver in childhood. This would normally be the mother but could also be the grand-mother, foster care parent, etc. Greater problematic attachment styles are considered to be the problematic direction.

ATTACHDAD – Problematic attachment styles towards male caregiver in childhood. This would normally be the father but could also be the grand-father, foster care parent, etc. Greater problematic attachment styles are considered to be the problematic direction.

Family Context Factors

RELSAT –relationship satisfaction at time of offence (vs. post offence). Indicators can include

ever separated or estranged and any variable measuring whether the couple gets along well. Measure of relationship satisfaction also are included here. Unsatisfied relationships at the time of the offence are the problematic direction.

RELCONF – relationship conflict (arguments, conflict, hostility, allegations or evidence of fights, domestic violence charges or the like) at time of offence (vs. post offence) toward a spouse. Conflicted relationships at the time of the offence are the problematic direction.

FAMCONF – Relationship conflict at the time of offense toward one's family in general or towards ones children. Can include measures of relationship quality with children or family generally (if it is specific to a spouse, code under RELCONF). Can include arguments, hostility, or evidence of physical abuse of children/family members (abuse cannot be related to the incestuous incidents).

PARTNER – partner's age at time of offence (vs. post offence). Young age is considered the negative direction.

HECHEAT – he was ever unfaithful (or suspected) at the current partner. Cheating is considered the problematic direction.

SHECHEAT – she was ever unfaithful (or suspected) to the offender. Cheating is considered the problematic direction.

WESTERMARCK – involved with child(ren) in first THREE years of life. Not being involved is considered the problematic direction.

GONE – Holds an employment that involves leaving the family home for period of time (e.g., military). Leaving home is considered the problematic direction.

LARGEFAM- Number of children. Larger number of children is considered the problematic direction.

Other factors

*LEISURE – aimless use of leisure time (e.g., television, videogames, solitary).

COMMREC – involved in structured activities in the community, including sport clubs, community service group, special interests groups [stamps, comics], music. Involves direct contact with real people. Fewer structured activities is considered the problematic direction

FORMULAS

COMBINING MEANS AND STANDARD DEVIATION FROM MULTIPLE GROUPS

These equations are helpful when you want to aggregate several groups into one (e.g., you want to combine the means of treatment completers and treatment dropouts into a treatment group average). You would need to aggregate the mean first (formula provided below) and then aggregate the standard deviation. This is preferable to taking a pooled standard deviation because that will artificially reduce your effect size variance (you need to add in between-group variance).

Combining multiple means (M) into one

$$W_M = (M_1 * N_1) + (M_2 * N_2) / N_1 + N_2$$

Combining multiple SDs into one

$$W_{SD} = \sqrt{\frac{sst}{df}}$$

$$SS_{within} = (n_1 - 1)(sd_1)^2 + (n_2 - 1)(sd_2)^2$$

$$SS_{btw} = n_1(\bar{m}_1 - w_m)^2 + n_2(\bar{m}_2 - w_m)^2$$

$$SS_{total} = SS_b + SS_w$$

$$df = N - 1$$

FORMULA FOR CALCULATING D

From sample sizes (N), means (M), and standard deviations (SD).

$$d = \frac{(M_1 - M_2)}{S_w} \quad \text{Variance of } d = \left[\frac{N_1 + N_2}{N_1 N_2} + \frac{d^2}{2(N_1 + N_2)} \right]$$

$$S_w \text{ is the pooled within standard deviation. } S_w = \sqrt{\frac{(N_1 - 1)(SD_1)^2 + (N_2 - 1)(SD_2)^2}{N_1 - 1 + N_2 - 1}}$$

Source: Cohen (1988); Hasselblad & Hedges (1995).

From raw frequencies in 2 x 2 tables:

	Not problematic	Problematic
incest sex offenders	a	b
extrafamilial offenders	c	d

$$d = \frac{\text{LnOR}}{1.65} \quad d = \frac{1}{1.65} \left[\ln \left(\frac{\{a + .5\}\{d + .5\}}{\{b + .5\}\{c + .5\}} \right) \right]$$

$$\text{Variance of } d = .3673 \left(\frac{1}{a + .5} + \frac{1}{b + .5} + \frac{1}{c + .5} + \frac{1}{d + .5} \right) \quad \frac{1}{(1.65)^2} \cong .3673$$

Note: d is directly proportional to the natural logarithm of the odds ratio.

Following the advice of Fleiss (1994), .5 was added to each cell of the twofold table to allow the calculation of odds ratio in the case of empty cells.

Source: Sánchez-Meca, Marín-Martínez & Chácon-Moscoso (2003).

From F/t.

$$d = t \sqrt{\frac{1}{N_1} + \frac{1}{N_2}} \quad \text{Variance of } d = \left[\frac{N_1 + N_2}{N_1 N_2} + \frac{d^2}{2(N_1 + N_2)} \right]$$

Note: $t^2 = F$, for $df = 1$.

Source: re-arranging Formula 2.4 from Rosenthal (1991).

From r

$$\text{or } d = \frac{(N_1 + N_2)r}{\sqrt{N_1 N_2 (1 - r^2)}},$$

$$\text{Variance of } d = \left[\frac{N_1 + N_2}{N_1 N_2} + \frac{d^2}{2(N_1 + N_2)} \right]$$

Source: re-arranging Formula 2.2.7 from Cohen (1988).

From probabilities

For exact probabilities, find the t value that corresponds to the desired probability value with appropriate degrees of freedom. If t is large (> 60), can be approximated with Z.

$$d = t \sqrt{\frac{1}{N_1} + \frac{1}{N_2}}, \text{ or } d = Z \sqrt{\frac{1}{N_1} + \frac{1}{N_2}}.$$

$$\text{Variance of } d = \left[\frac{N_1 + N_2}{N_1 N_2} + \frac{d^2}{2(N_1 + N_2)} \right]$$

Source: Rosenthal (1991).

For effects that are described as “non-significant”, $d = 0$.

For effects that are non-significant, but a direction is given, then calculate the d value needed for significance, then randomly select a two decimal number that fit between the range of zero and the minimally significant d value.

From χ^2

$$d = 2 \sqrt{\chi^2 / (N - \chi^2)}$$

ROC areas.

Given the assumption of equal variance in the recidivists and non-recidivist groups,

$d = \sqrt{2} Z(AUC)$, where $\sqrt{2} \cong 1.4142$ and $Z(AUC)$ is the area under the ROC curve expressed as Z units.

AUC	Z
.40	-.25
.50	.00
.60	.25
.75	.68
.80	.84
.90	1.28

For example, ROC AUC = .690, Z(AUC) = .496 (from Z table), $d = 1.4141(.496) = .701$.

Source: Swets (1986; equation 21, p. 114).

From non-dichotomous odds ratios

Transform the odds ratio and confidence interval to the natural logarithm.

$$SD = \frac{ConfidenceInterval / 2}{1.96}$$

$$Z = \frac{OddsRatio}{SD}$$

$$d = z \sqrt{\frac{1}{N_1} + \frac{1}{N_2}}$$

From Mann-Whitney U.

$AUC = U/(N_1 * N_2)$, then proceed as above.

Be careful that the direction is consistent with the coding scheme for the meta-analysis.

Source: Grissom & Kim (2005, Chapter 5).

From Logistic Regression

The regression coefficients from logistic regression are log odds ratios (natural log).
The expedient of the logistic regression coefficients are odds ratios.

For dichotomous predictors,

$$d = \frac{B_1}{1.65}$$

Source: Hosmer and Lemeshow (2000) for definition of logistic regression coefficients and Sánchez-Meca et al. (2003) for the transformation of a logged odds ratio into d .

From Cox Regression

The regression coefficients from Cox regression (survival analysis) are log hazard ratios. Hazard ratios are a close approximation of odds ratios (see Hanson, Babchishin, Helmus, & Thornton, 2012).

Consequently, for dichotomous predictors,

$$d = \frac{B_1}{1.65}$$

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Appendix B

Fathers Qualtrics Survey

Seeking Participants

Eligibility:

- **Male** participants.
- Who speak, read, and understand **English**.
- Are **18 or older**.
- Are **fathers with at least one daughter** (that is, you have a biological daughter, step-daughter, common-law daughter, or adoptive daughter).

Researchers at The Royal's Institute of Mental Health Research and the University of Ottawa want your opinion! We are conducting a survey asking for your opinions and experiences regarding a number of behaviours. Measures include questions about your relationship satisfaction, experiences as a father, your past behaviours, and questions about your beliefs and interests. You will be asked to complete some measures of your opinion and experiences about sexual behaviour (For example, sexual assault). Your responses to these measures will be completely confidential.

We highly recommend using a laptop or desktop computer to complete this survey. Some features of the survey may be difficult to complete on a mobile phone or tablet.

Potential Negative Consequences to Participating: You may experience anxiety, emotional distress, or embarrassment due to the sensitive topics being studied.

This study has received clearance by The Royal Ottawa Health Care Group's Research Ethics Board (Reference # 2015016) and the University of Ottawa Ethics Board (Reference # H-07-17-39)

Informed Consent

We are currently doing a study that will help us better understand sexual behaviour. To do this research, we want to ask you questions about your background, attitudes, and behaviours.

This form explains the research to help you decide whether you want to do the study. It explains what this study involves, and gives the names of who you can contact if you have any questions or concerns about this study.

The survey: You will be given some questions and asked to answer them as honestly as you can. There will be questions about what you think and feel, your relationships, and your childhood history. It should take you about 30 minutes to finish all of these questions. Compensation for this survey will be provided by Qualtrics, in the amount agreed upon between Qualtrics and yourself.

The questions asked may be embarrassing or offensive because of their sexual nature, explicit detail, the words used, or the topics covered. You are free to stop the survey at any time, not participate, and refuse to answer any of the questions.

Your answers will be kept confidential. Researchers from the Royal's Institute of Mental Health Research will not have access to any identifying information about you. Because of this, data cannot be withdrawn once submitted. The responses are kept in a secure server owned by Qualtrics.

In order to ensure your confidentiality, we recommend that you use standard safety measures such as locking your screen or device if drawn away from your computer while participating in the survey, and closing your browser when you have completed the survey.

The information you provide will be used only for research purposes. The data collected from this survey will be used for Ms. Lesleigh Pullman's PhD dissertation. Research information may be viewed by the Research Ethics Board and/or Research Quality Associate for quality assurance purposes.

IF YOU WOULD LIKE TO KEEP A COPY OF THE CONSENT FORM FOR YOUR
RECORD, PLEASE PRINT THIS SCREEN.

This research is being carried out by:

Kelly Babchishin (Ph.D.), Royal's Institute of Mental Health Research, Forensic Research Unit.
Email: [REDACTED] Phone #: [REDACTED]

Lesleigh Pullman (Ph.D. Candidate), University of Ottawa, School of Psychology. Email:
[REDACTED]

Michael Seto (Ph.D.), Royal's Institute of Mental Health Research, Forensic Research Unit.
Email: [REDACTED] Phone #: [REDACTED]

This study has received clearance by The Royal Ottawa Health Care Group's Research Ethics Board (Reference # 2015016) and the University of Ottawa Research Ethics Board (Reference # H-07-17-39)

If you have any questions regarding the ethical conduct of this study, you may contact the Protocol Officer for Ethics in Research, University of Ottawa, Tabaret Hall, 550 Cumberland Street, Room 154, Ottawa, ON K1N 6N5, Tel.: 613-562-5387, Email: ethics@uottawa.ca

Right to withdraw: Your participation in this study is **entirely voluntary**. At any point during the study, you have the right to not complete certain questions, or to withdraw. The information we collect will be kept safe. It will be kept in a locked filing cabinet and password-protected computer for a period of 10 years.

Click "I Agree" to indicate that you understand the information above and would like to participate in this study or "I Disagree" if you do not want to do the survey.

I Agree I Disagree

How many biological daughters do you have?

- 0
- 1
- 2
- 3
- 4
- 5 or more

How many biological sons do you have?

- 0
- 1
- 2
- 3
- 4
- 5 or more

How many step-daughters/common-law daughters do you have? Include all CURRENT and PAST step-daughters/common-law daughters, even if you no longer have contact with them. *A common-law daughter is the daughter of your romantic partner, who you had been living with for at least 1 year

- 0
- 1
- 2
- 3
- 4
- 5 or more

How many step-sons/common-law sons do you have? Include all CURRENT and PAST step-sons/common-law sons, even if you no longer have contact with them.

*A common-law son is the son of your romantic partner, who you had been living with for at least 1 year

- 0
- 1
- 2
- 3
- 4
- 5 or more

How many adopted daughters do you have? Include all CURRENT and PAST adopted daughters, even if you no longer have contact with them.

- 0
- 1
- 2
- 3
- 4
- 5 or more

How many adopted sons do you have? Include all CURRENT and PAST adopted sons, even if you no longer have contact with them.

- 0
- 1
- 2
- 3
- 4
- 5 or more

How old are you (in years)? _____

What is your sex? By sex we are referring to the biological characteristics of being male or female.

- Male
- Female
- I do not identify as male or female

What type of electronic device are you using to complete this survey?

- Desktop computer
- Laptop computer
- Tablet
- Cell phone
- Other
- I prefer not to answer

What country do you currently live in? _____

Were you ever arrested before age 16?

- No
- Yes
- I prefer not to answer

Did you get in a lot of physical fights (excluding siblings) before you were 16 years old?

- | | | | | | | | |
|----------------|---|---|------------------|---|---|---------------------|---------------------------|
| No
problems | | | Some
problems | | | Serious
problems | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | I prefer not
to answer |

Did you ever have discipline problems and/or attendance problems (skipping class) at elementary school?

- | | | | | | | | |
|----------------|---|---|------------------|---|---|---------------------|------------------------------|
| No
problems | | | Some
problems | | | Serious
problems | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | I prefer
not to
answer |

Were you ever suspended or expelled from school?

No

Yes

I prefer not to answer

Did you live with both of your biological parents until age 16?

No

Yes

I prefer not to answer

***If No:* What was the reason you did not live with both biological parents until age 16? For example, death of a parent, one parent left, divorce, abandonment, removed from home, Institutionalization.**

Were you separated from one or both biological parents for more than a month before you were 16 years old?

No

Yes

I prefer not to answer

Have you ever felt that, as a teenager, you had a problem with alcohol (that is, your drinking interfered in some way with your life)?

No
problems

1

2

3

Some
problems

4

5

6

Serious
problems

7

I prefer
not to
answer

Do you feel that one or both of your parents/caregivers had a drinking problem while you were growing up?

No

Yes

I prefer not to answer

How much money did you make last year before taxes?

- \$0 to \$10,000
- \$11,000 to \$20,000
- \$21,000 to \$30,000
- \$31,000 to \$40,000
- \$41,000 to \$50,000
- \$51,000 to \$60,000
- \$61,000 to \$70,000
- \$71,000 to \$80,000
- \$81,000 or more
- I prefer not to answer

What currency was used to answer the above question?

- Canadian (\$ CAD)
- American (\$ USD)
- Other. Please Specify: _____
- I prefer not to answer

Please indicate whether or not you engaged in the following behaviours before you were 15 years old:

	No	Yes	I prefer not to answer
Initiating physical fights (often)			
Lying often (other than to avoid physical and/or sexual abuse)			
Running away from home overnight (at least twice, or once without returning)			
Stealing (including forgery)			
Fire-setting (deliberately)			
Skiping school (often)			
Breaking into a car, house, or building			
Vandalism (other than fire-setting)			
Cruel to animals			
Forcing sexual activity on someone			
Using a weapon in more than one fight			
Physically cruel to people			

In the next few questions, we are asking about things your parents/caregivers may have done to you. A parent/caregiver is any parental figure in your life. If you have had multiple parental figures in your life (for example, biological parents and adoptive parents), we would like to know if any of them have done these things to you.

Did your parent (or caregiver) ever hit, beat, kick, or physically hurt you in any way?

- No
- Yes, my mother (or female caregiver)
- Yes, my father (or male caregiver)
- Yes, both parents (or caregivers)
- I prefer not to answer

When someone is neglected, it means that the grown-ups in their life didn't take care of them the way they should. They might not get them enough food, take them to the doctor when they are sick, or make sure they have a safe place to stay. Did your parents/caregivers ever neglect you as a child?

- No
- Yes, my mother (or female caregiver)
- Yes, my father (or male caregiver)
- Yes, both parents (or caregivers)
- I prefer not to answer

Did you ever witness violence in your home between family members (for example, parents hitting each other or hitting your siblings)?

- No
- Yes
- I prefer not to answer

Have you ever been married/in a common-law relationship*? *Common-law relationships are those where you are living with a romantic partner for at least 1 year

- No
- Yes
- I prefer not to answer

If Yes: How many marriages/common-law relationships have you been in? _____
OR I prefer not to answer

If Yes: Are you currently married/in a common-law relationship?

- No
- Yes
- I prefer not to answer

If Yes: How satisfied are you with your marriage/current relationship?

- Extremely Dissatisfied
- Very Dissatisfied
- Somewhat Dissatisfied
- Mixed

Somewhat Satisfied
 Very Satisfied
 Extremely Satisfied
 I prefer not to answer

What is the highest level of education that you have completed?

Less than elementary school
 Elementary school
 Some high school
 Completed high school
 Some college/university
 Completed a college/university degree
 Graduate school
 I prefer not to answer

What country do you currently live in? _____

What is the longest time you have lived with a sexual partner (For example, a wife, girlfriend, or boyfriend)?

Never lived with a sexual partner
 Less than 6 months
 Less than a year (but more than 6 months)
 1 year
 2 years
 3 years
 4 years
 5 years
 6 years
 7 years
 8 years
 9 years
 10 years
 11 years
 12 years
 13 years
 14 years
 15 years
 More than 15 years
 I prefer not to answer

The next few questions ask about consenting sexual intercourse defined as oral, vaginal, or anal sex.

How many women and/or men have you had consenting sexual contact with? _____

OR I prefer not to answer

If > 0: How old were you when you first had mutually consenting sexual contact with a male or female? _____ OR I prefer not to answer

The next few questions ask about sexual contact you may have had with older people when you were a child (under 12 years old). Sexual contact is defined as someone else touching your penis or anus, having you touch their penis, vagina, or anus, oral sex, or sexual intercourse.

Before you were 12 years old, did you ever have sexual contact with a boy or man at least 5 years older than you at the time?

No

Yes

I prefer not to answer

If Yes: To the best of your memory, how many older boys or men (who were at least 5 years older than you) did you have sexual contact with before you were 12 years old?
 _____OR I prefer not to answer

Select a number between thirty and thirty-five: _____

Before you were 12 years old, did you ever have sexual contact with a girl or woman at least 5 years older than you at the time?

No

Yes

I prefer not to answer

If Yes: To the best of your memory, how many older girls or women (who were at least 5 years older than you) did you have sexual contact with before you were 12 years old?
 _____OR I prefer not to answer

The next few questions ask about prior crimes that you may have committed.

Have you ever been arrested, charged or convicted for a non-sexual violent offence? For example: assaulting someone, robbing a bank.

No

Yes

I prefer not to answer

Have you ever been arrested, charged or convicted for a non-sexual non-violent offence? For example: break and enter, theft.

No

Yes

I prefer not to answer

Have you ever been arrested, charged, or convicted of forcing someone to engage in sexual activity against his or her will? This includes engaging in sexual activity with someone who cannot legally consent. For example, because they are too young to consent, or because they

are intoxicated.

No

Yes

I prefer not to answer

If Yes: Considering just the crimes that you have been arrested, charged, or convicted of, how many of the victims that you've forced into engaging in sexual activity were not related to you (that is, not family members)? _____ OR I prefer not to answer

If Yes: Considering just the crimes that you have been arrested, charged, or convicted of, how many of the victims that you've forced into engaging in sexual activity were complete strangers to you (that is, you never met or spoke to them at least 24 hours before the event happened)? _____ OR I prefer not to answer

Have you ever been arrested, charged, or convicted of watching child pornography?

No

Yes

I prefer not to answer

Have you ever been arrested, charged, or convicted of a sex offence that didn't involve contact, like watching an unsuspecting person undress (peeping), or exposing your genitals (flashing) to a non-consenting person?

No

Yes

I prefer not to answer

What is the highest level of education that you have completed?

Less than elementary school

Elementary school

Some high school

Completed high school

Some college/university

Completed a college/university degree

Graduate school

I prefer not to answer

What is the likelihood that you would rape an adult if you could be assured of not being caught and punished?

Not at all
likely

1

2

3

4

Very
likely

5

I prefer
not to
answer

What is the likelihood that you would have sexual contact with a child under 12 years old if you could be assured of not being caught and punished?

Not at all
likely

1

2

3

4

Very
likely

5

I prefer
not to
answer

If total number of daughters = 1: We would like you to answer the following questions about your daughter. Please keep this daughter in mind while answering all of these questions.

If total number of daughters > 1: We would like you to answer some questions about one of your daughters. Since you indicated that you had more than one daughter, please answer these questions about the first applicable daughter on this list:

(1) your oldest biological daughter.

(2) your oldest step/common-law/adoptive daughter

So, for example, if you have four biological daughters (that is, you are the biological father), you would answer the following set of questions about the oldest daughter. If you have one biological and one step/common-law/adoptive daughter (you are not the biological father), you would answer the question about your biological daughter. If you exclusively have step/common-law/adoptive daughters, then you would answer the questions about your oldest step/common-law/adoptive daughter.

What is your relationship to this child?

I am the biological father

I am the step/common-law/adopted father

I prefer not to answer

What is the sex of this child? By sex, we mean the biological characteristics of being male or female

Male

Female

My child does not identify as male or female

I prefer not to answer

How old is this child now? _____ OR I prefer not to answer

Have you ever lived in the same residence with this child?

No

Yes

I prefer not to answer

If Yes: How old was this child when you started living with them? _____

OR I prefer not to answer

If Yes: How old was this child when you stopped living with them? _____

OR

Not applicable - I am still living with this child

I prefer not to answer

How old are you (in years)? _____

In the first 16 years of this child's life, were you ever separated from the child for a month or more?

No

Yes

I prefer not to answer

If Yes: In the first 16 years of this child's life, how many times have you been separated from them for a month or more? _____ OR I prefer not to answer

Please answer the following questions about the earliest separation from this child.

How old was the child (in years) when this separation happened? _____

OR I prefer not to answer

How many months did this separation last? _____

OR I prefer not to answer

Why did this separation occur?

My work took me away on travel

The child went on an extended trip

I was incarcerated

I wasn't able to see my child because of a legal custody dispute

I was in the hospital

I separated from the mother of this child

Other. Specify: _____

I prefer not to answer

Did you know this child in the first 6 years of their life? If this is your biological child, by "know your child" we mean know that they existed. If this is a step/common-law/adopted child, we mean know them in the context of being a parental figure to this child.

No

Yes

I prefer not to answer

If Yes: The following questions ask about activities you may have done with this child. For each activity below, indicate how often you did the activity during the first 6 years of this child life, ranging from "Not at all" to "At least once a day".

	Not at all					At least once a day	
	1	2	3	4	5	6	I prefer not to answer
Give child a bath:							
Help child get dressed:							
Help change child's diaper or help with toilet:							
Prepare meals or bottles for the child:							
Assist child with eating or give child a bottle:							
Play with the child:							
Discipline the child:							
Supervise or monitor the child:							

The following questions ask about your relationship with this child, to the best of your memory. Answer these questions about your relationship with this child before she turned 16.

	Definitely does not apply	Not really	Neutral/ Not sure	Applies somewhat	Definitely applies	
	1	2	3	4	5	I prefer not to answer
I share an						

affectionate, warm relationship with my child.						
My child and I always seem to be struggling with each other.						
If upset, my child will seek comfort from me.						
My child is uncomfortable with physical affection or touch from me.						
My child values his/her relationship with me.						
When I praise my child, he/she beams with pride.						
When my child is in a bad mood, I know we're in for a long and difficult day.						
My child spontaneously shares information about himself/herself.						
My child easily becomes angry at me.						
Dealing with my child drains my energy.						

Next, we are going to ask you about your relationship with the mother of this child. Please answer each item as carefully and as accurately as you can on a YES or NO scale

Did you ever seek counseling (For example, minister, priest, therapist) for your relationship with the mother of this child?

No

Yes

Not applicable- I was never in a romantic relationship with the mother of this child

I prefer not to answer

Did you ever sleep in a separate bed from the mother of this child because you were having a fight or disagreement?

No

Yes

Not applicable - I was never in a romantic relationship with the mother of this child

I prefer not to answer

In your relationship with the mother of this child, did one of you ever kick the other out of the house because of a fight or disagreement?

No

Yes

Not applicable - I was never in a romantic relationship with the mother of this child

I prefer not to answer

Did a friend or family member ever express concern over the state of your relationship with the mother of this child?

No

Yes

Not applicable - I was never in a romantic relationship with the mother of this child

I prefer not to answer

Does five plus five equal ten?

No

Yes

How satisfied were you with your relationship with the mother of this child?

Somewhat Dissatisfied

Mixed

Somewhat Satisfied

Very Satisfied

Extremely Satisfied

Not applicable - I was never in a romantic relationship with the mother of this child

I prefer not to answer

Did you ever suspect the mother of this child of cheating on you?

We were not in an exclusive relationship/she was free to have sex with whoever she wanted

Extremely unlikely

Very unlikely

Somewhat unlikely

Unsure

Somewhat likely

Very likely

Extremely likely

I prefer not to answer

How closely does this child resemble you in appearance?

Not very
much

Not sure

Very
much

1

2

3

4

5

6

7

I prefer
not to
answer

How closely does this child resemble you in personality?

Not very
much

Not sure

Very
much

1

2

3

4

5

6

7

I prefer
not to
answer

We would like you to read 4 different stories, and answer a few questions about each of them.

[If relationship = biological, “young daughter”. If relationship= sociolegal, “young step-daughter”]

Brandon is alone with his young [daughter/step-daughter], Elisabeth, in their home on a Friday evening. They are sitting next to each other on the couch and watching a movie. Brandon has a bowl of popcorn in his lap. Elisabeth reaches her arm with the intention of grabbing some popcorn from the bowl. Instead she touches his genitals and starts caressing them.

How likely do you think it is that the man in this story will encourage continued sexual contact with his daughter?

Not at
all
likely

Somewhat
likely

Very
likely

1

2

3

4

5

6

7

8

9

10

I prefer not
to answer

If you were in a similar situation, how likely would you be to encourage continued sexual contact with your daughter?

Not at all likely					Somewhat likely						Very likely	
1	2	3	4	5	6	7	8	9	10		I prefer not to answer	

How arousing do you find this story?

Not at all arousing					Somewhat arousing						Very arousing	
1	2	3	4	5	6	7	8	9	10		I prefer not to answer	

How morally wrong do you find the man's behaviour in this story?

Not at all wrong					Somewhat wrong						Very wrong	
1	2	3	4	5	6	7	8	9	10		I prefer not to answer	

How disgusting do you find this story?

Not at all disgusting					Somewhat disgusting						Very disgusting	
1	2	3	4	5	6	7	8	9	10		I prefer not to answer	

Stephen and his young [daughter/step-daughter], Sarah, are at a public swimming pool. The water is a bit chilly so they both decide to soak a while in one of the Jacuzzis. The swimming pool is quite empty that day so it's just the two of them in the Jacuzzi. The water is nice and warm, so Stephen leans back to enjoy the warm water and relax. Suddenly he feels Sarah caressing his genitals.

How likely do you think it is that the man in this story will encourage continued sexual contact with his daughter?

Not at all likely					Somewhat likely						Very likely	
1	2	3	4	5	6	7	8	9	10		I prefer not to answer	

If you were in a similar situation, how likely would you be to encourage continued sexual contact with your daughter?

Not at all likely					Somewhat likely					Very likely	
1	2	3	4	5	6	7	8	9	10	I prefer not to answer	

How arousing do you find this story?

Not at all arousing					Somewhat arousing					Very arousing	
1	2	3	4	5	6	7	8	9	10	I prefer not to answer	

How morally wrong do you find the man's behaviour in this story?

Not at all wrong					Somewhat wrong					Very wrong	
1	2	3	4	5	6	7	8	9	10	I prefer not to answer	

How disgusting do you find this story?

Not at all disgusting					Somewhat disgusting					Very disgusting	
1	2	3	4	5	6	7	8	9	10	I prefer not to answer	

Paul takes his young [daughter/step-daughter], Sophie, to a secluded beach. It's really hot, the sun is shining and Paul is afraid of getting a sun burn. He asks Sophie to spread sun lotion on him. Sophie starts by rubbing sun lotion on his back, but suddenly Sophie reaches under his bathing suit and starts caressing his genitals. Paul responds by kissing her. They lie down on the beach towel, and begin to have intercourse.

How likely do you think it is that the man in this story will encourage continued sexual contact with his daughter?

Not at all likely					Somewhat likely					Very likely	
1	2	3	4	5	6	7	8	9	10	I prefer not to answer	

If you were in a similar situation, how likely would you be to encourage continued sexual contact with your daughter?

Not at all likely					Somewhat likely					Very likely	
1	2	3	4	5	6	7	8	9	10	I prefer not to answer	

How arousing do you find this story?

Not at all arousing					Somewhat arousing					Very arousing	
1	2	3	4	5	6	7	8	9	10	I prefer not to answer	

How morally wrong do you find the man's behaviour in this story?

Not at all wrong					Somewhat wrong					Very wrong	
1	2	3	4	5	6	7	8	9	10	I prefer not to answer	

How disgusting do you find this story?

Not at all disgusting					Somewhat disgusting					Very disgusting	
1	2	3	4	5	6	7	8	9	10	I prefer not to answer	

Andrew is driving his young [daughter/step-daughter], Nicole, home from a ballet recital. It's late in the evening and they have been driving for a good while when the car suddenly breaks down. Andrew decides they should spend the night in a hotel. The hotel is fully booked and there is only one room left with a double bed. They take the room and go to sleep. Andrew wakes up in the middle of the night because Nicole is embracing him and fondling his genitals with one hand. Andrew responds by kissing her. They move closer together under the covers and begin to have intercourse.

How likely do you think it is that the man in this story will encourage continued sexual contact with his daughter?

Not at all likely					Somewhat likely					Very likely	
1	2	3	4	5	6	7	8	9	10	I prefer not to answer	

If you were in a similar situation, how likely would you be to encourage continued sexual contact with your daughter?

Not at all likely					Somewhat likely						Very likely	
1	2	3	4	5	6	7	8	9	10		I prefer not to answer	

How arousing do you find this story?

Not at all arousing					Somewhat arousing						Very arousing	
1	2	3	4	5	6	7	8	9	10		I prefer not to answer	

How morally wrong do you find the man's behaviour in this story?

Not at all wrong					Somewhat wrong						Very wrong	
1	2	3	4	5	6	7	8	9	10		I prefer not to answer	

How disgusting do you find this story?

Not at all disgusting					Somewhat disgusting						Very disgusting	
1	2	3	4	5	6	7	8	9	10		I prefer not to answer	

Select the name of the daughter from the story presented above

Ashley
Nicole
Christine
Nikki
Michelle

Viewing Time

Computer Screen

How sexually attractive do you find this person?



1 2 3 4 5 6 7
Very unattractive Neutral Very attractive

NEXT

Figure 1. An example of a Viewing Time trial. The participants will be instructed to rate the picture by selecting their answer on the scale provided (1-7), and then press the next button when they are ready to move to the next picture. There are 40 pictures of males and females across the 5 Tanner stages of development. These pictures are from the “Not Real People” stimulus set.

Debriefing Form

Thank you very much for taking part in the study. This research would not be possible without your participation. We hope the following information addresses any questions and concerns you may have.

What Are We Trying to Learn in this Research?

The purpose of our research is to better understand why some men commit incest. We are trying to find out if fathers who have had sexual contact with related children are different from fathers who have never had such contact on a number of important factors.

Why Is This Research Important?

Finding out more about these possible explanations for incest can help us to better understand the motivation behind these behaviours and, ultimately, how to reduce them through assessment and treatment.

What if I Have Questions or Concerns?

Please direct any questions or concerns about this research to [REDACTED] or [REDACTED]

If you experience any distress (for example, feel sad or mad) as a result of this study, please seek help. Below is a website providing a global directory for crisis telephone lines broken up by country and region. If you are feeling distressed please look up and contact crisis line services available to you.

Your Life Counts - Find a Crisis Line Near You: <http://www.yourlifecounts.org/need-help/crisis-lines>

Thank you again for taking part in this study. Please click below to be redirected.

Appendix C

University of Ottawa REB Ethics Certificate for Father Incest Study



Université d'Ottawa University of Ottawa

Bureau d'éthique et d'intégrité de la recherche Office of Research Ethics and Integrity

LETTRE D'APPROBATION ADMINISTRATIVE | LETTER OF ADMINISTRATIVE APPROVAL

Numéro de dossier / Ethics File Number

H07-17-39

Titre du projet / Project Title

Testing Individual and Family Explanations for Father-Daughter Incest: Comparing Incest Offenders with Other Offenders and Non-Offending Fathers

Type de projet / Project Type

Doctoral Thesis

CÉR primaire / Primary REB

Royal REB

Statut du projet / Project Status

Approbation administrative / Administrative Approval

Date d'approbation (jj/mm/aaaa) / Approval Date (dd/mm/yyyy)

21/07/2017

Date d'expiration (jj/mm/aaaa) / Expiry Date (dd/mm/yyyy)

02/06/2018

Équipe de recherche / Research Team

Chercheur / Researcher Affiliation

Role

Lesleigh Pullman Social Sciences/ Psychology

Student Researcher

Michael Seto Social Sciences/ Psychology

Supervisor

Kelly Babchishin Social Sciences/ Psychology

Co-investigator

Conditions spéciales ou commentaires / Special conditions or comments: N/A

L'Université d'Ottawa a signé une Entente, conforme aux exigences de la plus récente version de l'EPTC et tout autre règlement ou législation applicable, permettant au CÉR ci-haut nommé d'être désigné comme CÉR primaire pour les projets de recherche où

- 1) les activités principales de recherche sont menées sous l'autorité ou sous les auspices de l'établissement lié au CÉR primaire et
- 2) Une partie du projet est également réalisé sous l'autorité ou sous les auspices de l'Université d'Ottawa.

Cette lettre confirme que l'Université d'Ottawa a autorisé que le CÉR primaire soit le CÉR officiel pour l'évaluation et la supervision de ce projet de recherche. Ceci n'est pas une approbation éthique.

Afin de nous aider à garder votre dossier à jour, veuillez soumettre une copie de toutes demandes de modification, renouvellement d'approbation éthique etc. soumis à et approuvé par le CÉR primaire dès qu'elles sont disponibles.

Cette approbation administrative est valide pour la durée indiquée ci-haut et est sujette aux conditions énumérées dans la section intitulée « Conditions spéciales ou commentaires ».

The University of Ottawa has signed an Agreement, compliant with current TCPS guidelines and any other applicable guidelines or legislation regarding multisite review, allowing the REB named above to serve as Board of Record (BoR) for research projects where

- 1) the main research activities are conducted within the auspices or jurisdiction of the BoR's institution and
- 2) parts of the project are also conducted under the jurisdiction or auspices of the University of Ottawa.

This letter confirms that the University of Ottawa has authorized the REB named above to serve as Board of Record for the review and oversight of this research project. This is not an REB approval.

In order to help us keep your file up to date, please submit a copy of all amendment requests, project renewals or any other changes submitted to and approved by the BoR, as they become available.

Administrative approval is valid for the period indicated above and is subject to the conditions listed in the section entitled "Special conditions or comments".

Catherine Paquet
Directrice/Director

Appendix D

Royal Ottawa Mental Health Centre REB Ethics Certificate for Father Incest Study



Mental Health - Care & Research
Santé mentale - Soins et recherche

1145 avenue Carling Avenue
Ottawa ON K1Z 7K4
theroyal.ca / leroyal.ca

Tel. / Tél. 613.722.6521
Toll free / Ligne sans frais 1.800.987.6424

RESEARCH ETHICS BOARD

April 9, 2018

Lesleigh Pullman, PhD candidate
Co-Investigator

Re: REB# 2015016
Testing Individual and Family Explanations for Incest: Comparing Incest Offenders with Other Offenders and Non-offending Fathers [PI: Dr. Michael Seto]

Dear Ms. Pullman,

This letter is to acknowledge receipt of the annual progress report (dated April 6, 2018) and request for renewal of the above-titled protocol.

The study has now received re-approval for the period of one (1) year from the date of this letter [next due date is April 8, 2019]

Sincerely, on behalf of the Board,

Pierre Blier, MD PhD
Chair, Research Ethics Board



Appendix E

Study 3 Results – Combined Sample of University and Community Participants

The Prevalence and Characteristics of Sexual Behaviour Between Siblings

The sample size of the combined sample was 1,694. On average, participants were approximately 24 years old ($M=23.95$, $SD=7.46$), and the majority of participants had at least some post-secondary education (75%). Approximately 2/3rds of the sample were female (66%). The majority of participants completed the survey questions about an opposite-sex full sibling (86%). The frequency of self-reported sexual behaviour with a sibling was 8%, which is similar to the frequency found in previous studies (7%-24%; Bevc & Silverman, 1993; Greenwald & Leitenberg, 1989; Hardy, 2001).

Among the participants who experienced sexual behaviour with a sibling, the majority reported sexual behaviour with a full sibling (64%). The majority of participants (44%) reported the experience as non-coercive, 15% reported that they coerced their sibling, 22% reported that their sibling coerced them, and 19% of cases were uncategorizable due to missing information. In regard to the type of sexual behaviour experienced, the most common types of sexual behaviour experienced was touching of sexual organs (75%) and kissing (52%). A substantial proportion of participants did, however, report more intrusive sexual behaviours ranging from masturbation of (40%) and by (38%) their sibling, to vaginal (29%) and anal intercourse (19%). The most commonly endorsed motivations for engaging in sexual behaviour with a sibling was curiosity (86%) and the behaviour was part of a game (66%). More details regarding these characteristics can be found in Table 1.

Non-full siblings were more likely to engage in incest than full siblings, $X^2 = 41.03$, $df = 1$, $p < .001$, $d = 0.76$, 95% CI [0.52, 1.00]. Furthermore, among siblings who had engaged in

Table 1. *Characteristics of Sexual Behaviour Between Siblings*

	Frequency
Sibling Type	
Full sibling	66.9%
Non-full sibling	33.1%
Coercion	
Non-coercive	43.8%
Participant coercive	15.4%
Sibling coercive	21.5%
Uncategorizable	19.2%
Type of Sexual Behaviour (% yes)	
Kissing	51.5%
Touching sexual organs	75.2%
Masturbate sibling	40.3%
Masturbated by sibling	38.0%
Receive oral sex	33.6%
Perform oral sex	38.6%
Vaginal intercourse	29.1%
Anal intercourse	19.4%
Reasons for Sexual Behaviour (% yes)	
Curiosity	85.9%
Game	66.4%
Desire	48.5%
Romance	21.5%
Urged	18.8%
Influenced	28.3%
Forced	15.6%
Other	14.8%

sexual behaviour, males were more likely to initiate this behaviour than females, $X^2 = 13.58$, $df = 1$, $p = .001$, $d = 1.35$ 95% CI [0.51, 2.19]. Furthermore, a lower degree of physical proximity was found to be associated with more intrusive sexual behaviour between siblings, $\tau = -.20$, $p = .009$, $N = 127$.

The Relationship Between Physical Proximity, Disgust, And Incest

After examination of the statistical assumptions associated with both linear and logistic regression, multivariate normality of residuals in the linear regression and linearity in the logit in the logistic regression were found to be violated. Thus, physical proximity and disgust toward

incest were log transformed to address these issues of non-normality. In both the linear and logistic regression models using these transformed variables, there was no evidence of multivariate outliers or outliers in the residual solution. To increase the interpretability of the results, especially in light of these transformations, all continuous variables were standardized prior to modeling.

As expected, lower levels of physical proximity were associated with an increased likelihood of sexual behaviour between siblings, $b = -0.24$, $SE = 0.08$, 95% CI $[-0.40, -0.09]$. Furthermore, lower levels of physical proximity were associated with lower levels of disgust toward incest, $b = 0.09$, $SE = 0.03$, 95% CI $[0.03, 0.14]$, and lower levels of disgust toward incest were associated with an increased likelihood of sexual behaviour between siblings, $b = -0.75$, $SE = 0.11$, 95% CI $[-0.96, -0.54]$. The indirect effect was tested using a bootstrap estimation approach with 5000 samples. These results indicated that disgust toward incest mediated the relationship between physical proximity and the likelihood of incest, $b = -0.07$, $SE = 0.02$, 95% CI $[-0.12, -0.02]$.

A few candidate moderators were assessed to ascertain whether the strength of this indirect effect differed across different sample characteristics. Disgust toward incest mediated the relationship between physical proximity and the likelihood of incest for both males, $b = -0.14$, $SE = 0.07$, 95% CI $[-0.29, -0.02]$, and females, $b = -0.06$, $SE = 0.03$, 95% CI $[-0.12, -0.02]$. Unexpectedly, there was not a difference in the magnitude of these indirect effects, Index = -0.08 , $SE = 0.07$, 95% CI $[-0.24, 0.05]$. Furthermore, disgust toward incest mediated the relationship between physical proximity and the likelihood of incest for full-siblings, $b = -0.04$, $SE = 0.03$, 95% CI $[-0.11, -0.003]$, but not for non-full siblings, $b = -0.11$, $SE = 0.06$, 95% CI $[-0.25, 0.02]$. Given the substantially smaller sample size for non-full siblings, however, this result is

unsurprising due to a lack of statistical power. Importantly, there was not a meaningful difference in the magnitude of these indirect effects, Index= -0.06, SE= 0.07, 95% CI [-0.21, 0.06]. Finally, disgust toward incest mediated the relationship between physical proximity and the likelihood of incest for participants who were older than their sibling, $b = -0.10$, SE = 0.04, 95% CI [-0.21, -0.03], but not for participants who were younger than their sibling, $b = -0.04$, SE = 0.03, 95% CI [-0.11, 0.01]. However, there was not a meaningful difference in the magnitude of these indirect effects, Index= -0.06, SE= 0.05, 95% CI [-0.18, 0.03].

Sensitivity analysis was also conducted to examine the magnitude of the indirect effect when examining different characteristics of incestuous behaviour between siblings. When predicting the likelihood of engaging in non-reproductive incest with a sibling (versus no incest with a sibling), disgust toward incest mediated the relationship between physical proximity and the likelihood of incest, $b = -0.05$, SE = 0.02, 95% CI [-0.09, -0.01]; 85% CI [-0.07, -0.02]. This model accounted for 7% of the variance in the likelihood of sibling incest (Nagelkerke $r^2 = .07$). When predicting the likelihood of engaging in reproductive incest with a sibling (versus no incest with a sibling), disgust toward incest mediated the relationship between physical proximity and the likelihood of incest, $b = -0.09$, SE = 0.04, 95% CI [-0.20, -0.02]; 85% CI [-0.16, -0.03]. This model accounted for 30% of the variance in the likelihood of sibling incest (Nagelkerke $r^2 = .30$). An examination of the 85% confidence intervals for these two indirect effects suggested that the confidence intervals do overlap, and therefore there was not a difference between the magnitudes of these indirect effects.

The results observed in this combined sample follow the same pattern of results observed when analyzing the community sample by itself. It was decided to report the results for the university and community samples separately in Study 3, because the differences between the

university and community sample (prevalence of sibling incest, variability in physical proximity and disgust toward incest) are important, and highlight the importance of being cognizant of how sample characteristics can influence statistical procedures, and thus conclusions.

Appendix F

Sibling Incest Survey for University and Community Samples

Study Examining Behaviour Between Siblings

Eligibility:

- 18 years of age or older.
- Speak, read, and understand English
- Have an opposite-sex sibling (full-sibling, maternal half-sibling, paternal half-sibling, or step-sibling).

Researchers at The Royal's Institute of Mental Health Research and the University of Ottawa want your opinion! We are conducting an online survey asking for your opinions experiences regarding a number of behaviours. Measures include questions about your childhood, your parents, your siblings, and your attitudes and opinions. You will be asked to complete some measures of your opinion and experiences about sexual behaviour (e.g., sexual assault). Your responses to these measures will be completely anonymous.

To thank you for completing the survey, you will receive [1 course credit/1 of 200 \$25 Amazon gift cards].

Your answers will be completely anonymous (that is, not tied to you in any way). No information that could be used to identify you can be connected with your survey responses, so your answers will be anonymous. In other words, nobody will be able to link your answers to your identity and we will not know who said what. The responses are kept in a secure survey owned by the researchers (not by a third party, or on the internet). As such, only the researchers listed below have access to participants' anonymous responses.

The questions asked may be embarrassing or offensive because of their sexual nature, explicit detail, the words used, or the topics covered. You are free to stop the project at any time, not participate, and refuse to answer any of the questions without penalty.

If you are eligible and interested in participating in this study, please click on the link below to take you to the online survey.

If you are eligible and interested in participating in this study, click Next.

Informed Consent - University Sample

We are currently doing a study that will help us better understand sexual behaviour between siblings. To do this research, we want to ask you a number of questions about your family, your childhood, and your behaviours. This survey is expected to take approximately 30-45 minutes to complete.

This form explains the research to help you decide whether you want to be part of the study. It explains what this study involves, and gives the names of who you can contact if you have any questions or concerns about this study.

This research is being conducted by:

Lesleigh Pullman (Ph.D. Candidate). University of Ottawa

Email: [REDACTED]

Kelly Babchishin (Ph.D.), Royal's Institute of Mental Health Research, Forensic Research Unit.

Email: [REDACTED] Phone #: [REDACTED]

Michael Seto (Ph.D.), Royal's Institute of Mental Health Research, Forensic Research Unit

Email: [REDACTED] Phone #: [REDACTED]

This study has received clearance by the Royal Ottawa Health Care Group's Research Ethics Board (Reference # 2016005) and the University of Ottawa Research Ethics Board (Reference # H10-16-13)

The survey:

You will be given some questions and asked to answer them as honestly as you can. There will be questions about what you think and feel, your relationships, your family, and your childhood history. It should take you about 30-45 minutes to finish all of these questions. To thank you for completing the survey, you will receive 1 course credit which will be issued at the end of the survey.

The questions asked may be embarrassing or offensive because of their sexual nature, explicit detail, the words used, or the topics covered. You are free to stop the project at any time, not participate, and refuse to answer any of the questions without penalty.

Your answers will be completely anonymous (that is, not tied to you in any way). No information that could be used to identify you can be connected with your survey responses, so your answers will be anonymous. We are not collecting IP addresses, or any other information that could be used to identify you. In other words, nobody will be able to link your answers to your identity and we will not know who said what. The responses are kept in a secure survey owned by the researchers (not by a third party, or on the internet). As such, only the researchers listed below have access to participants' anonymous responses. Because of the anonymous

nature of this study, data cannot be withdrawn once submitted.

In order to ensure your anonymity, we recommend that you use standard safety measures such as locking your screen or device if drawn away from your computer while participating in the survey, and closing your browser when you have completed the survey.

The information you provide will be used only for research purposes. The data collected from this survey will be used for Ms. Lesleigh Pullman's PhD dissertation. Research information may be viewed by the Research Ethics Board and/or Research Quality Associate for quality assurance purposes.

In order to receive your course credit, at the end of the survey, you will be asked to click on a link that will open a new browser window. In this window, you will be asked to enter your unique ISPR participant number and your UOttawa email address. This is needed in order to grant course credit. Your contact information (UOttawa email, ISPR participant number) will NOT be tied to your responses on the survey in anyway. As such, your response to the survey will remain anonymous.

IF YOU WOULD LIKE TO KEEP A COPY OF THE CONSENT FORM FOR YOUR RECORD, PLEASE PRINT THIS SCREEN.

Right to withdraw:

Your participation in this study is entirely voluntary. At any point during the study, you have the right to not complete certain questions, or to withdraw without penalty.

The information we collect will be kept safe. It will be kept in a secure server and password-protected computer for a period of 10 years. Only those people working on this research will have access to the information.

If you have any questions regarding the ethical conduct of this study, you may contact the Protocol Officer for Ethics in Research, University of Ottawa, Tabaret Hall, 550 Cumberland Street, Room 154, Ottawa, ON K1N 6N5, Tel.: 613-562-5387, Email: ethics@uottawa.ca

Click "I Agree" to indicate that you understand the information above and would like to participate in this study or "I Disagree" if you do not want to do the survey.

I Agree

I Disagree

Informed Consent – Community Sample

We are currently doing a study that will help us better understand sexual behaviour between siblings. To do this research, we want to ask you a number of questions about your family, your childhood, and your behaviours. This survey is expected to take approximately 30 minutes to complete.

This form explains the research to help you decide whether you want to do the study. It explains what this study involves and names of researchers who you can contact if you have any questions or concerns about this study.

The survey:

You will be given some questions and asked to answer them as honestly as you can. There will be questions about what you think and feel, your relationships, your family, and your childhood history. It should take you about 30 minutes to finish all of these questions. To thank you for completing the survey, you could win 1 of 200 \$25 Amazon gift card.

The questions asked may be embarrassing or offensive because of their sexual nature, explicit detail, the words used, or the topics covered. You are free to stop the project at any time, not participate, and refuse to answer any of the questions without penalty.

Your answers will be completely anonymous (that is, not tied to you in any way). No information that could be used to identify you can be connected with your survey responses, so your answers will be anonymous. We are not collecting IP addresses or any other information that could be used to identify you. In other words, nobody will be able to link your answers to your identity and we will not know who said what. The responses are kept in a secure server owned by the researchers (not by a third party, or on the internet). As such, only the researchers listed below have access to participants' anonymous responses.

The information you provide will be used only for research purposes. Research information may be viewed by the Research Ethics Board and/or Research Quality Associate for quality assurance purposes.

In order to be entered in the Amazon gift card draw, at the end of the survey, you will be asked to click on a link that will open a browser window. In this window, you will be asked to enter your email address to be entered in the draw. This information will NOT be tied to your responses on the survey in anyway. As such, your response to the survey will remain anonymous.

This research is being conducted by:

Kelly Babchishin (Ph.D.), Royal's Institute of Mental Health Research, Forensic Research Unit.

Email: [REDACTED] Phone # : [REDACTED]

Michael Seto (Ph.D.), Royal's Institute of Mental Health Research, Forensic Research Unit.

Email: [REDACTED] Phone # : [REDACTED]

This study has received clearance by the Royal Ottawa Health Care Group's Research Ethics Board (Reference # 2016005)

Right to withdraw:

Your participation in this study is **entirely voluntary** . At any point during the study, you have the right to not complete certain questions, or to withdraw without penalty.

The information we collect will be kept safe. Only those people working on this research will have access to the information.

Click "I Agree" to indicate that you understand the information above and would like to participate in this study or "I Disagree" if you do not want to do the survey.

I Agree

I Disagree

Important Information

Thank you very much for agreeing to participate in our study. Without your participation, this research would not be possible.

You will be able to withdraw from this study at any time. At the bottom of each page of the survey, there is a question that asks if you would like to withdraw from the study. If you do wish to stop participating in the study, select "withdraw" and then the next button at the bottom of the page. If you withdraw you will automatically be re-directed to some important debriefing information – **please do not close your browser window until you have read this information.**

If you complete this study, at the end of the survey you will be presented with some important debriefing information – **please do not close your browser window until you have read this information.**

Because this is an anonymous survey and we are not recording your IP address, you will not be able to save your responses and return to the survey later. Also, the web browser will timeout after 20 minutes of inactivity, so please complete the survey when you have enough time to do so in one sitting. You cannot use the back and forward button on your web browser.

Thank you very much for making this research possible!

What is your biological sex?

Female

Male

Neither of these options apply to me. I do not identify my biological sex as male or female.

What is your gender?

Woman

Man

You don't have an option that applies to me. I identify as (please specify):

How old are you (in years)? _____**How many opposite-sex siblings do you have?**

None

1

2

3

4

5 or more

How many full siblings (from the same mother and father) do you have?

None

1

2

3

4

5 or more

I prefer not to answer

How many opposite-sex full siblings do you have?

None

1

2

3

4

5 or more

I prefer not to answer

Please answer the following questions about your youngest opposite-sex full sibling to your oldest opposite-sex full sibling (i.e., Sibling # 1 is your youngest opposite-sex full sibling, Sibling # 2 is your next youngest opposite-sex full sibling etc.)

Age of Opposite-Sex Full Sibling #1/2/3/4/5

Under 18

18 - 24

25 - 29

30 - 34

35 - 39

40 - 44

45 - 49

50 - 54

55 - 59

60 - 64

Over 65

I prefer not to answer

Do you have any other siblings (That is, any step-, half-, or adoptive siblings)?

No

Yes

I prefer not to answer

How many maternal half-siblings (same mother, but different fathers) do you have?

None

1

2

3

4

5 or more

I prefer not to answer

How many opposite-sex maternal half-siblings (same mother, but different fathers) do you have?

None

1

2

3

4

5 or more

I prefer not to answer

Please answer the following questions about your youngest opposite-sex maternal half-sibling to your oldest opposite-sex maternal half-sibling (i.e., Sibling # 1 is your youngest opposite-sex maternal half-sibling, Sibling # 2 is your next youngest opposite-sex maternal half-sibling etc.)

Age of Opposite-Sex Maternal Half-Sibling #1/2/3/4/5

Under 18

18 - 24

25 - 29

30 - 34

35 - 39

40 - 44

- 45 - 49
- 50 - 54
- 55 - 59
- 60 - 64
- Over 65
- I prefer not to answer

How many paternal half-siblings (same father; but different mothers) do you have?

- None
- 1
- 2
- 3
- 4
- 5 or more
- I prefer not to answer

How many opposite-sex paternal half-siblings (same father, but different mothers) do you have?

- None
- 1
- 2
- 3
- 4
- 5 or more
- I prefer not to answer

Please answer the following questions about your youngest opposite-sex paternal half-sibling to your oldest opposite-sex paternal half-sibling (i.e., Sibling # 1 is your youngest opposite-sex paternal half-sibling, Sibling # 2 is your next youngest opposite-sex paternal half-sibling etc.)

Age of Opposite-Sex Paternal Half-Sibling #1/2/3/4/5

- Under 18
- 18 - 24
- 25 - 29
- 30 - 34
- 35 - 39
- 40 - 44
- 45 - 49
- 50 - 54
- 55 - 59
- 60 - 64
- Over 65
- I prefer not to answer

How many step-siblings (different mother and father) do you have?

None

1

2

3

4

5 or more

I prefer not to answer

How many opposite-sex paternal step-siblings (existing child from your dad's new partner) do you have?

None

1

2

3

4

5 or more

I prefer not to answer

Please answer the following questions about your youngest opposite-sex paternal step-sibling to your oldest opposite-sex paternal step-sibling (i.e., Sibling # 1 is your youngest opposite-sex paternal step-sibling, Sibling # 2 is your next youngest opposite-sex paternal step-sibling etc.)

Age of Opposite Sex Paternal Step-Sibling #1/2/3/4/5

Under 18

18 - 24

25 - 29

30 - 34

35 - 39

40 - 44

45 - 49

50 - 54

55 - 59

60 - 64

Over 65

I prefer not to answer

How many opposite-sex maternal step-siblings (existing child from your mother's new partner) do you have?

None

1

2

3

4

5 or more

I prefer not to answer

Please answer the following questions about your youngest opposite-sex maternal step-sibling to your oldest opposite-sex maternal step-sibling (i.e., Sibling # 1 is your youngest opposite-sex maternal step-sibling, Sibling # 2 is your next youngest opposite-sex maternal step-sibling etc.)

Age of Opposite Sex Maternal Step-Sibling #1/2/3/4/5

- Under 18
- 18 - 24
- 25 - 29
- 30 - 34
- 35 - 39
- 40 - 44
- 45 - 49
- 50 - 54
- 55 - 59
- 60 - 64
- Over 65
- I prefer not to answer

How many adoptive siblings do you have?

- None
- 1
- 2
- 3
- 4
- 5 or more
- I prefer not to answer

How many opposite-sex adoptive siblings (same mother and father) do you have?

- None
- 1
- 2
- 3
- 4
- 5 or more
- I prefer not to answer

Please answer the following questions about your youngest opposite-sex adoptive sibling to your oldest opposite-sex adoptive sibling (i.e., Sibling # 1 is your youngest opposite-sex adoptive sibling, Sibling # 2 is your next youngest opposite-sex adoptive sibling etc.)

Age of Opposite Sex Adoptive Sibling #1/2/3/4/5

- Under 18
- 18 - 24
- 25 - 29

30 - 34
 35 - 39
 40 - 44
 45 - 49
 50 - 54
 55 - 59
 60 - 64
 Over 65
 I prefer not to answer

Are you adopted?

No
 Yes
 Unsure
 I prefer not to answer

What country are you living in currently? _____

How important is religion to you?

Not very important					Unsure				Very important	
0	1	2	3	4	5	6	7		I prefer not to answer	

What is the highest grade you completed in school?

Grade 8 or equivalent or lower
 Some secondary school
 Secondary school diploma
 Some post-secondary education
 College diploma
 Apprenticeship or Trades Certificate
 Bachelor's Degree
 Master's Degree
 Doctorate
 I prefer not to answer

**What would you consider was your family's social economic class during your childhood
 (Before age 18)**

Lower class
 Lower middle class
 Middle class
 Upper middle class
 Higher class
 I prefer not to answer

Prior to age 16, did you live with both biological parents throughout your childhood (except due to parents death)?

Yes

No

No (one or two of my parents died before the age of 16)

I prefer not to answer

How old are you (in years)? _____

Have your parents ever separated in childhood (before you turned 18) for at least 1 month?

*If you are adopted, this question refers to your adoptive parents.

No

Yes

I prefer not to answer

If yes: How old were you during their first separation? _____

*If you are adopted, this question refers to your adoptive parents.

Did your parents ever form another long-term relationship (i.e., 2 or more years) with a new partner (before you turned 18)? If you are adopted, this question refers to your adoptive parents.

No

Yes, my mom

Yes, my dad

Yes, both parents

Unknown/Unsure

I prefer not to answer

Did your parents ever move in with a new partner?

*If you are adopted, this question refers to your adoptive parents.

No

Yes, my mom

Yes, my dad

Yes, both parents

Unknown/Unsure

I prefer not to answer

Did you ever live with an opposite-sex sibling?

	No	Yes	I do not have this type of sibling	I prefer not to answer
Opposite-sex maternal-half sibling				
Opposite-sex paternal-half sibling				
Opposite-sex full sibling				

How much was nudity accepted in your home?						
How often did you see one of your parents or both nude before the age of 18?						
How much did your parents monitor you when you were growing up?						
How often did you hurt animals on purpose?						
As a child (under the age of 18), how often did you shout at other people?						
As a child (under the age of 18), how often did you hit or hurt other people?						

When I was growing up...

	Never	Rarely	Sometimes	Often	Very Often	I prefer not to answer
I didn't have enough to eat						
My parents were too drunk or high to take care of me						
I knew there was someone to take care of me and protect me						
I had to wear dirty clothes						
There was someone to take me to the doctor if I needed it						

How frequently did your parents have loud arguments?

Never		Unsure		Very much	
1	2	3	4	5	I prefer not to answer

How frequently did your parents have physical fights?

Never		Unsure		Very much	
1	2	3	4	5	I prefer not to answer

During your childhood (before the age of 18), did your mother (or female caregiver) and/or father (or male caregiver)...

	No	Yes	Unsure	I prefer not to answer
Have an alcohol or drug use problem?				
Have a mental disorder?				
Have been involuntarily unemployed for more than two years?				
Committed a criminal offence?				

During your childhood (before the age of 18), did your parents ever seek marriage counseling (from a priest or a therapist)?

No
Yes
Not sure
I prefer not to answer

In general, as compared to the average individual, how would you describe your memory of the following events from a scale of 1 (very poor) to 5 (very good)?

	Very poor 1	2	Average 3	4	Very good 5	I prefer not to answer
Gifts you have received at holidays during the past several years						
Details of holidays or special occasions of your childhood						
Details of family events that occurred during the past year						
Who was with you at events attended weeks or months ago						

Did you ever have sexual contact with your parents or caregivers?

*If you had sexual contact with an adoptive parent, please list this in the "other" category and specify whether it was your adoptive mother and/or adoptive father. If you do not have a parental figure to list under the "other" option, please select the "Not Applicable" option.

	No	Yes	Not Applicable – I do not have this type of parent	I prefer not to answer
My mother				
My father				
My stepmother				
My stepfather				
Other (Please Specify):				

Please rate how sexually attractive you find:

	Not sexually attractive 1	2	3	Neutral 4	5	6	Very sexually attractive 7	I prefer not to answer
Women (16 years old and over)								
Men (16 years								

old and over)								
Girls (12 to 15 years old)								
Boys (12 to 15 years old)								
Young girls (under the age of 12)								
Young boys (under the age of 12)								

How old were you when you first had consenting sexual contact with a female (in years)? __

0 = Never

How old were you when you first had consenting sexual contact with a male (in years)? ____

0 = Never

How much do you think of sex on a daily basis?

Rarely

Often

1

2

3

4

5

6

7

I
prefer
not to
answer

Please select the number that reflects how often you did the following behaviour during your childhood (between the age of 3 and 12)

	Never	Less than once a month	One to three times a month	At least once a week	I prefer not to answer
Touched sex (private) part when in public places					
Drew sex parts when drawing pictures of people					
Tried to have sexual intercourse with another child or adult					
Touched sex (private) parts when at home					
Touched an adult's sex (private) parts					

Touched an animal sex parts					
Asked others to engage in sexual acts with you					
Put objects in vagina and/or rectum					
Tried to look at people when they were nude or undressing					
Pretended that dolls or stuffed animals were having sex					
Tried to look at picture of nude or partially dressed people					
Kissed adults you did not know well					
Kissed other children you did not know very well					
Tried to undress other children against their will (opening pants, shirts, etc)					
Showed sex (private) parts to children					
Knew more about sex than other children your age					

Have you ever had sexual contact (for example: kissing, touching, intercourse) with a sibling?

No

Yes, one sibling

Yes, two siblings

Yes, three or more siblings

I prefer not to answer

QUESTIONS FOR THOSE WITH INCEST BEHAVIOUR WITH 1 SIBLING

Please answer the following questions about the sibling that you have had a sexual experience with.

What type of sibling is he or she?

- Opposite-sex full sibling
- Opposite-sex maternal half sibling (that is, you share the same biological mother)
- Opposite-sex paternal half sibling (that is, you share the same biological father)
- Opposite-sex step-sibling
- Opposite-sex adoptive-sibling
- Same-sex full sibling
- Same-sex maternal half sibling (that is, you share the same biological mother)
- Same-sex paternal half sibling (that is, you share the same biological father)
- Same-sex step-sibling
- Same-sex adoptive-sibling
- I prefer not to answer

What sexual behaviours did you do?

	No	Yes	I prefer not to answer
French kissing/with tongue			
Touching sexual organs			
Masturbating your sibling			
Getting masturbated by your sibling			
Receiving oral sex			
Giving oral sex			
Vaginal intercourse			
Anal intercourse			

The first time the sexual behaviour occurred with your sibling, how old were you? _____

The first time the sexual behaviour occurred with your sibling, how old was your sibling? _____

The last time the sexual behaviour occurred with your sibling, how old were you? _____

Did you consent to these behaviours?

- No
- Yes
- Not sure
- I prefer not to answer

Did your sibling consent to these behaviours?

- No
- Yes
- Not sure
- I prefer not to answer

How often did you initiate these behaviours?

- Always myself
- Mostly myself
- Sometimes myself
- Never myself
- Unsure
- My parents/another adult initiated these behaviours
- I prefer not to answer

How often did your sibling initiate these behaviours?

- Always my sibling
- Mostly my sibling
- Sometimes my sibling
- Never my sibling
- Unsure
- My parents/another adult initiated these behaviours
- I prefer not to answer

Did you ever offer bribes (for example, money or other favours) to encourage the behaviours to happen?

- No
- Yes
- Sometimes
- Not sure
- I prefer not to answer

Did your sibling ever offer bribes (for example, money or other favours) to encourage the behaviour to happen?

- No
- Yes
- Sometimes
- Not sure
- I prefer not to answer

Was your sibling ever arrested or charged for these behaviours?

- No
- Yes
- Not sure
- I prefer not to answer

Were you ever arrested or charged for these behaviours?

No

Yes

Not sure

I prefer not to answer

What were the reasons for these behaviours?

	No	Yes	I prefer not to answer
Curiosity			
Sexual desire			
Romantic feelings			
I was urged			
I was forced			
I'm easily influenced by my sibling			
It was more like a game			
Other (Please specify):			

QUESTIONS FOR THOSE WITH INCEST BEHAVIOUR WITH MORE THAN 1 SIBLING

OPTION 1: Please answer the following questions about the two siblings whom you had sexual experiences with.

OPTION 2: We are only going to ask questions about two of your siblings. Please answer the following questions for the two siblings you had sexual experiences with that are closest in age to you.

Sibling #1 = The siblings closest in age to you (or the same age as you) whom you had a sexual experience with

Sibling #2 = The sibling that is next closest in age (after Sibling#1) with whom you had a sexual experience with

What type of sibling was he or she?	Sibling 1	Sibling 2
	Opposite-sex full sibling	Opposite-sex full sibling
	Opposite-sex maternal half sibling (that is, you share the same biological mother)	Opposite-sex maternal half sibling (that is, you share the same biological mother)
	Opposite-sex paternal half sibling (that is, you share the same biological father)	Opposite-sex paternal half sibling (that is, you share the same biological father)
	Opposite-sex step-sibling	Opposite-sex step-sibling
	Opposite-sex adoptive-sibling	Opposite-sex adoptive-sibling
	Same-sex full sibling	Same-sex full sibling

	Same-sex maternal half sibling (that is, you share the same biological mother)	Same-sex maternal half sibling (that is, you share the same biological mother)
	Same-sex paternal half sibling (that is, you share the same biological father)	Same-sex paternal half sibling (that is, you share the same biological father)
	Same-sex step-sibling	Same-sex step-sibling
	Same-sex adoptive-sibling	Same-sex adoptive-sibling
	I prefer not to answer	I prefer not to answer

What sexual behaviours did you do?

	Sibling 1			Sibling 2		
	No	Yes	I prefer not to answer	No	Yes	I prefer not to answer
French kissing/with tongue						
Touching sexual organs						
Masturbating your sibling						
Getting masturbated by your sibling						
Receiving oral sex						
Giving oral sex						
Vaginal intercourse						
Anal intercourse						

	Sibling 1	Sibling 2
The first time the sexual behaviour occurred with your sibling, how old were you?		

	Sibling 1	Sibling 2
The first time the sexual behaviour occurred with your sibling, how old was your sibling?		

	Sibling 1	Sibling 2
The last time the sexual behaviour occurred with your sibling, how old were you?		

Did you ever offer bribes (for example, money or other favours) to encourage the behaviour to happen with Sibling # 1?

- No
- Yes
- Sometimes
- Not sure
- I prefer not to answer

Did you ever offer bribes (for example, money or other favours) to encourage the behaviour to happen with Sibling # 2?

- No
- Yes
- Sometimes
- Not sure
- I prefer not to answer

Did Sibling # 1 ever offer bribes (for example, money or other favours) to encourage the behaviour to happen?

- No
- Yes
- Sometimes
- Not sure
- I prefer not to answer

Did Sibling # 2 ever offer bribes (for example, money or other favours) to encourage the behaviour to happen?

- No
- Yes
- Sometimes
- Not sure
- I prefer not to answer

	Sibling 1				Sibling 2			
	No	Yes	Not sure	I prefer not to answer	No	Yes	Not sure	I prefer not to answer
Was your sibling ever arrested or charged for these behaviours?								

Were you ever arrested or charged for these behaviours?								
---	--	--	--	--	--	--	--	--

What were the reasons for these behaviours?

	Sibling 1			Sibling 2		
	No	Yes	I prefer not to answer	No	Yes	I prefer not to answer
Curiosity						
Sexual desire						
Romantic feelings						
I was urged						
I was forced						
I'm easily influenced by my sibling						
It was more like a game						
Other (Please specify):						

QUESTIONS/INSTRUCTIONS FOR THOSE WITH NO INCEST BEHAVIOUR A SIBLING

OPTION1: The next set of questions involves behaviours and experiences you may have had with your brother.

OPTION2: The next set of questions involves behaviours and experiences you may have had with your brother. Since you have several brothers, please base your answer on the brother that is closest in age to you. If you have two brothers with the same age gap, select the youngest brother.

OPTION3: The next set of questions involves behaviours and experiences you may have had with your sister.

OPTION4: The next set of questions involves behaviours and experiences you may have had with your sister. Since you have several sisters, please base your answer on the sister that is closest in age to you. If you have two sisters with the same age gap, select the youngest sister.

OPTION5: The next set of questions involves behaviours and experiences you may have had with your opposite- sex sibling.

OPTION 6: The next set of questions involves behaviours and experiences you may have had with your opposite-sex sibling. Since you have several opposite-sex siblings, please base your answer on the opposite-sex sibling that is closest in age to you. If you have two opposite-sex siblings with the same age gap, select the youngest opposite-sex sibling.

What type of sibling is he or she?

- Opposite-sex full sibling
- Opposite-sex maternal half sibling (that is, you share the same biological mother)
- Opposite-sex paternal half sibling (that is, you share the same biological father)
- Opposite-sex step-sibling
- Opposite-sex adoptive-sibling
- I prefer not to answer

INSTRUCTIONS FOR THOSE WITH INCEST BEHAVIOUR WITH A SIBLING

Although you have several siblings, the remainder of the survey is only asking about behaviours and experiences you may have had with Sibling #1 (not your other sibling(s)).

Sibling#1 refers to the sibling closest in age to you (or the same age as you) whom you had a sexual experience with.

QUESTIONS FOR ALL PARTICIPANTS

How old is your sibling today? ____

Is your sibling older or younger than you?

- Older
- Younger
- Same age
- I prefer not to answer

Did you ever live in the same household as this sibling?

- No
- Yes
- I prefer not to answer

When did you start living with your sibling?

- When I was born
- When my sibling was born
- I prefer not to answer
- Other (please specify your age when you started living with this sibling):

Did you or your sibling ever live in different household for more than one month during childhood (before age 18)?

No

Yes

I prefer not to answer

What age were you when you and sibling started living in different households? _____

What country are you living in currently? _____

How many occasions were there when you live in different households for more than one month during your childhood? _____

What is the longest amount of time (in months) that you and your sibling lived in a different household? _____

For each activity listed below, indicate how often you saw your mother doing these activities to your sibling, ranging from not at all to more than once a day.

	Not at all 1	2	3	4	More than once a day 5	I prefer not to answer
Put your sibling to bed						
Give your sibling a bath						
Help get your sibling dressed						
Help change your sibling's diaper or help with toilet						
Help your sibling brush teeth						
Prepare meals or bottles for sibling						
Assist your sibling with eating or give your sibling a bottle						
Get up with your sibling when he/she wakes up during night						
Play with your sibling						
Provide monetary support for your sibling						

For each activity listed below, indicate how often you saw your father doing these activities to your sibling, ranging from not at all to more than once a day.

	Not at all 1	2	3	4	More than once a day 5	I prefer not to answer
Put your sibling to bed						
Give your sibling a bath						
Help get your sibling dressed						
Help change your sibling's diaper or help with toilet						
Help your sibling brush teeth						
Prepare meals or bottles for sibling						
Assist your sibling with eating or give your sibling a bottle						
Get up with your sibling when he/she wakes up during night						
Play with your sibling						
Provide monetary support for your sibling						

How closely does your sibling resemble you in appearance?

Not very
much

Not sure

Very
much

1

2

3

4

5

6

7

I prefer
not to
answer

How closely does your sibling resemble in personality?Not very
much

Not sure

Very
much

1

2

3

4

5

6

7

I prefer
not to
answer**Select the response "no"**

No

Yes

How much do you like your sibling?Not very
muchVery
much

1

2

3

4

5

I prefer
not to
answer**In childhood, how often did you play with your sibling?**Not very
muchVery
much

1

2

3

4

5

I prefer
not to
answer**How physically attractive do you rate your sibling?**Not very
muchVery
much

1

2

3

4

5

I prefer
not to
answer**How sexually attractive do you rate your sibling?**Not very
muchVery
much

1

2

3

4

5

I prefer
not to
answer

Please select the level of disgust you feel for each of the following behaviours:

	Not disgusting at all 0	1	2	3	4	5	Extremely disgusting 6	I prefer not to answer
Passionately kissing your sibling								
Having sex with your sibling								
Sibling fondling you								
Sibling intentionally laying on top of you								
Sibling unintentionally touches you								
Sibling trips on shoes and falls on you								
Sibling passionately kissing you								
Sibling having sex with you								

Not thinking of your own sibling, please select the level of disgust you feel for each of the following behaviours:

	Not disgusting at all 0	1	2	3	4	5	Extremely disgusting 6	I prefer not to answer
Passionately kissing between sibling								
Siblings having sex								
Siblings getting married								
Siblings fondling one another								
Siblings intentionally laying on top of one another								
Siblings unintentionally touching								
Siblings tripping and falling on one another								

Siblings having sexual fantasies for one another								
--	--	--	--	--	--	--	--	--

Rate how sexually interesting you find the following behaviour;

	Not interesting at all 0	1	2	3	4	5	Extremely interesting 6	I prefer not to answer
Passionately kissing your sibling								
Having sex with your sibling								
Sibling fondling you								
Sibling intentionally laying on top of you								
Sibling unintentionally touches you								
Sibling trips on shoes and falls on you								
Sibling passionately kissing you								
Sibling having sex with you								

Not thinking of your own sibling, rate how sexually interesting you find the following behaviours:

	Not interesting at all 0	1	2	3	4	5	Extremely interesting 6	I prefer not to answer
Passionately kissing between sibling								
Siblings having sex								
Siblings getting married								
Siblings fondling one another								
Siblings intentionally laying on top of one another								
Siblings unintentionally touching								

Siblings tripping and falling on one another								
Siblings having sexual fantasies for one another								

How willing would you be to give your sibling a free place to live?

Not willing
at all

Extremely
willing

0 1 2 3 4 5 6

I prefer
not to
answer

How willing would you be to give money to your sibling?

Not willing
at all

Extremely
willing

0 1 2 3 4 5 6

I prefer
not to
answer

Select the number two on the scale below

0 1 2 3 4 5 6

I prefer
not to
answer

How willing would you be to donate a kidney to your sibling?

Not
willing at
all

Extremely
willing

0 1 2 3 4 5 6

I prefer
not to
answer

Have you ever had sexual fantasies or sexual interests towards your sibling?

No

Rarely

At times

Frequently

I prefer not to answer

Did you ever physically hurt your sibling with a weapon or severely enough to cause physical injury?

No

Yes

I prefer not to answer

Did your sibling ever physically hurt you with a weapon or severely enough to cause physical injury?

No

Yes

I prefer not to answer

Debriefing Form

Thank you for taking the time to participate in our survey. We have provided some additional information about the study below.

What Are We Trying to Learn in this Research?

The purpose of this study is to identify family context variables that may promote or protect against sexual behaviour between siblings and to identify themes that are common in the family environment where this behaviour occurs.

Why Is This Research Important?

Finding out more about the explanation for sexual behaviour between siblings can help us to better understand the motivation behind these behaviours and, ultimately, how to reduce them through assessment and treatment.

Is There Anything I Can Do if I Find This Experiment to be Emotionally Distressing?

If you experience any distress (e.g., feel sad or mad) as a result of this study, please seek help. Below is a website providing a global directory for crisis telephone lines broken up by country and region. If you are feeling distressed please look up and contact crisis line services available to you.

·Your Life Counts - Find a Crisis Line Near You: <http://www.yourlifecounts.org/need-help/crisis-lines>

What if I Have Questions or Concerns?

[If you have any questions or concerns, please contact Lesleigh Pullman (Email:

_____), Kelly Babchishin (Email: _____ Phone #: _____

_____) or Michael Seto (Email: _____ Phone #: _____

_____) / If you have any questions or concerns, please contact Kelly Babchishin (Email:

_____ Phone #: _____) or Michael Seto (Email:

_____ Phone #: _____).]

[If you have any questions about your rights as a research participant, you may contact the Protocol Officer for Ethics in Research, University of Ottawa, Tabaret Hall, 550 Cumberland Street, Room 154, Ottawa, ON K1N 6N5, Tel.: 613-562-5387, Email: ethics@uottawa.ca/ If you have any questions about your rights as a research participant, you may contact the Royal's

Research Ethics Board at (613) 722-6521 ext. 6214, during regular business hours.]

Thank you again for taking the time to participate in our study.

[To thank you for completing this survey, we would like to offer you one course credit. Please click on the link below. Importantly, this link will open a browser window that is NOT tied to any of your responses on the survey. As such, your responses will remain anonymous/To thank you for completing this survey, we would also like to invite you to participate in a draw to win 1 of 200 \$25 Amazon gift cards! If you are interested, please click on the link below. Importantly, this link will open a browser window that is NOT tied to any of your responses on the survey. As such, your responses will remain anonymous.]

Appendix G

University of Ottawa REB Ethics Certificate for Sibling Incest Study

File Number: H10-16-13

Date (mm/dd/yyyy): 06/29/2017



Université d'Ottawa
Bureau d'éthique et d'intégrité de la recherche

University of Ottawa
Office of Research Ethics and Integrity

Ethics Approval Notice

Health Sciences and Science REB

Principal Investigator / Supervisor / Co-investigator(s) / Student(s)

<u>First Name</u>	<u>Last Name</u>	<u>Affiliation</u>	<u>Role</u>
Michael	Seto	Social Sciences / Psychology	Supervisor
Kelly	Babchishin	Social Sciences / Psychology	Student Researcher
Lesleigh	Pullman	Social Sciences / Psychology	Student Researcher

File Number: H10-16-13

Type of Project: PhD Thesis

Title: Sexual Behaviours Between Siblings: An Examination of Mechanisms that Facilitate Sibling Incest

<u>Renewal Date (mm/dd/yyyy)</u>	<u>Expiry Date (mm/dd/yyyy)</u>	<u>Approval Type</u>
07/18/2017	06/25/2018	Renewal

Special Conditions / Comments:
N/A

File Number: H10-16-13

Date (mm/dd/yyyy): 06/29/2017



Université d'Ottawa
Bureau d'éthique et d'intégrité de la recherche

University of Ottawa
Office of Research Ethics and Integrity

This is to confirm that the University of Ottawa Research Ethics Board identified above, which operates in accordance with the Tri-Council Policy Statement (2010) and other applicable laws and regulations in Ontario, has examined and approved the ethics application for the above named research project. Ethics approval is valid for the period indicated above and subject to the conditions listed in the section entitled "Special Conditions / Comments".

During the course of the project, the protocol may not be modified without prior written approval from the REB except when necessary to remove participants from immediate endangerment or when the modification(s) pertain to only administrative or logistical components of the project (e.g., change of telephone number). Investigators must also promptly alert the REB of any changes which increase the risk to participant(s), any changes which considerably affect the conduct of the project, all unanticipated and harmful events that occur, and new information that may negatively affect the conduct of the project and safety of the participant(s). Modifications to the project, including consent and recruitment documentation, should be submitted to the Ethics Office for approval using the "Modification to research project" form available at: <https://research.uottawa.ca/ethics/forms>.

Please submit an annual report to the Ethics Office four weeks before the above-referenced expiry date to request a renewal of this ethics approval. To close the file, a final report must be submitted. These documents can be found at: <https://research.uottawa.ca/ethics/forms>.

If you have any questions, please do not hesitate to contact the Ethics Office at extension 5387 or by e-mail at: ethics@uOttawa.ca.

Signature:

Melanie Rioux
Ethics Coordinator
For Catherine Paquet, Director of the Office of Research Ethics and Integrity

Appendix H

Royal Ottawa Mental Health Centre REB Ethics Certificate for Sibling Incest Study



1145 avenue Carling Avenue
Ottawa ON K1Z 7K4
theroyal.ca / leroyal.ca

Tel. / Tél. 613-722-6521
Toll free / Ligne sans frais 1.800.987.6424

RESEARCH ETHICS BOARD

July 3, 2018

Michael Seto, PhD
Co-Investigator

Re: REB# 2016005
Sexual Behaviours Between Siblings: An Examination of Mechanisms that Facilitate Sibling Incest [PI: Dr. Kelly Babchishin]

Dear Dr. Seto,

This letter is to acknowledge receipt of the email from Lesleigh Pullman (dated June 21, 2018) which included an annual progress report (signed by Dr. Babchishin) and request for renewal of the above-titled protocol.

The study has now received **re-approval for the period of one (1) year from the date of this letter.**

Sincerely, on behalf of the Board,

Pierre Blier, MD PhD
Chair, Research Ethics Board



Glossary of Terms

Direct fitness: an individual's direct survival and reproductive success.

Distal cause: a selection pressure that existed in evolutionary history, which caused the selection of genes that favoured a given trait.

Fitness: the probability that an individual's genes will remain in the population.

Inbreeding depression: reduced biological fitness from breeding between relatives, caused by increased genetic homozygosity that increases morbidity and mortality in offspring.

Incest avoidance mechanism: psychological mechanisms that have evolved through natural history to ensure humans avoid incest, because of the deleterious effects incest has on fitness.

Incest taboo: the universal societal condemnation of sexual behaviour with a close relative.

Inclusive fitness: the probability that an individual's genes will remain in the population, based on their own survival and reproductive success, as well as the survival and reproductive success of their genetic relatives.

Indirect fitness: the survival and reproductive success of an individual's genetic relatives.

Kinship cue: A signal that our brain uses to estimate the probability that we are genetically related to someone.

Maternal perinatal association: an older sibling observing their mother taking care of their younger sibling.

Mating effort strategy: the tendency for men to devote resources and time to finding sexual partners and increasing the number of offspring they have, as opposed to caring for their offspring.

Natural selection: the differential survival and reproduction of individuals based on variability

in the expression of genes.

Parental investment strategy: the tendency for women to invest many resources in their children, at the expense of their ability to devote efforts elsewhere, to increase the likelihood that their genes will remain in the population.

Parental solicitude: the degree of affection, care, and concern a parent experiences toward their child.

Phenotypic expression: refers to how different genes/combinations of genes result in the expression of different traits.

Proximate cause: the mechanisms responsible for facilitating a selected trait.

Selection pressures: refer to environmental stimuli which shape evolution based on whether the expression of a trait, within a given environment, increases survival and reproduction.

Westermarck hypothesis: a phenomenon in which people that live in close physical proximity with one another during childhood will develop a sexual indifference or aversion toward one another.

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