The Relationship between Risk-Taking and Adolescent Pubertal Status

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Abstract

While there are a number of social theories for increased risk-taking in adolescence, certain biological theories suggest an evolutionary component for adolescent risk-taking. It has been suggested that biological brain changes associated with puberty may play a role in such increases (Spear, 2000), as well as decreases in fear levels. The current study examines whether adolescent pubertal status is related to their levels of temperamental surgency, a construct encompassing individual differences in high intensity pleasure, fear, and shyness. Ninety middle school students in the Western United States (38 males and 52 females) ranging from age 11.5 – 14.5 (mean = 13.1) completed self-report measures of pubertal status and surgency. Results indicate that adolescent levels of surgency increase as pubertal status increases. Age, however, was not significantly associated with surgency levels. These results suggest that biology (specifically puberty) may be a significant factor in adolescent behavior. Future research should seek to employ improved measures of adolescent pubertal status as well as risk-taking behavior.
Introduction

It is widely acknowledged that adolescence is a period in which there is an enormous rise in risk-taking behaviors. According to Muuss & Porton (1998), to take a risk means to “consciously [choose] a behavior that is potentially dangerous to one’s physical or mental health and may result in injury, disability, and even death” (p. 422). Youth in America today have a higher chance of engaging in risky behavior than at any other time in the history of the United States. This may be because today they are maturing at a much earlier time in addition to having more risky opportunities that tempt them (Ponton, 1997). Now, even individuals in late childhood are taking risks, which is especially worrisome since they are so much more suggestible (Muuss & Porton, 1998). Risk-taking is the most dangerous hazard to adolescents’ mental and physical health (Igra & Irwin, 1996). Adolescents usually view their risks as bringing them short-term satisfaction, and they do not usually see the potentially harmful consequences their actions can bring. Out of any age group, their attitude toward risk-taking is the most lenient (Gardner, 1992, in Muuss & Porton, 1998). There are many theories offering explanations for this increase in risky behaviors. Such theories include cognitive, psychosocial, and/or biological reasoning. The current study employs biological reasoning to explain why adolescents engage in such an increase of risk-taking behavior than when they were children.

Adolescence is a difficult period to describe because there is not one single incident that signifies the transition from childhood to adolescence. It is often described as the age range from 12-18, but others describe it as the entire second decade of one’s life, while some even consider age twenty-five to be late adolescence (Baumrind, 1987, in Spear, 2000a). For the purpose of this study, adolescence will be synonymous with the period encompassing the earliest stages of
puberty to its completion. As such, we shall define all adolescents as being in one stage of puberty or another.

In spite of the literature claiming that adolescence is a difficult time, all adolescents experience different levels of risk-taking behavior and some studies suggest that 80% of adolescents do not experience serious problems (Ponton, 1997). It must be made clear that not all adolescents will engage in risky behavior. Yet, levels of risk-taking in adolescence are higher than in any other age group (Arnett, 1996). This is consistent in every time period and culture (Arnett, 1992). In fact, most adolescents will eventually engage in some type of risky behavior, but the outcomes will seldom be disastrous (Muuss & Porton, 1998). However, a quarter of adolescents will behave in such a risky manner that is likely to harm their future mental or physical health (Dryfoos, 1990, in Muuss & Porton, 1998).

A broad array of activities is included under the phrase “risk-taking” behavior. Examples of risk-taking behavior include alcohol and drug consumption and abuse, unsafe sexual behavior, dangerous vehicle use, school-related problems (underachievement, failure, and dropping out), antisocial and delinquent behavior (crime and violence), behavior associated with accident and injury, running away from home, eating disorders, and suicide and suicide attempts (Graber & Brooks-Gunn, 1995; Igra & Irwin, 1996; Irwin, Igra, Eyre, & Millstein, 1997; Irwin & Millstein, 1986; Levitt, Selman, & Richmond, 1991; Millstein & Igra, 1995; Muuss & Porton, 1998; Spear, 2000a; Spear, 2000b; Steinberg & Belsky, 1996).

Adolescent risk-taking statistics are astonishing. The mortality rate of 15-25-year-olds has been increasing while the overall mortality rate of humans has been decreasing (Irwin & Millstein, 1990). Interestingly, adolescent females have about half the mortality rate of adolescent males (Muuss & Porton, 1998). The number one cause of death in adolescence is
accidents (Brown, 1979, in Irwin & Millstein, 1986). Accidents also result in the largest number of non-fatal injuries in adolescence (Irwin & Millstein, 1986).

With regard to drug use and abuse, 1 million adolescents begin smoking cigarettes every year. Addiction to cigarettes often begins in adolescence and there are 100,000 deaths each year that are result of cigarette smoking (Muuss & Porton, 1998). Irwin et al. (1997) found that over 66.2% of adolescents have used tobacco. Seventy eight percent of adolescents have ever used alcohol and 42.8% of high school students use it more than once a month (Irwin et al, 1997). In addition, 61.4% of high school students have used marijuana and 33% of them use it more than once a month (Irwin et al., 1997).

Regarding unsafe sexual practices, 44% of high school students have had sexual intercourse while 20% have had “casual” (Irwin et al., 1997, p. 21) sex. In addition, 32.6% of high school students have had unprotected sex (Irwin et al., 1997). 2.5 million adolescents contract an STD every year. Furthermore, 1 million adolescents become pregnant every year (Muuss & Porton, 1998).

With regard to reckless vehicle use, 25% of high school students have driven a vehicle while intoxicated, 63% have driven an automobile faster than 80 MPH, 48% have raced another car while driving, 50% have passed another car in a no-passing zone (Arnett, 1996), 71.9% have not used a seat belt while driving in a car, and 58.3% have ridden in a car with an alcohol or drug-impaired driver (Irwin et al., 1997). According to Irwin & Millstein (1986), in 42% of motor vehicle accidents among 16-24-year-olds, alcohol was a contributing factor.

A great deal of literature upholds that risk-taking behavior rarely occurs by itself; it is almost always accompanied by one or more other type(s) of risky behavior (Arnett, 1992; Arnett, 1998; Graber & Brooks-Gunn, 1995; Igra & Irwin, 1996; Irwin et al., 1997; Irwin & Millstein,
A number of studies have found significant relationships between many types of risk-taking behavior. Arnett (1998) found a significant correlation between driving while intoxicated, binge drinking, and sex with someone not well known with all types of risk behavior he studied, including driving recklessly, smoking marijuana, and unsafe sexual practices. He also found a correlation between all types of risky sexual behavior (such as sex without contraception and sex with someone not well known), as well as between risky driving and substance abuse and between risky sexual behavior and substance abuse (Arnett, 1998). A number of studies have also found a correlation between sexual activity and substance abuse (Arnett, 1992; Graber & Brooks-Gunn, 1995; Igra & Irwin, 1996; Irwin et al., 1997; Irwin & Millstein, 1986; Millstein & Igra, 1995; Muuss & Porton, 1998). Sixty-three percent of incarcerated youth also use drugs regularly, 32% were under the influence of alcohol while they committed their crime, and 39% were under the influence of drugs (Muuss & Porton, 1998). Adolescents who use one type of drug are also far more likely to use other drugs (Irwin & Millstein, 1986; Muuss & Porton, 1998; Spear, 2000a). Alcohol abuse during adolescence has been attributed to “non drug-related alcohol problems” (p.427) and unlawful conduct in young adulthood (Duncan et al., 1997, in Spear, 2000a).

There are several different explanations for the covariation of risk-taking behavior. One such theory is that one risk behavior leads to other risk behaviors. Another theory claims that there is a common cause for all risk-taking behavior (Millstein & Igra, 1995). Jessor & Jessor (1977, in Steinberg & Belsky, 1996) use a problem behavior syndrome to explain the phenomenon. They believe that some adolescents possess an “underlying personality constellation . . . composed of impulsivity, independence striving, and unconventionality”
Risk-taking behaviors are inherently risky. Some of the negative consequences of risk-taking include sexually transmitted diseases, unplanned pregnancies, school failure, unemployment, injury, alcohol or drug dependence, medical expenses, incarceration, physical and psychological disability, and death (Arnett, 1999; Irwin et al., 1997; Muuss & Porton, 1998; Spear, 2000a). Knowledge about the negative consequences of risk-taking does not deter adolescents from engaging in risky behavior (Arnett, 1992; Igra & Irwin, 1996; Levitt, Selman, & Richmond, 1991; Muuss & Porton, 1998). However, some evidence shows that adolescents do possess the cognitive abilities to recognize the consequences of their decisions (Keating, 1990, in Graber & Brooks-Gunn, 1995.) Other research claims that adolescents recognize short-term consequences more often than they recognize long-term consequences (Igra & Irwin, 1996; Muuss & Porton, 1998).

Risk-taking in adolescence is often seen as a paradox because to some degree we expect these behaviors from adolescents, but we are also very concerned when adolescents exhibit these behaviors (Steinberg & Belsky, 1996). Most experts believe that risk taking, because it is so prevalent in adolescence, is actually a natural part of adolescent development. Moffitt (1993, in Spear, 2000a) even claims that not exhibiting risk-taking behavior would be abnormal as so many adolescents do partake in risk-taking behavior. Indeed, Muuss & Porton (1998) maintain that risk-taking is “desirable” (p. 424). Many researchers claim that it is necessary for adolescents to begin making their own decisions even though this may result in negative consequences (Ponton, 1997). Further, some authorities claim that risk taking can have positive consequences. Ponton (1997) claims that “experimenting with new behaviors and feelings can
promote complex thinking, increase confidence, and help develop a young person’s ability to assess and undertake risks in the future” (p. 6). Risk-taking has been linked to a positive self-esteem (Silbereisen & Reitzle, 1992, in Spear, 2000a). Moreover, adolescents who experiment with drugs (mostly marijuana) were found to have better social skills and better “personality adjustment” (Shedler & Block, 1990, in Graber & Brooks-Gunn, 1995, p. 22) in childhood and adolescence than non-experimenters (Shedler & Block, 1990, in Graber & Brooks-Gunn, 1995; Spear, 2000a; & Spear, 2000b).

Risk-taking in adolescence can serve many purposes. It can help adolescents get approval and respect from peers, create autonomy from parents, establish an identity, cope with anxiety and frustration, learn to make independent decisions, achieve intimacy, and gain self-esteem (Igra & Irwin, 1996; Millstein & Igra, 1995; Muuss & Porton, 1998).

Ponton (1997) believes that viewing risk-taking as normal is problematic as many people have “blurred the lines” (p. 3) between acceptable risk-taking behavior and dangerous risk taking behavior. Irwin & Millstein (1986) claim that risk taking is normal only on occasion, but at other times it can be very devastating. Muuss & Porton (1998) agree, claiming that risk-taking is “problematic only when [it] results in tragic outcomes” (p. 426).

It is very important to distinguish between what it normal and what is not normal based on age. Sex is normal once one reaches late adolescence (Graber & Brooks-Gunn, 1995). Similarly, alcohol consumption is normal once the adolescent reaches 21.

**Theories of Risk-Taking**

Social theories are often utilized to explain adolescent risk-taking behavior. There are a number of social factors that make adolescents more susceptible to risk-taking. These factors include poor self esteem, psychiatric problems, familial conflict, poverty, being a parent, low
level of parental education, a negative attitude toward school, being in a single-parent family, frequent failure in school, having no religion, poor social skills, high population density, high unemployment rate, being single, impulsivity, changes in family structure (such as divorce or remarriage), being male, and having childhood behavioral problems (Arnett, 1992; Arnett, 1998; Arnett, 1999; Crockett & Petersen, 1993; Igra & Irwin, 1996; Irwin et al., 1997; Muuss & Porton, 1998; Ponton; 1997).

Some literature suggests that high levels of risk-taking behavior are related to high levels of sensations seeking (Arnett, 1992, Arnett, 1996; Arnett, 1998; Spear, 2000a). Sensation seeking is a personality trait defined as “the need for varied, novel, and complex sensations and experiences and the willingness to take physical and social risks for the sake of such experiences” (Zuckerman, 1979, p. 10 in Arnett, 1992, p. 344). This means that adolescents who are high in sensation seeking take risks because they enjoy the sensation they acquire from the particular behavior. Adolescents have the highest levels of sensations seeking, which most likely relates to their high levels of risk-taking. Adolescents who are high in sensation-seeking do not fear risks; contrarily, they look forward to them (Arnett, 1992). This relates to research that claims adolescents take risks because they are bored (Levitt, Selman, & Richmond, 1991; Zuckerman, 1992, in Spear, 2000a).

Peer pressure is also cited as one of the main social explanations for adolescent risky behavior. In adolescence, peers’ opinions begin to take precedence over families’ (Arnett, 1992; Crockett & Petersen, 1993; Igra & Irwin, 1996; Irwin et al., 1997). It is often difficult to say whether peers engage in risk-taking behavior after viewing their friends’ risky behavior, or whether adolescents seek out peers with similar interests (Crockett & Petersen, 1993; Irwin et al., 1997). One study shows that whether or not a friend is sexually active is the best predictor of
whether or not an adolescent will become sexually active in the next year (Billy & Udry, 1985, in Irwin & Millstein, 1986). This is also the case for whether a friend smokes or not (Center for Disease Control, 1987, in Muuss & Porton, 1998).

Parents are also a big influence on whether adolescents engage in risky behavior. Adolescents whose parents’ styles are authoritarian or permissive are more likely to take risks than adolescent’s whose parents’ style is authoritative (Crockett & Petersen, 1993; Irwin et al., 1997; Levitt, Selman, & Richmond, 1991). However, there is evidence that an authoritarian-type parenting style may discourage adolescents from taking risks (Arnett, 1992). Parental supervision likely declines in adolescence; this can make them more susceptible to poor choices (Crockett & Petersen, 1993). Parents may also influence their adolescents’ risk behaviors by example (Igra & Irwin, 1996; Irwin et al., 1997; Levitt, Selman, & Richmond, 1991). Research shows that adolescents whose parents use drugs are more likely to use drugs themselves (Werner, 1991, in Irwin et al., 1997). Simply letting your children know you disapprove of their actions can minimize their desire to continue the behavior (Arnett, 1992). Muuss & Porton (1998) assert that that one of the reasons that risk-taking is so much more of a problem today is because parents are more permissive than they used to be.

Media can also have a strong effect on adolescents’ behavior (Igra & Irwin, 1996; Irwin et al., 1997; Ponton, 1997). The media often portrays adolescents engaging in risky behavior (Ponton, 1997). The environment and neighborhood in which an adolescent lives can also impact risk-taking in adolescence. Some neighborhoods have more risky opportunities than others (Igra & Irwin et al., Irwin et al., 1997; Muuss & Porton, 1998). Culture can also influence adolescents’ choices. For example, the United States has the highest rate of teenage pregnancy
and abortion in the world even though adolescents in other countries become sexually active at around the same age (Igra & Irwin, 1996; Irwin et al., 1997).

Research shows that is common for adolescents to believe they are less vulnerable to harsh consequences than everyone else, which can help to explain why adolescents are so willing to take risks in the first place (Muuss & Porton, 1998; Irwin et al, 1997). Many adolescents have what Elkind (1967, in Arnett, 1992) refers to as an imaginary audience, which means that they believe that people are continually watching and critiquing their actions. This leads them to believe they are special in some way and therefore invincible. This phenomenon is also referred to as the personal fable. This sense of invulnerability is also emphasized if peers share this belief (Arnett, 1992). Contrary to the research done on the presence of a personal fable in adolescence, most research done on the topic shows that it is not particular to adolescence (Igra & Irwin, 1996; Millstein & Igra, 1995). According to Igra & Irwin (1996, p. 40), “people [of all ages] generally underestimate their [own] likelihood of experiencing negative events.”

There are also a number of biological and evolutionary explanations for risk-taking behavior in adolescence. Adolescent deviant behavior is often attributed to “raging hormones” (Spear, 2003, p. 63). Adolescents experience a significant rise in testosterone and estrogen (gonadal hormones). This is caused by a release of luteinizing and follicle stimulating hormone. There is also a rise in growth hormone and adrenal androgens. Some researchers claim that there is no empirical evidence showing that adolescents’ behavior is caused by this dramatic change in hormones (Susman, Inoff-Germain, & Nottelmann, 1987, in Spear, 2003). However, other research shows a correlation between the rise of gonadal hormones and sexual activity (Booth et al., 2003; Igra & Irwin, 1996; Irwin et al, 1997; Steinberg & Belsky, 1996). Additional studies show that adolescents who achieve puberty sooner engage in sexual relations sooner (Udry,
Studies concerning the relationship between parents and their children have found that conflict is worse between the ages of 10 and 14, which is when bodily testosterone rises the most (Booth et al., 2003). In a study done by Booth and colleagues (2003), testosterone was found to be related to risk taking in males but not females. In addition, the rise in adrenal androgens has also been linked to behavioral problems in adolescence (Spear, 2000a). Nonetheless, scientists have been exploring other explanations for this change in adolescent behavior, like changes in the brain (Spear, 2003). According to Spear (2003, p.62), “adolescents rival newborns in the sheer magnitude of the developmental transformations occurring in their brains.” It would be surprising if a significant change in behavior did not coincide with such significant changes in the brain (Spear, 2000b; Spear, 2003).

There are a number of changes that occur in the brain of adolescents as well as in other animals. These changes in the adolescent brain include a decrease in the number of synapses, an increase in cortical pruning, a decrease in the size of gray matter, a decrease in prefrontal cortex size, and a decline in brain activity in general (less energy expenditure). In adolescent rats, there is also a significant increase of dopaminergic (DA) neuron input to the prefrontal cortex in early adolescence, along with a decrease in the amount of certain DA receptor subtypes (Spear, 2003).

This increase in DA activity in the brain is important because dopamine is significant in regulating risk taking, social behaviors, and the reinforcing affects of drugs and other stimuli (Spear, 2003). Because of this increase of DA input in early adolescence, there is a decrease in late adolescence. The DA activity transfers from mesolimbic to mesocortical brain regions, which may cause a “reward deficiency syndrome” (Spear, 2003, p. 69). This means they do not feel the rewarding effects of things the same way other people do. This “syndrome” has been suggested to play a role in drug abuse in adolescents (Spear, 2003).
Dopamine is also related to stress. Adolescents have higher levels of the stress hormone cortisol (Spear, 2000a). In addition, Spear (2000b, p. 112) states that they “exhibit greater increases in blood pressure and in blood flow through the heart in response to various laboratory test procedures than do children.” This may be a factor in adolescents’ tendency to use and abuse drugs and alcohol (Spear, 2000b).

Adolescent rat brains also have less “turnover rates” (Spear, 2003, p. 70) of serotonin in the nucleus accumbens. This discovery is important because low serotonin is associated with hyperresponsiveness to stress, alcohol abuse, and anxiety. The cannabinoid (the chemical component of marijuana) receptors in adolescent rats also mature during adolescence. In addition, Leptin (a protein thought to send satiety signals to the brain) levels increase, which could influence drug use (Spear, 2003). The hallucinogenic drugs ketamine and PCP have an effect on adolescent rats, but not child rats. This is a result of differing functions of NMDA receptors (Spear, 2003). Other studies have shown that adolescent rodents react differently to ethanol and stimulants than do children or adults (Spear, 2000a; Spear, 2003).

In 1974, Epstein (p. 208, in Spear, 2000a, p. 438) said that “fairly abrupt changes in behavior are likely to reflect associated changes in the biophysical properties of brains.” Spear (2000a; 2000b; 2003) has done a large quantity of research on the influence of changes in the adolescent brain on risk-taking behavior, as well as on other changes in the adolescent body that may contribute to their risk-taking behavior. She has documented biological changes in other animals and discovered that other animals engage in adolescent risk-taking behavior as well. This commonality in humans and animals suggests an evolutionary explanation for risk-taking behavior in adolescence. Adolescence is the stage just prior to adulthood, and adolescents must prepare to make it on their own in the world. Therefore, it is helpful for adolescents to try new
things and become more independent in order to survive on their own. She has discovered that adolescent mice and rats are more active in a new environment and that they “exhibit higher levels of novelty seeking than their adult counterparts” (Spear, 2000a, p. 422). They are also more easily surprised than adult rodents.

Autonomy is also facilitated by peer interaction. Spear (2000a; 2000b; 2003) found that, once rodents reach adolescence, they begin to spend more time with their peers. She also found this to be the case with non-human primates. Sometimes this increase in peer relations is accompanied with parental conflict (Spear, 2003). Spear (2000a; 2000b; 2003) also states that this separation from the home and family may also help prevent inbreeding. The adolescent stage of both rodents and primates is the period in which they begin to spend less time with parents and gain independent skills (Spear, 2000a; 2003).

From an evolutionary standpoint, all behavior once served a purpose essential to survival even if that behavior may look deviant today (Steinberg & Belsky, 1996). Thus, risk-taking may “have proved advantageous to our ancestors when refusing to incur such risk was in fact even more dangerous to survival or reproduction” (Steinberg & Belsky, 1996, p. 96). This raises the question, why is it so important that risks are taken during adolescence? It may be because adolescence is the time when organisms begin interest in sexual relations (Steinberg & Belsky, 1996). Adolescent males who engaged in risk-taking behavior may have been better at attracting mates than males who did not engage in risk-taking (Spear, 2000a; Steinberg & Belsky, 1996).

Sensation seeking was mentioned above as a social factor in adolescent risk-taking behavior. However, there are biological factors that may be involved in sensation seeking (Arnett, 1992; Irwin et al, 1997; Levitt, Selman, & Richmond, 1991). Average Evoked Potential augmenting reducing is a “measure of the brain’s tendency to respond to a strong visual or
auditory stimulus by augmenting the stimulus or reducing it” (Arnett, 1992, p. 346). Sensation seeking has been found to be related to augmenting (Arnett, 1992). In addition, sensation seeking has been found to be negatively correlated with platelet monoamine oxidase (MAO) levels. MAO has to do with the speed at which neurons fire (Arnett, 1992). Furthermore, androgen, estrogen, and testosterone have been found to be positively correlated with sensation seeking (Arnett, 1992).

With the exception of delinquent behavior, which usually declines after age 17 (Irwin et al., 1997), some studies show that risk-taking peaks at late adolescence (Arnett, 1996; Arnett, 1998). Arnett (1996) found that college students’ prevalence of risk-taking behavior far preceded that of high school students. A number of studies have shown that risk-taking increases with age (Booth et al., 2003; Igra & Irwin, 1996; Irwin et al., 1997; Spear, 2000a; Steinberg & Belsky, 1996). This increase in risk-taking may relate to fear levels decreasing in adolescence. A good deal of research demonstrates that adolescent fear levels decrease with age (Burnham & Gullone, 1997; Gullone & King, 1993; King et al., 1989; Ollendick & King, 1994; Sanavio, 1998).

Fear and risk-taking may both be part of a temperamental construct Rothbart & colleagues (2000) have labeled “surgency.” Surgency is composed of three parts: an increased level of high intensity pleasure, low levels of fear, and low levels of shyness (Ellis, 2002). High intensity pleasure is defined as “the pleasure derived from activities involving high intensity pleasure or novelty” (Ellis, 2002, p. 43) and is quite similar to sensation seeking mentioned above. Fear is defined as “unpleasant affect related to anticipation of distress” (p. 43) while shyness is defined as “behavioral inhibition to novelty and challenge, especially social” (Ellis, 2002, p. 43). Surgency has been shown to relate to individual differences in sensation seeking in
adolescence (Capaldi & Rothbart, 1992) and thus, in the current study, is employed as a measure of behavioral tendencies and attitudes rather than a measure of actual risk-taking behavior.

Little research has been done on the association between risk-taking, fear levels, and pubertal levels. The current study seeks to determine if adolescent pubertal maturation corresponds to their level of surgency. It is hypothesized that adolescents’ levels of surgency will increase as their pubertal maturation increases. If this is the case, it would support biological theories of adolescent risk-taking and sensation seeking.

Method

Participants

Ninety (52 females, 38 males) middle school students ranging in age from 11.5 – 14.5 (mean age = 13.1) participated in this study. They attended St. John the Baptist Middle School, which is a private Catholic school located in the Western United States. All students were predominantly Caucasian.

Procedure

Students were initially recruited by sending home a letter to their parents explaining the nature of the study along with a consent form. Students who participated were required to bring the assigned consent form back a week later, and all students who brought back the form were asked to participate. The questionnaires were given to the students in one of their classrooms.

The first questionnaire was the Surgency Scale from the Early Adolescent Temperament Questionnaire – Revised (Ellis & Rothbart, in preparation). This measures high intensity pleasure, fear, and shyness. Students scoring high in surgency demonstrated high levels of high intensity pleasure, low levels of fear, and low levels of shyness. Students were asked to rate on a 5-point Likert scale whether they agreed or disagreed with a particular statement. Their five
choices were “almost always untrue,” “usually untrue,” “sometimes true/sometimes untrue,”
“usually true,” and “almost always true.” An example of a high intensity pleasure question is “I
wouldn’t be afraid to try something like mountain climbing.” An example of a fear question is “I
worry about getting into trouble,” while an example of a shyness question is “I am shy about
meeting new people.”

The second questionnaire used was the Body Changes Questionnaire, adapted from
Carskadon & Acebo (1993), designed to measure pubertal status. Males and females were given
different questionnaires. Each had four questions. Both male and female versions inquired
about skin changes and body hair. Males’ asked about voice change and facial hair while
females’ asked about breast growth and menarche. The adolescents were given 5 choices in
which to rate how far they had progressed through these processes. These choices were “has not
started yet,” “has barely started,” “has definitely started,” “change seems complete,” and “I don’t
know.” Researchers examined the pubertal status questionnaires and divided the students into
three groups: early puberty (lacking early development of some secondary sexual
characteristics), middle puberty (some development of many or most secondary sexual
characteristics), and late puberty (development of nearly all secondary sexual characteristics and
the onset of menstruation for females).

Results

A one-way ANOVA revealed a significant relationship between students’ pubertal status
and surgency scores. As hypothesized, as students’ pubertal status increased, their surgency
scores increased ($F(2,87)=3.33, p<.05$). These results are summarized in Figure 1.
In addition, Pearson correlations revealed that surgency scores were significantly correlated with pubertal status ($r = .234$, $p < .05$). As would be expected, age was significantly correlated with pubertal status ($r = .294$, $p < .01$). Age, however, was not significantly correlated with surgency. These results are summarized in Table 1.

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** Significant at the .01 level
* Significant at the .05 level
Discussion

The purpose of this study was to explore possible relations between pubertal status and levels of surgency. The results supported the hypothesis. Pubertal status was significantly correlated with adolescent surgency levels. Age, however, was not related to adolescent surgency levels. These results suggest that biology (specifically puberty) may be a significant factor in adolescent behavior. Adolescent pubertal changes may possibly be the primary factor that is driving their considerable behavioral transformations. The fact that age was not correlated with surgency levels further emphasizes this biological premise. If surgency were correlated with age, this would suggest more of a social explanation because adolescents who are the same age are not necessarily in the same pubertal stage. Therefore, for example, if all adolescents began to experiment with drugs when they turned fourteen, this would suggest they were being influenced by social factors, like peers for example.

If we know the causes of adolescent behavior, we are better equipped to treat them. If an individual is prone to psychological disorders, adolescence is often a time when these disorders begin to emerge. There are completely different ways of understanding and treating behaviors depending on whether they are more influenced by biological factors or more influenced by social factors. Many biological disorders, for example, are treated with medication; while many social or cognitive disorders are treated with counseling. The knowledge that biology may be a significant factor in adolescent behavior can help parents, therapists, and teachers be more sensitive to adolescent behavior. If parents and other authority figures were to consider that risk-taking may be part of a healthy adolescent’s development, they may be less likely to deal with the behavior in a way that could be detrimental to the adolescent’s well-being.
Although the current study did determine that puberty is possibly a significant factor in adolescent behavior, it did not explain whether these behavioral changes occurring throughout puberty can be attributed to hormone changes, brain changes, or other changes that could be going on in the adolescent body. Further research should try to explore what specific bodily changes could be affecting adolescents’ dramatic change in behavior.

The current study did not focus on gender differences with regard to risk-taking behavior. Future researchers may choose to examine gender differences in risk-taking behaviors due to past research’s findings of a higher rate of risk-taking among males (Booth, Johnson, Granger, Crouter, & McHale, 2003; Spear, 2000a; Steinberg & Belsky, 1996). The fact that risk-taking is more prevalent in males may have something to do with the concept of sexual selection. In the past, males who took risks may have been sending the message to females that they possessed “hardy” genes (Steinberg & Belsky, 1996, p. 98). There is further speculation as to why males may take more risks than females. Steinberg & Belsky (1996) maintain that externalizing risk-taking behavior is more socially acceptable for males than females. Moreover, women are much more concerned with their ability for childbirth and therefore must protect their future children. Finally, Steinberg & Belsky (1996, p. 115) explain that “because it is males who may benefit more from dominance in the social hierarchy, as well as because it is males who seek to demonstrate their genetic hardiness, it is males who are more likely to be risk takers and evince problem behavior.” Higher levels of testosterone in males, brought on by puberty, may also be a factor in their greater tendency toward risk-taking because there have been links between testosterone and aggression (Booth et al., 2003; Spear, 2000a), which could contribute to risk-taking behaviors such as delinquency.
While the current study focused on adolescent pubertal status, it did not address the issue of pubertal timing. There is a vast amount of evidence that pubertal timing has a significant effect on adolescent risk-taking. Females who begin puberty early are far more likely to engage in risk-taking behaviors (Crockett & Petersen, 1993; Graber & Brooks-Gunn, 1995; Igra & Irwin, 1996; Irwin et al., 1997; Irwin & Millstein, 1986; du Mont, 1998; Spear, 2000a; Steinberg & Belsky, 1996). Du Mont (1998) found that early menarche was associated with several risk-taking behaviors. Some research indicates this is true for males as well (Crockett & Petersen, 1993; Igra & Irwin, 1996; Spear, 2000a; Steinberg & Belsky, 1996). Since puberty is beginning earlier and earlier, young adolescents are becoming more and more at risk for risk-taking behavior (Ponton, 1997). A common behavior early bloomers exhibit is sexual activity (Crockett & Petersen, 1993); this is probably due to the rise in sex hormones occurring in puberty. Also, adolescents who mature early may seek out older friends, who may encourage them to try risky behaviors (Crockett & Petersen, 1993; Igra & Irwin, 1996).

Steinberg & Belsky (1996) have a very interesting evolutionary view on pubertal timing. They propose that it is social factors like risk taking that cause adolescents to begin puberty early, as opposed to the other way around. There is some evidence to support the notion that social factors can affect biology. Examples include synchronous menstrual cycles among close friends, the fact that sex can speed up or bring on ovulation, and that dealings with the opposite sex can regulate and shorten menstrual cycles (Steinberg & Belsky, 1996). Most research shows that puberty is associated with adolescents becoming more independent from their parents. In animals, if the separation between adolescents and their parents is delayed, their reproductive maturation is slowed. If the parting is then allowed, “reproductive maturity is rapidly attained”
(Steinberg & Belsky, 1996, p. 111). Human studies show that familial conflict is highly associated with early pubertal maturation (Steinberg & Belsky, 1996).

Therefore, Steinberg & Belsky (1996) suggest that “the conventional view that early pubertal maturation is a cause of externalizing psychopathology in adolescence may have confused causation with correlation” (p. 113). The rationale behind Steinberg’s & Belsky’s (1996) theory is that “early maturation is an important component of an opportunistic reproductive strategy” (p. 117) because it provides the opportunity for early reproduction. Early maturation provides a number of evolutionary benefits. Females who begin sexual activity early may have better reproductive success. Other evidences suggests that sexual activity regulates the menstrual cycle, which may, in turn, provide greater chances for the females to procreate and pass on their genes (Steinberg & Belsky, 1996).

In spite of the compelling results, there were a number of limitations to this study. The sample size was rather small and may not have been representative of adolescents in general. Although sampling a private Catholic school may give rise to questions about representation, there are some advantages of utilizing such a sample. Using a sample from a fairly private, somewhat sheltered environment can partially control for factors such as race, religion, socio-economic status, and other variables that could have influenced the outcome of the study. There are also questions surrounding the reliability of self-report measures. Adolescents may not always be truthful when inquiring about personal matters, such as pubertal status. However, previous studies have demonstrated a significant correlation between adolescent self-report measures and parent-report measures (Ellis, 2002). Still, future research should seek to employ an improved measure of adolescent pubertal status, such as a physician’s examination or measures of hormone levels. Future research should also examine the relationship between
pubertal status and externalizing risk-taking behavior, while attempting to find an improved technique of measuring risk-taking behavior, such as observational data instead of self-report measures.

Improvements in the sample of adolescents can also help the representativeness of similar studies. As with any study, it would be wise to seek out a larger and more diverse sample size that includes subjects with various ethnicities, socioeconomic statuses, and schools. In addition, a sample that integrated different countries would be ideal. It would also be interesting to examine a wider range of ages throughout adolescence and even into early adulthood due to the tendency for risk-taking behavior to peak in late adolescence.

In conclusion, this study found a significant correlation between adolescent surgency levels and pubertal status. If parents, teachers, and counselors were to consider that adolescent risk-taking behavior was biological, even possibly evolutionary, they may be more sensitive when they experience these behaviors first-hand. Further research should explore the relationship between pubertal status and actual externalizing risk-taking behavior in adolescents.
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