
A Biopsychosocial Perspective of Adolescent Health and Disease

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Adolescence is a developmental stage characterized by dramatic physical, cognitive, social and emotional changes. For most adolescents, it is a period marked by rapid physiological change, increased independence, a change in family relationships that is more interdependent, prioritizing peer affiliations, initiation of intimate partner relationships, identity formation, increased awareness of morals and values, and cognitive and emotional maturation. Despite the rapid change, the majority of adolescents cope successfully with the demands of physical, cognitive, and emotional development during this time period (Cicchetti & Rogosch, 2002). In addition to the “positive growth” seen during adolescence, it is also a developmental stage recognized for turmoil and challenges, partly due to increased exploration and risk-taking typical of adolescence. Although considered to be a normative part of adolescence, risk-taking behaviors are nonetheless concerning to parents, peers, teachers, clinicians, researchers, and society because these actions often

endanger adolescents’ current and future health and well-being (Sales & Irwin, 2009).

Risk is defined as a chance of loss and risk-taking is often defined as engaging in behaviors that may have harmful consequences, but simultaneously provide an outcome that can also be perceived as positive (Beyth-Marom & Fischhoff, 1997). For example, driving too fast is considered a risk-taking behavior because it can result in a positive feeling (i.e., rush of adrenaline) while the action is occurring, but it also can result in serious harm to self or others (i.e., health-endangering). Examples of frequent health-endangering behaviors adolescents engage in include the use of tobacco and alcohol, experimentation with illicit and/or prescription drugs, unsafe sexual activities, poor eating habits, as well as delinquent actions (Centers for Disease Control and Prevention, 2010).

Adolescent risk-taking is concerning because of the immediate danger it poses, but also because research has demonstrated that the behaviors established during adolescence often persist into adulthood (Park, Mulye, Adams, Brindis, & Irwin, 2006). The potential long-term consequences of engaging in the most prevalent adolescent risk-taking behaviors include substance abuse, cancers associated with tobacco use, unwanted pregnancies, sexually transmitted infections (STIs) including HIV, obesity or other health problems caused by problem eating (i.e., eating disorders), and serious criminal activity (Sales & Irwin, 2009). For instance, in 2010 the *Monitoring the Future Study* found that

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41 % of high school seniors had consumed alcohol in the past 30 days, and over 35 % had used marijuana in the past year, with 6.1 % using marijuana daily, and that the use of non-prescribed prescription-type drugs was high (21.6 % lifetime use) (Johnston et al., 2011). Specific to sexual behavior, after a decade of declining adolescent pregnancy rates, in 2006 the numbers inclined (Centers for Disease Control and Prevention (CDC), 2008), and in 2007 a report by the CDC indicated that one in four adolescent females have had an STI, with rates doubling in certain subgroups (Forhan et al., 2008). Finally, juveniles accounted for 17 percent of all arrests and 16 percent of all violent crime arrests in 1999 (Snyder, 2000). Adolescent female detainees are currently the fastest growing population of incarcerated adolescents. In 2008, female adolescents represented 30 % of total juvenile arrests. While the overall crime rate has declined in the past decade, the incarceration rate for girls, relative to boys, decreased less than males in most categories of crimes, including violent offenses (Puzzanchera, 2009).

Adolescent death is the ultimate consequence of risk-taking, with most cases of mortality in the USA during the adolescent period (approximately 75 %) resulting from preventable causes like motor vehicle crashes, unintended injuries, homicide and suicide (Fingerhut & Anderson, 2008). Thus, due to the immediate and long-term health consequences associated with adolescent risk-taking, identifying and understanding factors associated with adolescent risk-taking have become a public health priority. A variety of factors, including biological, psychosocial, and environmental, have been found to be associated with various adolescent risk-taking behaviors (Irwin & Millstein, 1986; Sales & Irwin, 2009). However, many studies, as well as theories, of risk-taking behavior are uni-dimensional and predominately focus on either biological, psychological, or environmental factors independently as they affect risk-taking.

Given the complexity of behavior, to provide a complete framework for examining the range of factors found to influence adolescent risk-taking behavior a theory or model must simultaneously

take into account the role of biology, psychosocial influences, and the environment. In line with this ideology, the National Institute of Health (NIH) issued a report explicitly stating the need for a better understanding of the interaction between biology, environment, and behavior and stressed the utility of such an approach for advancing our understanding of behavior, particularly behaviors which place one at risk (Working Group of the NIH Advisory Committee, 2004). The biopsychosocial model of risk-taking (Irwin & Millstein, 1986) provides a framework in which social environmental factors as well as existing biological and psychological predispositions interact to influence risk-taking behavior.

In the remainder of this chapter, we (1) briefly review the studies or theories of risk-taking that focus predominately on one factor (i.e., biological, psychological, and environmental) as it related to risk-taking behavior; (2) describe the multi-dimensional biopsychosocial model of risk-taking; (3) provide empirical evidence supporting the utility of the biopsychosocial model for better understanding various adolescent health-endangering behaviors; and (4) suggest future directions for the utility of the biopsychosocial model of risk-taking for advancing our understanding of adolescent health.

The Biology of Adolescent Risk-Taking

Biological factors are thought to influence risk-taking behaviors through four sources: (1) genetic predispositions, (2) "direct" hormonal influences, (3) the influence of asynchronous pubertal timing (i.e., earlier or later timing than peers), and (4) brain/central nervous system development. Examples of each type of biological influence are presented in turn.

Genetic Predispositions

Long before the mapping of the human genome, the familial nature of health risk behaviors led some to speculate about the role of genetic predispositions in risk-taking behaviors. Early evidence

from family studies demonstrated that risk-taking behaviors tended to cluster within families. Examples include substance abuse, criminal activity, and injury-related behavior. Specific to injury, Schor (1987) found that a small number of families accounted for a disproportionately large number of injury-related health care visits, and individual members of these “high injury” families had similar rates of unintentional injuries, with injury rates being stable over time. Moreover, many studies have demonstrated that children of alcoholics are nearly four times more likely than children of nonalcoholics to abuse alcohol as adults (Adger, 1991; Windle, 1997). Eloquent twin-adoption studies have been able to disentangle the effects of shared environment or learned behaviors from genetic predispositions, as children of alcoholic biological parents show a greater predisposition toward alcohol abuse even when raised by nonalcoholic adoptive parents (Cloninger, 1987).

Recent advances in genotyping techniques now allow the ability to further explore the role of genetic predispositions on adolescent risk-taking behaviors. For example, in regard to alcohol use, genetic studies support the A1 allele of the D2 dopamine receptor gene (DRD2) as a risk marker for alcoholism and substance use disorders. Conner and colleagues (2005) found that male adolescents with the A1 (+) allele tried and got intoxicated on alcohol more often than boys without this genetic marker providing support for the DRD2 A1 allele as a marker identifying a subgroup of adolescent males at high risk for developing substance use problems.

Further, a genetic vulnerability factor in the promoter region of the serotonin transporter gene (5-HTTLPR) has been associated with both substance use and risky sexual behavior. One study conducted with adolescents found that substance use had a significant impact on the sexual risk behavior of youth with one or two copies of the short allele (the genetic variant associated with risk) at this site, but substance use had little effect on sexual behavior for youth without the short allele (Kogan et al., 2010).

These are only two examples of the current work in this emerging field. As the ability to affordably collect and analyze genetic data

becomes more feasible, identifying other genetic markers that predispose adolescents towards other risk-taking behaviors is, certainly on the horizons.

Direct Hormonal Influences

Adolescence is a period also marked hormonal changes (increased reproductive/sex hormones, including estrogen, testosterone, etc.) (Spear, 2000). Puberty is associated with increases in gonadal sex hormones (Spear, 2000), and hormones have been postulated to play a role in brain development and in adolescent risk-taking (Irwin & Millstein, 1986; Shirtcliff, 2009; Steinberg, 2008). Hormones influence brain maturation of white matter (Asato, Terwilliger, Woo, & Luna, 2010; Perrin et al., 2008), and sex hormones contribute to the reorganization of dopaminergic neurons in the motivational system (Sisk & Zehr, 2005; Steinberg, 2008), which can then lead to behavioral manifestations in puberty (Shirtcliff, 2009; Sisk & Zehr, 2005; Steinberg, 2008). Hormones are necessary to activate neural circuitry dedicated to sexuality (Shirtcliff, 2009; Sisk & Foster, 2004), but are no longer necessary once individuals become sexually experienced (Shirtcliff, 2009). Stronger findings of the effects of sex hormones such as testosterone on sexual behavior are more commonly reported among females than males since small changes in testosterone are able to stimulate females' sex drive. According to Udry et al. (1986), the effects of androgens, such as testosterone, on sexual behavior of adolescent girls work directly on motivation for sexuality, libido, and possibly also personality. All these factors make adolescence and puberty particularly vulnerable periods, especially for young females in regard to sexual decision-making.

Influence of Asynchronous Pubertal Maturation

The timing of pubertal maturation is related to both genetics and hormonal fluctuations. For example, menarcheal age of mothers and daughters are

usually significantly correlated, and physical pubertal development is preceded by elevations in respective sex steroid levels. There is recent evidence that pubertal timing in females is impacted by environmental factors as well, such as presence or absence of the father during childhood (Belsky, 2011; Deardorff et al., 2011).

Asynchronous pubertal maturation is maturation that occurs earlier or later than peers, and it has been hypothesized to be a factor in risk-taking (Irwin & Millstein, 1986). Physically mature-appearing adolescents, because of their older appearance, may be more apt to associate with older peers and engage in “adult” behaviors such as smoking, drinking, and sexual intercourse (Brooks-Gunn, 1988), and engaging in such behaviors may then be supported and imitated by peers. Research indicates that early maturing females are more likely to initiate sexual intercourse at younger ages (Phinney, Jensen, Olsen, & Cundick, 1990). Younger age at sexual debut is associated with less consistent contraception and increased numbers of lifetime sex partners, resulting in an increased risk for pregnancy and STIs (Ford et al., 2005; Kaestle, Halpern, Miller, & Ford, 2005; Manning, Longmore, & Giordano, 2000).

Brain and Central Nervous System Development

Recent advances in developmental neuroscience indicate that the brain continues to develop into adulthood. In fact, the cognitive-control system in the brain, which regulates impulse control, is a slow maturing system and makes adolescence a time of heightened vulnerability for risk-taking behavior (Steinberg, 2004). According to Steinberg (2007), adolescent risk-taking is the product of both logical reasoning and psychosocial factors. Logical reasoning abilities are mostly fully developed by the age of 15. However, the psychosocial capacities (i.e., impulse control, emotion regulation, delay of gratification, and resistance to peer influence) that facilitate decision-making and moderate risk-taking are guided by the cognitive-control systems in the brain and this system continues to mature well into young adulthood

(Steinberg, 2004, 2007). The cognitive-control system, which mainly consists of outer regions of the brain such as the lateral prefrontal and parietal cortices and portions of the anterior cingulate cortex, is involved in executive function tasks like planning, thinking ahead, impulse control, and self-regulation (Giedd, 2008).

In addition, according to a recent review by Steinberg (2008), puberty is associated with the remodeling of dopaminergic pathways in the socioemotional brain system that influence reward salience and reward sensitivity, especially in social situations. This neural transformation is also accompanied by a significant increase in oxytocin receptors located within the socioemotional system, which is critical as oxytocin heightens adolescents’ attentiveness to, and memory for, social information. Steinberg (2008) argues that the increase in oxytocin leads to an increase in the salience of peers, and this increase in the importance of peers and peer relations plays a role in encouraging risky behaviors. In sum, in comparison to younger youth, adolescents who have gone through puberty are more inclined to take risks in order to gain rewards, and this tendency is exacerbated by the presence of peers. Recent research from behavioral science is consistent with Steinberg’s position. For instance, his laboratory-based research found that the presence of peers more than doubled the number of risks teenagers took in a video driving game and increased risk-taking by 50 % in college students, but had no effect among adults (Gardner & Steinberg, 2005).

Beyond Biology

Biological development during adolescence is accompanied by physiological changes in the ways in which adolescents perceive both themselves and the world around them. Cognitive development may occur in concert or asynchronously with physical development. When physical development precedes cognitive development (as often is the case with females experiencing early maturation) adolescents are at increased risk for engaging in health-endangering behaviors.

Further, although developmental neuroscience research has found that the brain is still developing into adulthood, the social world may have unrealistic or unhealthy expectations of adolescents, especially those whom physically appear as adults. Thus, it is imperative to include the social environment in models exploring adolescent risk-taking. Indeed, when biological models are expanded to include “psychological” variables the combined effects of biological and psychological factors explains more of the variation in health-endangering behaviors (e.g., used cigarettes or marijuana) than either of these factors alone.

The Psychology of Adolescent Risk-Taking

Psychologically based studies of adolescent risk-taking behavior examine the roles of cognition, personality traits, and dispositional characteristics, such as self-esteem and depression, in risk-taking behavior. Examples of each are briefly presented and discussed in turn.

The Role of Cognition

Cognitive theories of risk-taking behavior explore how people perceive risk and make decisions about risk-taking. Specific to adolescents, risk perception theory has been guided by the premise that adolescents are “optimistically biased” or that they believe themselves invincible. The concept of invincibility has been frequently employed to explain or justify adolescent risk-taking behavior, although little evidence supports this assertion as people of all ages, not just adolescents, tend to underestimate the likelihood of experiencing adverse consequences of their actions (Reyna & Farley, 2006). For instance, Millstein and Halpern-Felsher (2002) demonstrated that increasing the salience of the risks associated with making a potentially dangerous decision had the same effect on adolescents and adults. Further, few age differences have been found in regard to individuals’ evaluations of the risks inherent in a variety of dangerous behaviors, or in judgments

about the seriousness of consequences resulting from risky behavior (Beyth-Marom, Austin, Fischhoff, Palmgren, & Jacobs-Quadrel, 1993).

Research has also examined the role of decision-making on adolescent risk-taking. Fischhoff (1992) identified five salient components of decision-making: (1) identify alternative options, (2) identify possible consequences, (3) evaluate the desirability of the potential consequences, (4) assess the likelihood of those consequences, and (5) combine the information to make a decision. According to Keating (1990), by middle adolescence (i.e., 14 or 15 years of age), most adolescents make decisions in a similar manner to adults. Although the decision-making process may be similar, the content of the aforementioned components may differ substantially between adults and adolescents. For instance, Beyth-Marom et al. (1993) found that adolescent and adult patterns of responses regarding risk-taking were similar, with both producing more negative consequences than positive ones. The difference was that adults reported more consequences overall than adolescents.

Another cognitive theory of adolescent is called fuzzy-trace theory (Reyna & Farley, 2006). Fuzzy-trace theory proposes that adolescent decision-making is based on simple, gist mental representations of choices (i.e., “fuzzy” memory traces) as opposed to more detailed, verbatim representations or traces. Because of this, when adolescents attempt to rationally weigh costs and benefits (via the use of verbatim memory traces), risk-taking increases. However, risk-taking decreases when the core gist of a decision is processed and a decision is based on this gist information (Rivers, Reyna, & Mills, 2008).

The Role of Personality

Some evidence indicates that adolescent decision-making may reflect an overall tendency toward unconventional behavior. Jessor’s Problem Behavior Theory links “unconventionality” in personality, among other things, with an increased likelihood of participating in problem behaviors such as risky sexual activity, substance use, and delinquency (Jessor, 2008; Jessor & Jessor, 1977).

Problem Behavior Theory has attempted to provide a theoretical framework for the connection observed between multiple problem behaviors. This theory suggests that multiple factors contribute to problem behaviors, defined as socially problematic, concerning, or undesirable behaviors usually eliciting some form of social or personal consequence (e.g., disapproval from others, incarceration, health compromise). The theoretical framework includes three major systems of explanatory variables: (1) the perceived-environment system, involving social controls, models, and support; (2) the personality system, involving values, expectations, beliefs, attitudes, and orientations toward self and society; and (3) the behavior system, encompassing both problem and conventional behaviors. Considering these explanatory systems, it is possible that engaging in health-compromising behaviors (i.e., smoking, sexual risk behaviors) may be related due to factors such as social support, depressive symptoms, self-esteem, and other factors underlying these risk behaviors and potentially accounting for the relationship among them.

The personality trait “sensation-seeking” has been used to explain adolescent risk-taking behavior. For example, Zuckerman (1979) states that sensation seeking is a “trait defined by the need for varied, novel and complex sensations and experiences and willingness to take physical and social risks for the sake of such experiences.” Zuckerman developed a Sensation Seeking Scale to assess individual differences in optimal levels of arousal. Often high-sensation seekers tend to perceive less risk in many activities than low-sensation seekers. Even when the evaluation of the risk involved is equal between the two groups, high-sensation seekers are significantly more likely to anticipate more positive potential outcomes than low-sensation seekers. Sensation seeking has been associated with a variety of risk-taking behaviors including substance abuse, reckless driving, delinquent actions, and risky sexual behavior (Andrucci, Archer, Pancoast, & Gordon, 1989; Kalichman & Rompa, 1995; Newcomb & McGee, 1991; Tonkin, 1987). Further, an adolescent-specific sexual sensation-seeking scales has been recently developed (DiClemente et al., 2010), and adolescent females

who endorsed high levels of sexual sensation seeking attitudes and behaviors also reported high levels of sexual risk-taking behaviors such as frequency of vaginal intercourse, number of sexual partners, and inconsistent condom use (Spitalnick et al., 2007). Not surprisingly perhaps, sensation seeking has also been linked to various biological markers including testosterone levels, electrodermal and heart rate responses, and cortical evoked potentials (Zuckerman, 1990).

The impulsivity seen among sensation-seekers may be seen in psychopathologic states that have been linked to an increased likelihood of risk-taking behaviors, primarily in male adolescents. Attention deficit hyperactivity disorder (ADHD) in males has been associated with an increased risk for delinquency. One study found that male youths with ADHD had arrest rates more than twice those of controls (Farrington, Loeber, & Van Kammen, 1990). Similarly, male youth with conduct disorders are at increased risk for alcohol and substance abuse (Kazdin, 1989).

The Role of Dispositional Characteristics

Self-esteem, depression and locus of control are often cited as theoretical or empirically supported predictors of risk-taking behavior. Lower self-esteem has been associated with age of sexual debut in adolescent females (Orr, Wilbrandt, Brack, Rauch, & Ingersoll, 1989). Depressive symptoms and stress have been related to the initiation and intensity of use of tobacco among adolescents (Covey & Tam, 1990), and more recently, to a various risky sexual behaviors in both adolescent males and females (Crepaz & Marks, 2001, Sales, Spitalnick, Crittenden, & DiClemente, 2009). Further, depression and external locus of control have been associated with substance use (Baumrind, 1987; Dielman et al., 1987). Kohler (1996) examined the relationship between locus of control, sensation-seeking, critical-thinking skills, and risk-taking among adolescents and found a significant correlation between risk-taking and gender, critical thinking, and locus of control. However, it should be noted that research has not supported

a consistent role for any of these psychological factors in various risk-taking behaviors (Dryfoos, 1990; McCord, 1990; Sales, Spitalnick, Crittenden, & DiClemente, 2009).

Beyond the Psychological

In summary, cognitive factors such as risk perception and decision-making contribute to adolescent risk-taking. Although adolescents' decision-making processes appear to differ little from adults, adolescents lack adult experience interacting with the social/environmental world in general, and engaging in decision-making specifically. As articulated in fuzzy-trace theory, their judgments cannot reflect the influence of these experiences. Further, adolescent risk-related decision-making may reflect young people's tendencies toward unconventionality and/or sensation seeking. Sensation seeking is clearly related to increased rates of adolescent risk-taking behaviors, but not all risk-taking behavior can be construed as sensation seeking. Some clinical psychological difficulties such as excessive aggression, impulsivity, and attention deficit and conduct disorders increase the likelihood of adolescents engaging in risk-taking behavior. The role of depression, a highly prevalent issue facing adolescents, has been linked to substance abuse and risky sexual behaviors, but role of depressive mood in other types of risk behavior has yet to be established. Further, the evidence for a causal role for self-esteem and locus of control on risk-taking is unclear. Thus, biological and psychological factors are themselves important determinants of risk-taking behavior. They also are the personal filters through which social and environmental stimuli are interpreted and translated into action.

The Environment of Adolescent Risk-Taking

Environmental models of adolescent risk-taking behavior look at the roles of peers, family, and institutions (school, church, and/or social media)

in risk-taking behaviors. These studies examine how the social/environmental context provides models, opportunities, and/or reinforcements for adolescent participation in risk-taking behaviors. The role of family, peers, and society in risk-taking behaviors are presented in turn.

The Role of Family

Although adolescence is a time of emerging autonomy and individuation from the family, most adolescents maintain close relationships with their parents (Steinberg, 1993) and parents continue to influence their children's behavior throughout adolescence. Parents play an important role in determining adolescent involvement in risk behaviors. Parental modeling of and permissive attitudes toward substance use have been implicated in the initiation of substance use in early adolescence (Hawkins & Fitzgibbon, 1993; Werner, 1991). Further, adolescents are less likely to abuse substances or to initiate sexual activity when parents provide emotional support and acceptance, and have a close relationship with their children (Turner, Irwin, Tschann, & Millstein, 1993).

In addition to modeling, parental monitoring has been widely studied as an important correlate of adolescent risk-taking behavior (Jaccard & Dittus, 1991). Monitoring and supervision incorporates both communication between parent and child, and supervision of the youth. Borawski and colleagues (2003) found that perceived parental monitoring, combined with trust, served as a significant protective factor against sexual activity for both males and females, and tobacco and marijuana use in females, and alcohol use in male adolescents. Less perceived parental monitoring has been associated with increased participation in antisocial activities, sexual risk-taking, and increased substance abuse or use (Chilcoat et al., 1995; Smith & Rosenthal, 1995; Steinberg, 1993).

Parental influence on adolescent behavior varies with the quality of the relationship between the adolescent and the parent (Bijur et al., 1991; Turner et al., 1993). Related to this, parental approaches to child rearing have also been associated with

adolescents engaging in risk-taking behaviors. For instance, Baumrind (1991) found an association between adolescent substance use and parenting styles. Adolescents whose parents were “authoritative” (i.e., demanding and responsive) were less likely to use substances than either those with “authoritarian” (i.e., demanding but unresponsive) or those with “permissive” (i.e., nondemanding but responsive) parents. Adolescent with “neglecting and rejecting” parents were the most likely to engage in substance abuse.

In summary, family approval and modeling of risk behavior has been linked to adolescent risk-taking behavior. Parent–child relationships characterized by conflict, increased emotional distance, and non-responsiveness increase the likelihood of adolescents engaging in health endangering behaviors (see Chapter “Determinants of Health-Related Behaviors in Adolescence” by DiClemente, Brown, and Davis for a more thorough review).

Peers

According to Jessor and Jessor (1977) the relatively greater influence of peers compared to parents is associated with a greater tendency (or proneness) toward problem behaviors. As a result, parental impact on risk-taking behavior may wane as peer influences increase throughout adolescence. Consistent with this assertion, Jessor and colleagues (1980, 1983) found that peer influence more so than parental influence predicted marijuana use, problem drinking, and precocious sexual debut.

Peer influence has been a significant factor associated with adolescent substance use (Jessor, 1976; Kandel, 1985; Newcomb & Bentler, 1989), alcohol use (Urberg, Degirmencioglu, & Pilgram, 1997), delinquency (McCord, 1990) and sexual behaviors. Accordingly, peers have been identified as an important influence on the sexual behavior of adolescents in a wide range of populations (Buhi & Goodson, 2007; Pedlow & Carey, 2004). Also, adolescents are usually accompanied by one or more persons when committing crimes that range in seriousness from vandalism and

drug use (Erickson & Jensen, 1977) to rape and homicide (Zimring, 1998). Further, social network analysis of smoking and drug-use behaviors among adolescents has found that both risk-taking and non-risk-taking behaviors (i.e., smoking and drug-use) are learned in the context of peer clusters, and risk-taking peer clusters exert greater influence on those peers on the periphery of clusters than do non-risk-taking peer clusters (Pearson & Michell, 2000).

Traditionally “peer pressure” has been viewed as an etiologic factor in adolescent risk-taking behavior. It remains unclear if risk behaviors are initiated in order to conform to an existing peer group or if those prone to engage in risk-taking behaviors are drawn to those who are similarly inclined. Lashbrook (2000) provides one possible explanation for how peers exert their impact on adolescent risk-taking. Specifically, he demonstrated that older adolescents may attempt to avoid negative emotions, such as feelings of isolation and inadequacy, by participating in risky behaviors with peers. Recent findings suggest that the answer is not straightforward. Brady, Dolcini, Harper, and Pollack (2009) found that adolescents with low social support from peers may be prone to engaging in sexual risk-taking as a response to stress, whereas adolescents with high peer support may engage in sexual risk-taking due to peer socialization of risk.

Society

Societal influences such as mass media and community norms may also influence risk-taking behavior. Role models and/or images portrayed in the media are regularly presented by the media engaging in various health-endangering behaviors (including unprotected sexual behavior and alcohol/substance use), though evidence for the influence of these models/images on actual behavior is lacking. A recent study conducted among adolescent African American girls found that those who watched rap music videos and who perceived more sexual stereotypes in the videos were more likely to engage in binge drinking, test positive for recent marijuana, have multiple sexual

partners, and have a negative body image (Peterson, Wingood, DiClemente, Harrington, & Davis, 2007).

In addition to media, different communities and neighborhoods provide adolescents with opportunities and motivations to engage in risk-taking behavior. Peer norms reflected in local rates of substance use and teen pregnancy create expectancies of “typical” adolescent behavior (Crockett & Petersen, 1993). Local ordinances allowing cigarette vending machines, legalization of marijuana for medical purposes for adolescents, or lower ages to purchase alcohol provide opportunities for engaging in risk-taking behavior. Johnston and colleagues (1993) have reported that the perceived availability of marijuana in a community is not necessarily related to prevalence of use by teens. In fact, declines in marijuana use by high school seniors have been accompanied by unchanged or even increased perceived availability in recent years.

Cultural expectations may also influence adolescent risk-taking behavior. For instance, despite similar ages of sexual debut, the USA has the highest rates of adolescent childbearing and abortion in the developed world (Martin et al., 2006). This is speculated to be related to differing cultural attitudes toward adolescent sexuality and contraception (Geronimus, 2003). When looking within the USA only, contraception rates vary significantly by ethnicity and religious affiliation (Brewster, Cooksey, Guilkey, & Rindfuss, 1998; Santelli, Morrow, & Carter, 2004). Substance use and age of sexual debut also differ among different ethnic groups in the USA (Cavanagh, 2004; Guerra, Romano, Samuels, & Kass, 2000). (Note: Ethnicity associated differences may be confounded by factors related to socioeconomic status; See Chapter “Determinants of Health-Related Behaviors in Adolescence” by DiClemente, Brown, and Davis for further discussion.)

Beyond Environment

The studies presented demonstrate the complexity of the interaction between adolescents and their environment. The biopsychosocial model provides

a framework in which environmental factors are brought to bear on existing biological and psychological predispositions to influence risk-taking behavior, and ultimately adolescent health.

The Biopsychosocial Model of Risk-Taking

The biopsychosocial model integrates two areas of research that have often been considered separately: (1) the relationship of biological development to psychosocial processing during adolescence, and (2) the relationship of risk-taking behaviors to psychosocial correlates of these behaviors (Sales & Irwin, 2009). According to this model, biological, psychological, and social or environmental factors influence adolescent risk-taking behaviors (Irwin & Millstein, 1986). Specifically the timing of biological maturation directly influences psychosocial functioning (i.e., cognition, perceptions of self and the social environment, and personal values). According to the model, biological, psychological, and social or environmental variables, mediated by perceptions of risk and peer-group characteristics, best predict adolescent risk-taking. Biological variables influencing adolescent risk-taking behavior include pubertal timing, hormonal effects, genetic predispositions, and brain maturation. Psychological variables associated with risk-taking include self-esteem, sensation seeking, and cognitive and affective states. Social influences on adolescent risk-taking include peers, parents, and school (see Fig. 1).

Given the framework of the biopsychosocial perspective, Irwin and colleagues (Irwin, 1990; Irwin & Millstein, 1986; Irwin & Ryan, 1989), have elaborated on the theory to include conditions that may increase the probability that a given adolescent will engage in risk-taking behaviors (see Fig. 2). Because of advances in our understanding of developmental neuroscience, a fourth biological factor has been added to the model. Now, the biological factors thought to predispose adolescents to risk-taking behaviors include male gender, genetic predispositions, hormonal influences, and prolonged brain

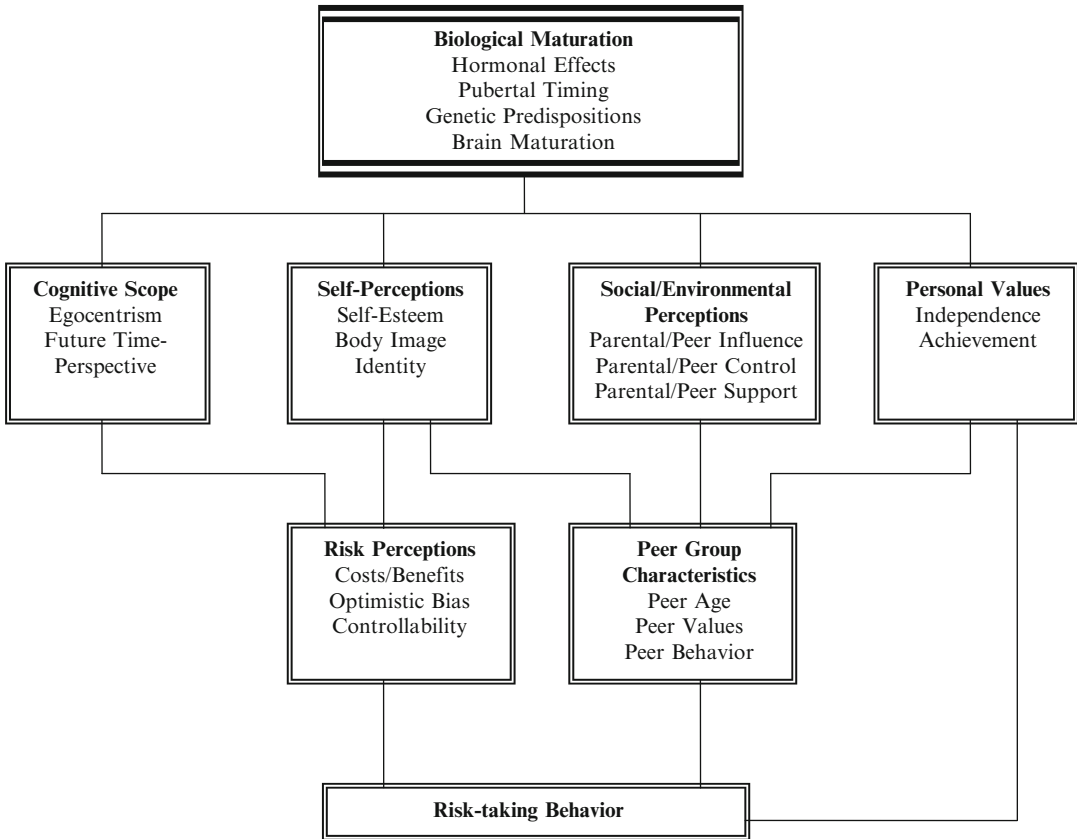


Fig. 1 Model based on the biopsychosocial causal model of risk-taking behavior (Irwin & Millstein, 1986)

maturation. Psychological predisposing factors include sensation seeking, risk perception, depression and low self-esteem. Social environmental predisposing factors include maladaptive parenting styles, parental modeling of risk behaviors, peer behaviors and socioeconomic status. Finally, adolescent vulnerability to risk-taking behaviors may be increased situationally by family disruption, school transitions, and substance use and peer initiation of risk-taking behaviors.

Research Supporting the Utility of the Biopsychosocial Model

A variety of studies provide support for the utility of the biopsychosocial model for examining adolescent risk-taking. For instance, Brooks-Gunn (1988) found that among female adolescents,

early maturational timing was associated with a more negative self-image, and with earlier onset of sexual activity. For both males and females, early maturation is a risk factor for the initiation of substance use in adolescents (Tschan et al., 1994). Seminal work by Jessor and Jessor (1977) supports the roles of environment and personal values (i.e., psychosocial factors) in the onset of adolescent risk-taking behavior. Specifically, the predominance of peer influence over parental influence, along with adolescents placing a greater personal value on independence versus achievement resulted in an increased likelihood of adolescents engaging in risk-taking behavior. Moreover, Hughes et al. (1991) conducted a study with urban delinquent youth and concluded that alcohol/substance abuse during adolescence further added to biological predispositions, educational difficulties, and coercive family

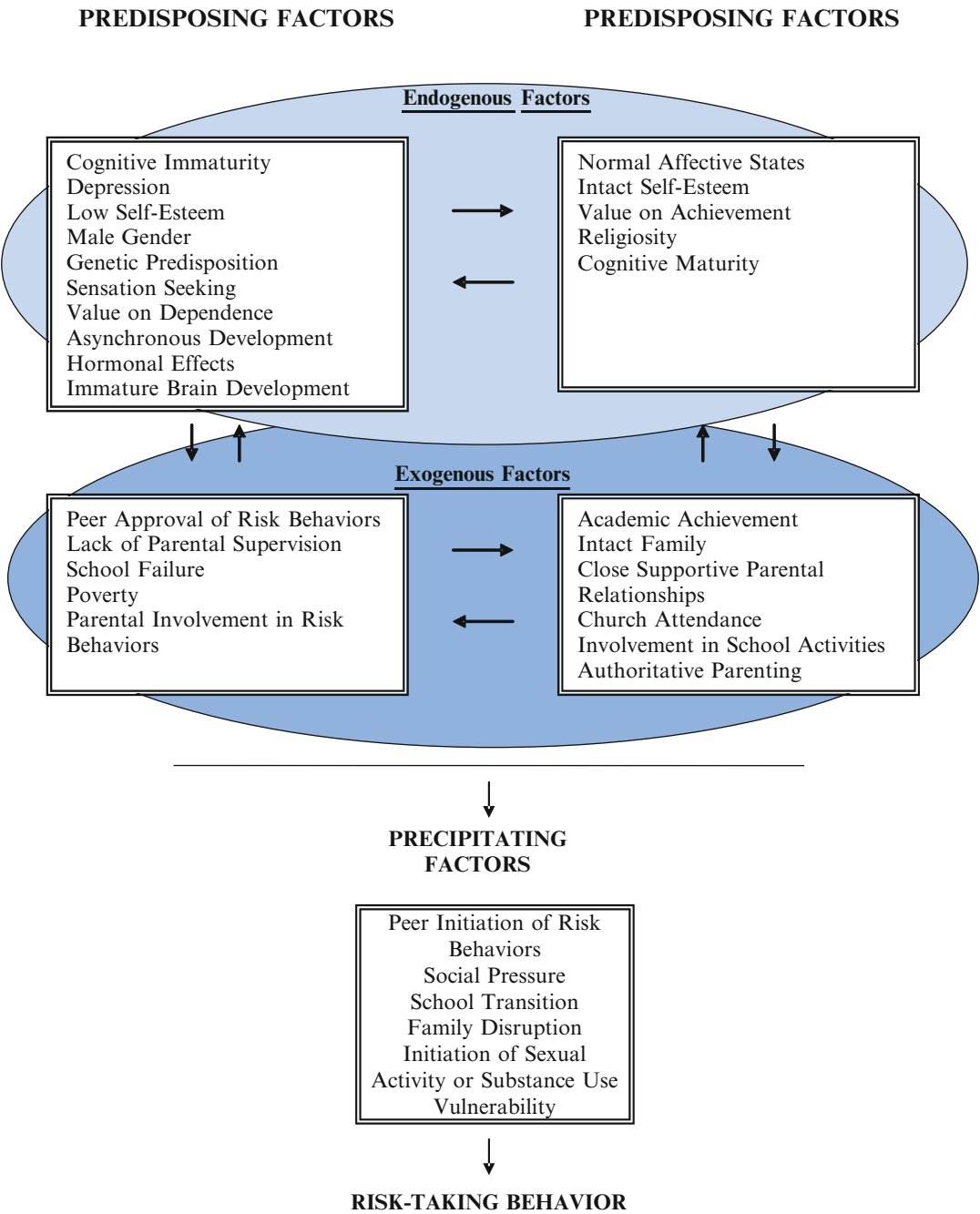


Fig. 2 Factors contributing to the onset of risk-taking behaviors during adolescence (Irwin & Millstein, 1986; Irwin & Ryan, 1989; Sales & Irwin, 2009)

environments, all of which contribute to their delinquent behavior. While most evidence supporting the biopsychosocial model stems from research in the USA, a study conducted with Japanese students, utilizing structural equation

analysis, found that egocentrism contributes directly to health-endangering behaviors while influences of self-esteem and perceived social norms are mediated by risk perception (Omori & Ingersoll, 2005).

Often it is difficult for a single study to collect data for each area emphasized in the biopsychosocial model. Thus, articles which can overview and synthesize studies provide additional support for the utility of the biopsychosocial model. For example, a review by Ricciardelli and McCabe (2004), synthesized the literature and reported that among adolescent males, disordered eating and the pursuit of muscularity are consistently associated biological factors such as body mass index (BMI), psychological factors such as negative affect and self-esteem, and sociocultural factors such as perceived pressure to lose weight by parents and peers (Ricciardelli & McCabe, 2004). Further, Dodge and Pettit (2003) reviewed of the empirical literature pertaining to the development of chronic conduct problems in adolescence and conclude that reciprocal influences among biological dispositions, environments, and life experiences lead to recursive iterations across time which either worsen or diminish antisocial development. Additionally, their findings indicate that adolescents' cognitive and emotional processes mediate the relationship between life experiences and conduct problems. Finally, specific to aggression and delinquency in adolescent girls, a review by Celio, Karnik, and Steiner (2006) found that early maturation is a risk factor for aggression and delinquent behavior. However, the way in which early physical maturation is perceived and treated by others (family, peers, and society) also determines how adolescent girls behave.

Additional support for the biopsychosocial model comes from interventions designed to reduce adolescent risk-taking. For example, Brody et al. (2009) found that youth in the control group of their Strong African American Families (SAAF) intervention program with the polymorphism in the SCL6A4(5HTT) gene at 5-HTTLPR showed significant increases in risk behavior initiation (particularly substance use initiation) across 29 months of follow-up in comparison to youth in the SAAF program with the same genetic risk. These findings demonstrate that despite genetic predispositions, programs that work to intervene at the family level to build supportive family environments, along with increasing self-esteem and improving life

skills of youth, can attenuate risk initiation among adolescents.

Thus, across various behavioral domains, research supports the utility of the biopsychosocial model for explaining adolescent risk-taking.

Future Directions for the Biopsychosocial Model

Give the complexity of human behavior, a model must encompass a variety of constructs to more fully explain and understand why some people opt to participate in health-endangering activities. Because the biopsychosocial approach includes various constructs empirically linked to adolescent, it is a more complex model, and until recently it has been incredibly difficult to empirically examine all of the factors comprising the model in one study. However, with recent advances in technology and a concerted effort by researchers (and funding agencies) to engage in interdisciplinary collaborations to more thoroughly examine health-compromising decisions and behaviors, future research may be able to do so more frequently.

For instance, the recent mapping of the human genome has allowed us to explore the biological underpinnings of behavior and cognition in ways not possible even a decade ago. Advances in gene mapping have lead to findings implicating particular genes in alcoholism and substance use disorders (Conner et al., 2005). Also, genetic markers for impulsivity (e.g., DRD4) and depressive symptomatology (e.g., 5HTT and MAOA) are currently being explored, and identifying a multitude of other genetic markers that predispose adolescents towards various risk-taking behaviors is on the horizon.

Advances in brain imaging science have allowed researchers to examine the brain across development and while engaging in problem solving. Many now believe, based upon neuroimaging studies, that mature decision making is composed of two networks: a highly interconnected cognitive-control network that biases decisions in favor of rational outcomes and a socioemotional network that biases decision making toward reward-based demands (Chein, 2008).

It is postulated that, in adults, the cognitive-control network can regulate the behavior of the socioemotional network, allowing for people to make rational, utilitarian decisions. However, neither of these systems is fully matured during adolescence, and each one develops along different timetables (Giedd, 2008). Thus, these two underdeveloped networks and their differing rates of development pave the way for heightened risk-taking during adolescence, which, as demonstrated by Gardner and Steinberg's (2005) work with teen drivers, may be further compounded by social and environmental factors, particularly the presence of peers. In the past decade great scientific advances have been made through neuroimaging studies, but understanding the relationship between neuroimaging findings and behavior is still in its infancy. Although this is an area of great academic interest and active research, demonstrating straight-forward relationships between the size of, neural activity in, or connectedness between particular brain regions and a specific behavior or ability has, to date, been challenging at best (DiFranza, 2011; Giedd, 2008; Rubinstein et al., 2011; Steinberg, 2008).

Technological advances have also bettered researchers' ability to assess adolescent risk-taking, as well as psychological and environmental influences on risk-taking. For example, it is now possible to detect through self-collected vaginal swab specimens, the presence of semen in vaginal fluid (Yc PCR). This can then be used as a nondisease marker of unprotected vaginal intercourse (Zenilman, Yuenger, Galai, Turner, & Rogers, 2005). Also, novel techniques, such as GeoCoding, allow researchers to spatially place participants in their physical neighborhoods, which are then mapped onto Census data to establish neighborhood profiles (Sales & Irwin, 2009). This provides an objective measure of neighborhood level social conditions including socioeconomic status, racial makeup, population density, as well as access to potentially health-compromising venues (such as fast-food restaurants and liquor stores) or health-promoting venues (such as grocery stores and green spaces). Further, the explosion of social media (e.g., Facebook, MySpace, YouTube) and mobile communication (e.g., cell-phones,

iPhones, iPads, Netbooks) among adolescent populations in the USA and around the globe provide teens with nearly unlimited access to information (health promoting and health endangering) and social networks. These advances allow unique opportunities to access and assess adolescents, especially as it relates to decision-making, risk-taking, and health outcomes.

In the coming years it will be possible to explore biological influence on behavior and the interaction between biology, psychology, environment, adolescent risk-taking behavior, and health outcomes in ways never possible before. Thus, just as our society is becoming more and more complex, the utility of complex models of adolescent risk-taking like the biopsychosocial model will prove invaluable in guiding the next generation of adolescent health research.

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