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## Translational Research Applications for the Study of Adolescent Sexual Decision Making

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### Abstract

Although the initiation of sexual behaviors in adolescence is normative, adverse sexual health outcomes disproportionately affect adolescents relative to adults. Efforts to improve sexual health and increase health promotion behaviors in adolescent populations have not been fully successful. In this paper, we propose that translational research that integrates insights from neuroscience, ecological systems theory, and decision science with adolescent sexual behavior research can lead to advances in our understanding of the etiology and prevention of sexual risk behaviors among adolescents. Moreover, these insights can be further translated to the design and implementation of clinical interventions that improve sexual health.

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Sexual desire and behavior develop gradually beginning in childhood.<sup>1,2</sup> By age 12, three-quarters of boys and girls have experimented with some form of early partnered sexual activity (e.g., kissing, feigning intercourse),<sup>3</sup> and by high school 47% of adolescents report having had sexual intercourse.<sup>4</sup> Sexual debut occurs overwhelmingly outside of marriage (91%).<sup>5</sup>

Although the initiation of sexual behavior in adolescence is normative, its negative effects affect adolescents to a greater degree than adults. Adolescents aged 15-19 make up only 7% of the U.S. population<sup>6</sup> but account for 33% of new sexually transmitted infections (STIs)<sup>7</sup> and 28% of new HIV cases.<sup>8</sup> Twelve percent of unplanned pregnancies occur among adolescents,<sup>9</sup> and among sexual assault victims, 42% were raped as adolescents.<sup>10</sup> Educational and psychosocial interventions to reduce negative sexual outcomes among adolescents have been only partially successful; at the last sexual encounter, 40% of adolescents report that they did not use a condom, and 78% did not use another form of contraception.<sup>4</sup>

Translational approaches, integrating interdisciplinary knowledge and insights into adolescent sexual decision making, may help to reduce these disparate risks. In this paper,

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we describe innovative translational approaches for improving understanding of adolescent sexual decision making and behavior. First, we examine research on the neural underpinnings of adolescent sexual decisions. Second, we discuss social contextual influences on adolescent decision making, focusing on parental efforts to nurture adolescent decision making competence. Third, we explore how behavioral decision science can be applied to understand sexual choices. Finally, we describe a translational effort to apply decision science to a behavioral intervention. Just as interdisciplinary translational approaches have led to rapid advances in areas such as genetics, neuroscience and behavioral economics, we believe such innovations may help to improve sexual outcomes among adolescents.

## Neural Bases for Adolescents' Decision Making

Adolescence is a sensitive period for the development of the neural bases of decision making. During adolescence, the brain experiences tremendous growth and remodeling, a process that continues into the third decade of life.<sup>11</sup> Importantly, adolescent brain development includes changes in both the structure and function of neural reward circuitry. Reward circuitry is relevant to adolescent decision making during experiences in which the adolescent deliberates between behavioral options that differ in their expected reward (e.g., pursuing versus quelling a sexual encounter). Brain regions critical to reward-related decision making include the striatum, orbitofrontal cortex, anterior cingulate cortex, and medial prefrontal cortex (mPFC).<sup>12</sup> Function in these regions changes across adolescence,<sup>13-15</sup> and work by Forbes and colleagues has revealed changes in reward responding, with decreases in the striatum and increases in the mPFC during puberty specifically.<sup>16</sup>

Reward-focused behaviors such as sensation-seeking and substance use increase during adolescence and often occur in peer social contexts.<sup>17,18</sup> Accordingly, conceptual models for adolescent development emphasize the role of reward systems<sup>19,20</sup> and propose that relative to childhood, adolescence is a period during which adolescents begin to place greater reward value on the social goals of intimate friendships and romantic/sexual relationships.<sup>21</sup> From a biological perspective, the behaviors most directly associated with puberty are sensation-seeking and sexual dominance behaviors.<sup>22</sup> Adolescence thus creates demands for self-regulation of reward function in peer social contexts. Sexual risk reduction interventions therefore need to account for the greater salience of social rewards, the reward-driven nature of decision making, and the sensitivity to peer social context during adolescence.

Investigating brain-behavior associations in adolescents' reward-related decision making can help to elucidate the mechanisms underlying adolescents' risky and reward-seeking behavior. A fruitful approach has been to combine neuroimaging with ecologically valid, real-world measurement of adolescents' mood, behavior, and decision making. Several studies by Forbes and colleagues have used ecological momentary assessment, a technique for measuring adolescents' mood and behavior in natural contexts and real time, to complement functional magnetic resonance imaging of reward function.<sup>16,23</sup> In one study, response in a region of the striatum with lower function among adolescents with depression was positively correlated with the level of positive affect that adolescents experienced in daily lives, indicating that laboratory measures of neural response reflect real-world affective processes.<sup>23</sup> In another study, brain function during a simple decision making task was related to pubertal development, depression, and real-world positive affect.<sup>16</sup> Another approach is to incorporate natural rewards into laboratory studies. For example, the presence of peers leads adolescents to exhibit more risk-taking behaviors during simulated driving scenarios, and this behavior corresponds to a greater response to risky choices in the striatum and orbitofrontal cortex.<sup>24</sup> In all, a better understanding both of brain development

and its association with real-life mood and behavior can point toward targets for preventive intervention. A view of adolescence as a time of both vulnerability to the risks of reward-seeking and opportunity for learning adaptive decision making can inform strategies to promote healthy sexual decision making.<sup>25</sup>

## Social Contextual Influences

Social Ecological theory posits multiple social elements that influence an individual's decisions, including the self, family, peers, social institutions, community, and culture. Research has primarily focused on adolescents and peers. Yet, families also affect adolescent sexual health.<sup>26-29</sup> The most consistent findings regarding family influences on adolescent sexual health have focused on parent-adolescent communication about sex. When parents talk about sex, their adolescents are more likely to delay sexual initiation<sup>30-34</sup> and use condoms<sup>28,35-37</sup> and contraceptives<sup>32,38-40</sup> when they become sexually active.<sup>36,41-43</sup> Most studies simply quantify topics discussed. However, studies that directly observe parent-adolescent discussions find that *how* parents communicate sexuality messages is a critical determinant of adolescent sexual decisions.<sup>44-46</sup> For example, Whalen<sup>46</sup> and Lefkowitz<sup>46,47</sup> noted that adolescents whose mothers were more domineering during discussions had less sexual health knowledge.

In a recent study, Akers and her colleagues examined audio-recorded conversations about sexual health topics between 21 mothers and their adolescent sons or daughters, aged 10-14. Three distinct maternal communication styles emerged that may affect adolescent sexual decision making. The first, *Developmental Guides*, are mothers who are very open when discussing sexuality and invite bi-directional discussion for sharing information. They are responsive to their adolescent asking questions, which they try to answer in a developmentally appropriate manner. The second style, *Double Communicators*, are mothers who attempt to invite bilateral discussions but exhibit discomfort with their adolescent's emerging sexuality and their own sexual health knowledge. They articulate a wide range of sexual health messages although two dominate: abstinence as the preferred behavior, but condoms and contraception when one chooses to be sexually active. Finally, the third style is termed *The Enforcer*. These mothers are highly dictatorial and lacking in warmth or support for their child's decisional autonomy when discussing sexuality. They have a limited range of sexuality messages to convey, emphasizing abstinence as the only acceptable behavior, although some mention condoms or contraceptives. They are generally not open to questions or comments.

Several interventions aim to improve parent-adolescent communication about sexuality, but most focus on improving parents' sexual knowledge or the frequency and range of topics discussed. Only one program teaches parents specific, measurable communication strategies,<sup>46</sup> an unfortunate oversight because the frequency and content of parental discussions may not matter if adolescents interpret their parents' conversation style as antagonizing. Research associating maternal communication styles with better adolescent sexual health outcomes could guide interventions in teaching mothers to use strategies characteristic of these more effective communication styles.

## Decision Science and Adolescent Sexual Decision Making

Intervention programs targeting adolescent sexual risk often hinge on an implicit assumption that the adolescents share the goal of the program, whether it be STI prevention or delaying sexual initiation, and, moreover, that this is their only goal. Adolescents criticize this simplistic approach,<sup>48</sup> noting that STI prevention is not always their primary objective and that many adolescents weigh sexual risk against relationship stability or improvements in social status.<sup>48,49</sup>

Adolescents' sexual decision making is complicated by conflicting values and goals, and uncertain outcomes.<sup>48</sup> Normative decision models may help practitioners and interventionists map adolescents' values and objectives, identifying "options in the decision makers' best interests, given their goals and the information available to them, all integrated by the application of a rational decision rule".<sup>50</sup> For example, despite advice from prevention programs to signal sexual non-consent forcefully, an adolescent who wishes to avoid unwanted sex *while* maintaining the relationship may select instead a subtle, non-verbal cue. This adolescent may be trading off a perceived increase in risk for unwanted sex against a perceived decrease in risk for relationship damage. To the extent that these are her values, her decision can be considered logically consistent.

The notion that adolescents may be capable of rationally weighing the effect of a choice with uncertain outcomes on multiple goals is incongruent with popular notions of adolescent cognition. Despite the fact that parents, providers, and the media often characterize adolescents as impulsive decision makers driven by perceived invulnerability to negative outcomes, the empirical evidence does not support this characterization. Although adolescents perceive their personal risk to be lower than comparable peers, this optimistic bias is no more common among adolescents than among adults.<sup>50-52</sup> Where objective probabilities of negative outcomes are available, adolescents (like adults) typically *over-*estimate their risk.<sup>53,54</sup> Risk behavior seems not to be driven by underestimates of negative outcomes, but rather, by perceived benefits overshadowing the estimated risks.<sup>55-58</sup> Adolescents may forgo condoms, not because they are unaware of the risk for STI transmission, but because the perceived benefits (increased commitment, pleasure, convenience) outweigh other goals.<sup>48</sup>

These insights suggest that adolescents may need to know not only the "best" strategies to reduce their sexual risk, but also the second- and third-best approaches. Even if their other goals lead them to reject an expert's first choice for sexual risk reduction (e.g., abstinence), they may be willing to implement an alternative harm reduction approach (e.g., monogamy). It is important also to recognize that adolescents often over-estimate their risk, which may lead traditional intervention approaches that stress accurate risk assessments to backfire.<sup>50</sup> For example, adolescents may relax their health promotion behavior when they learn that HIV transmission is rarer than they had guessed. Finally, from a normative perspective, if adolescents rationally weigh rare risks against common benefits, then to protect them from rare but catastrophic outcomes interventions might train adolescents to approach risky gambles less rationally, and more like adults, who rely on visceral reactions to categorically reject risky gambles.<sup>50</sup>

## Decision Science Contributions to Sexual Risk Reduction Intervention

Although many studies reviewed above suggest promising strategies for supporting sexual decision making, behavioral interventions tend to favor persuasion over education, sometimes even sacrificing medical accuracy.<sup>59</sup> They tend to avoid taboo subjects that instructors and facilitators are reluctant to broach, relying instead on vague terms such as "abstinence," which young people see as more inclusive than educators may realize.<sup>60</sup> Foregoing specific information may be justifiable if it led to the desired outcome, but many of these interventions fail to reduce risky behavior, or have not even been evaluated.<sup>61,62</sup> Such interventions may fail because they lack any normative structure and neglect the mental models that adolescents bring with them to the sexual tableau. Without a basis for understanding what content needs to be addressed, it would be difficult for an intervention to target adolescents' misconceptions about sex and its risks, or to address gaps in understanding that may undermine decisions.

Type 2 translational research is needed to bring promising science to the community. For example, a decision science approach can systematically analyze the decisions that adolescents are making, in light of a normative model, thus providing guidance aimed at those decisions from adolescents' perspectives. For example, Downs and her colleagues developed an interactive video intervention ([www.SeventeenDays.org](http://www.SeventeenDays.org)) based on research findings illuminating female adolescents' decisions about risky sexual behavior.<sup>63</sup> This project used the mental models approach to systematically compare normative and descriptive accounts of adolescent sexual behavior, focusing the intervention on what should be the most efficacious targets for change. The descriptive research revealed several key gaps between the experts' view of adolescent sexual behavior compared to adolescents' own view, as well as misconceptions that adolescents had about risk.

Perhaps most striking was that young women did not talk about sexual behavior as a choice that they made. Although young women were expected to talk about peer pressure, partner pressure, and difficult decisions about having sex, instead they described a lack of any decision at all. From very early in a social situation (a party), sex seemed a foregone conclusion to many participants describing typical behavior. The intervention addressed this gap in decision making by presenting choices in sexual situations very explicitly, highlighting points in usual situations where choices exist, and modeling options that reduce risk,<sup>64</sup> ranging from how to avoid a kiss to how to refuse sex without a condom. These demonstrations were bolstered by asking viewers to engage in cognitive rehearsal of their (safer) choice, a technique that has been shown to improve athletic performance<sup>65</sup> and medical techniques.<sup>66</sup>

Other misconceptions addressed in the intervention included an impoverished view of risk, neglecting the value of relative risk reduction and comparisons between behaviors, as well as many misconceptions about condoms, how to use them, and their effects. A randomized controlled trial found that the intervention increased abstinence, even though it never explicitly advocated behavior change nor did it include the word abstinence anywhere in the video. It also decreased condom failures and STI acquisition over a six-month period.<sup>63</sup>

The success of this intervention, especially in light of so many past failures, reflects the power of a systematic approach to developing interventions. It benefitted from a strong scientific basis, as well as formative research with the target audience to understand what they really needed so that the intervention could provide realistic guidance and strategies. Using video allows sensitive topics to be included without putting individual teachers or group leaders in the difficult situation of talking about things that they would rather not. It also allows the intervention to be delivered with true fidelity as it is scaled up.

## Conclusion

In this review, we argued that translational approaches to adolescent sexual decision making can help to elucidate the etiology of risky sexual choices and to inform effective interventions. Strides in understanding adolescent brain development, changes in neural reward circuits and the influence of peers on decision making provide a window on the mechanisms underlying risky behavior in adolescence. Careful analysis of maternal-child communication patterns suggests that parental influence on healthy sexuality may be linked not only to the frequency of communication but, more importantly, to the quality of the communication style. Insights from decision science highlight the importance of considering all sexual goals relevant to adolescents, not only negative outcomes, and furthermore, suggest that adolescents may have the capacity to engage in rational decision making. Finally, in contrast to many sexual risk reduction interventions with poor or untested outcomes, those with a strong theoretical and scientific basis informed by the knowledge

and perspectives of adolescents can improve healthy sexual outcomes. In sum, translational approaches, which build on the strength of multiple disciplines or work to bridge basic and applied science, have demonstrated capacity to produce rapid advances in understanding the etiology of risky behavior in adolescents and to improve interventions.

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