

Identifying a Cultural Resource: Neural Mechanisms Underlying Familial Influence on
Adolescent Risk Taking

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Abstract

Family obligation, which implies children's role in the support and assistance of their family, is a fundamental aspect of family life. Family obligation has important implications for the adjustment of adolescents from Mexican backgrounds, relating to lower levels of risky behavior. Risk taking underlies many behavioral and health problems, such as substance use and externalizing behavior that contribute to the public health burden during the adolescent period. Recent advances in developmental neuroscience have identified key neurobiological underpinnings of adolescent risk taking, but there is little understanding of how these neural processes interact with cultural and social processes in order to promote or prevent risk taking. In this chapter, we present a multi-method, longitudinal program of research that uses self reports of risk taking and substance use, experimental tasks, and functional magnetic resonance imaging (fMRI), to examine the mechanisms by which a culturally meaningful type of family relationship – family obligation – buffers Mexican youth from drug use and risk taking.

Family obligation, which implies children's role in the support and assistance of their family, is a fundamental aspect of family life. Family obligation has important implications for the adjustment of adolescents from Mexican backgrounds, relating to lower levels of risky behavior. Risk taking underlies many behavioral and health problems, such as substance use and externalizing behavior that contribute to the public health burden during the adolescent period. Recent advances in developmental neuroscience have identified key neurobiological underpinnings of adolescent risk taking, but there is little understanding of how these neural processes interact with cultural and social processes in order to promote or prevent risk taking. In this chapter, we present a multi-method, longitudinal program of research that uses self reports of risk taking and substance use, experimental tasks, and functional magnetic resonance imaging (fMRI), to examine the mechanisms by which a culturally meaningful type of family relationship – family obligation – buffers Mexican youth from drug use and risk taking.

Risk Taking and Drug Use in Adolescence

Adolescence is a time of heightened propensity for risk-taking, impulsivity, and reckless behavior that often lead to poor decisions such as drug initiation (Arnett, 1992; Chambers et al., 2003; Steinberg, 2008). Adolescent drug use is one of today's most important social concerns as it contributes to a host of serious immediate and long term problems such as risky sexual behavior, incarceration, morbidity and mortality, violent behavior, and high school drop out (Fergusson et al., 2002; Guy, Smith, & Bentler, 1994; Ramirez et al., 2004; Lancot & Smith, 2001; Kann et al., 1998; Ellickson et al., 1998). These consequences are of particular concern during high school, a critical time for drug use initiation and experimentation. By the time youth reach 12th grade, 47% have tried an illicit drug at least once (Johnston et al., 2009).

Challenges associated with immigration, discrimination, and socioeconomic disparities place adolescents from Mexican backgrounds at a greater risk for a variety of adjustment problems including substance use. Compared to other ethnic groups, Latino teenagers begin using drugs at an earlier age, show greater risk for developing drug use disorders in adulthood due to early drug use onset, and have higher overall rates of illicit drug use (Johnston et al., 2009; Ellickson et al., 2004; Gil et al., 2004; Centers for Disease Control, 2005; Vega et al., 1993). In particular, Latinos have the highest rate for the most dangerous drugs, such as heroin, crack, and crystal methamphetamine (Johnston et al., 2009).

Drug use among Latinos is an especially important social concern as Latinos have become the largest ethnic minority group in the United States, comprising 16.3% of the U.S. population, with those from Mexican backgrounds representing 63% of all Latinos in the United States (Ennis, Rios-Vargas, & Albert, 2011). Furthermore, in Los Angeles, California, the site of the current study, Latinos make up 48% of the population, with those from Mexican backgrounds representing 84% of Latinos in Los Angeles (Ennis, Rios-Vargas, & Albert, 2011). Attending to the health of this growing population should be a central concern and seen as an investment in the health of the country (Ojeda et al., 2008). In order to address cultural disparities in substance use, there is great need for systematic research that examines cultural risk and protective factors for Latino youth who come from families that may possess beliefs and values that differ from the norms of American society. Given the higher rate of drug use among Latinos and the serious consequences of drug use, it is imperative to identify culturally relevant factors that can enhance the development of efforts to reduce drug use among this growing population.

Culturally Important Family Relationships

The emphasis upon the role of children and adolescents to support, assist, and take into account the needs and wishes of the family is perhaps the most distinctive aspect of family relationships among families from Mexican backgrounds in the United States. This type of family connection, often called “familism” or “family obligation,” exists within Mexican and other Latin American families (Suárez-Orozco & Suárez-Orozco, 1995). Youth from these families stress the importance of spending time with the family, high family unity, family social support, and interdependence for daily activities (Cuellar et al., 1995; Fuligni, 2001). When families immigrate to the United States, this tradition takes on a very real significance when parents face difficulty finding stable and well-paying employment and are unfamiliar with the norms of American society.

Compared to youth from European backgrounds, youth from Mexican backgrounds spend almost twice as much time helping their family each day, and assist their family 5-6 days per week on average, suggesting that family assistance is a meaningful daily routine for these adolescents (Telzer & Fuligni, 2009). Further, young adults from Mexican backgrounds make financial contributions to their families at higher rates than their peers (Fuligni & Pedersen, 2002), and those from second and third generations continue to maintain a strong sense of family obligation (Fuligni, et al., 1999).

One way to capture the meaning and importance of family obligation is to think of the family as a social identity. Thinking about the family as a social identity captures an aspect of family relationships that is often overlooked. That aspect is a sense of “we-ness” that comes from being a member of a group. Such group membership is experienced through shared values, norms, and beliefs. According to social identity theory, identifying with a social group enhances

one's willingness to support and assist that group and provides a sense of meaning, belonging, and well-being (Hogg, 2003). Indeed, adolescents who internalize the familistic values of their family feel more connected to and embedded within a supportive family network, which can provide them with a sense of support and structure to help them deal with the challenges associated with being a teenager in American society (Hardway & Fuligni, 2006).

The following quotes from teenagers who have participated in our research help to exemplify how family obligation is associated with a sense of connection to the family. A fifteen year-old female adolescent from a Mexican immigrant family said the following:

“Sometimes my mom feels sick or she feels bad. We'll all come and help her, and I'll help her as well to clean the house. And my dad, when he really needs help working I'll, I'll go help him, and, well my family, sometimes they'll need someone to go help and I'll help, I'll go. I guess that just makes me feel more closer to the family.”

This adolescent derives a sense of family cohesion from providing help to her family. Such cohesion can provide adolescents with a sense of connection and support, potentially increasing their willingness to talk to and share their experiences with their family. For example, a fifteen-year-old female from a Mexican-American family said the following about her father:

“He loves to be in the kitchen. And, that's how I help him out. I'm washing dishes before he starts cooking, he loves cooking in a clean kitchen. And I know that. So I'll go in and, like, start washing dishes. So, that's usually how we, like, we come together and just start talking.”

By helping her father in the kitchen, this adolescent feels closer to her father and finds the time and space to talk to him. Thus, adolescents with greater family obligation values may feel stronger attachments to their family and use their family as a source of support and guidance (German, et al., 2009) more willingly sharing their daily experiences with them (Yau et al., 2009). Such disclosure may open up family discussions about appropriate behavior and strategies

for dealing with peer pressure. Parents can provide advice and support, helping their child develop coping strategies to avoid risky behavior.

Family Obligation and Adolescent Risk Taking

Family obligation values may be a cultural resource, protecting youth from substance use. To test this association, we examined the links between family obligation and substance use among 385 Mexican-origin adolescents in the 9th and 10th grades. Adolescents completed several self-report measures, including the Youth Risk Behavior Survey Questionnaire, a common measure of substance use that has been shown to be valid and reliable for Latino youth (Kerr, Beck, Shattuck, Kattar, & Uriburu, 2003; Centers for Disease Control and Prevention, 1989). Youth indicated the frequency with which they used substances in the past 30 days, including cigarettes, alcohol, marijuana, prescription drugs without a doctor's prescription, cocaine, crystal meth, and heroin. Youth also completed the family obligation values scale (Fuligni, Tseng, & Lam, 1999) indicating how often they felt they should assist with household tasks, spend time with their family, and consider their families' needs and wishes when making important decisions.

Our findings demonstrated the protective role of family obligation, such that Mexican-origin youth with higher family obligation values had lower rates of substance use, including lower cigarette, alcohol, marijuana, and cocaine/methamphetamine use (see Figure 1; Telzer, Gonzales, & Fuligni, 2013). Although some prior research has highlighted the protective role that family obligation values play for adolescents' health risk behaviors (e.g., German, et al., 2009; Gil, et al., 2000; Kaplan, et al., 2001; Ramirez, et al., 2004; Romero & Ruiz, 2007; Unger, et al., 2002), we know little about the mechanisms by which it is protective. We therefore examined potential mediators to explain the protective role of family obligation. We found that

family obligation values were associated with lower levels of substance use because adolescents were less likely to associate with deviant peers and were more likely to disclose their activities to their parents. Deviant peer association and adolescent disclosure accounted for 37-100% of the original effect of family obligation values on substance use. Our findings suggest that Mexican adolescents' decisions to engage in substance use may depend upon their cultural values; adolescents with stronger family obligation values engage in less substance use behavior because they are avoiding deviant peers and are opening up to their parents more.

[Figure 1 here]

These findings suggest that family obligation may reduce risky behavior in several ways. First, youth with stronger family obligation values may develop better decision making skills. By putting their families' needs first and delaying personal gratification for the families' sake, these youth may develop more effective cognitive control, a skill necessary for avoiding deviant peers and health compromising behaviors. Secondly, family obligation may make risk taking comparatively less rewarding. Youth with stronger family obligation values report more negative consequences for engaging in risk taking, as it would reflect poorly upon their whole family (German, et al., 2009). Therefore, risk taking itself may be less salient and enticing. To test these potential explanations, we turned to fMRI to better understand the underlying neural mechanisms of family obligation and risk taking behavior.

The Neurobiology of Risk Taking during Adolescence

Evidence from developmental neuroscience suggests that risk taking behavior increases during adolescence partly due to changes in the brain's neural circuitry (Casey et al., 2011; Steinberg, 2008). Subcortical regions, which comprise neural regions associated with the evaluation of rewards (e.g., amygdala and ventral striatum (VS)), mature functionally relatively

early, leading to increased reward sensitivity during adolescence. In contrast, cortical regions, which comprise neural regions involved in higher order cognition and impulse control (e.g., ventral and dorsal lateral prefrontal cortices (VLPFC, DLPFC)), gradually mature over adolescence and into adulthood. The relative imbalance in the functional use of these systems (see Figure 2a) is thought to leave the adolescent more vulnerable to take risks and less able to modulate social and emotional decisions (Casey et al., 2011; Steinberg, 2008). Immature cognitive control development relative to the reward system may hinder appropriate evaluation of risk and bias youth towards risky decisions.

Although risk taking can lead to problems, it can also be an adaptive and beneficial behavior, supporting the propensity for learning new skills. Risk taking may support the evolutionarily-adaptive, goal-directed behavior which begins to emerge during adolescence (Spear, 2000; Crone & Dahl, 2012). Indeed, prior work has demonstrated the adaptive role of risky behavior (e.g., Humphreys et al., 2013) with higher levels of risky, exploratory behavior associated with more mature white matter integrity in frontal-limbic circuitry in adolescence (Goldenberg, Telzer, Fuligni, Lieberman, & Galvan, submitted). Some aspects of risk taking may therefore be positive behaviors that lead to learning and benefits to youths' development. Nonetheless, when occurring within a health-compromising context, such as drug use, risky sexual behavior, or reckless driving, adolescent risk taking can be problematic.

The dual systems model of neurobiological development offers a promising way to view the maturational underpinnings of risk taking during the teenage years. Yet, risk taking does not occur in a social or cultural vacuum, and it is critical to examine how neural mechanisms interact with fundamental social and cultural processes during adolescence. We tested the hypothesis that this normative functional imbalance between cognitive and affective systems is reduced in youth

with high family obligation values. If indeed family obligation is helping adolescents to make better decisions by engaging in more cognitive control and reducing the salience of risks, we predicted that it may be functioning by reducing the neural imbalance during adolescence by increasing cognitive control and reducing reward sensitivity (see Figure 2b).

[Figure 2 here]

Testing the Hypothesized Model of Family Obligation and Risk Taking

Our goal was to examine the links between family obligation, neural activation, and adolescents' risk taking behaviors (Figure 3). By examining each of these links (cultural values → brain; brain → risk taking behavior), we can gain a deeper understanding of how family obligation is processed in the developing brain and how these neural activations are associated with relevant behavioral changes. To test this, we examined:

- (1) whether family obligation was associated with activation in neural regions involved in reward processing and whether this reward activation was associated with reduced risk taking behavior
- (2) whether family obligation was associated with reduced reward sensitivity during risk taking and whether this reduced reward activation was associated with reduced risk taking behavior
- (3) whether family obligation was associated with increased activation in the PFC during cognitive control and whether this heightened cognitive control activation was associated with reduced risk taking behavior.

[Figure 3 here]

Family Obligation and Reward Activation. We created a family obligation task modeled after the work of Moll and colleagues on charitable giving (Moll et al., 2006). During a

functional brain scan, 40 Mexican-origin adolescents were presented with a series of financial offers that varied in terms of whether they represented gains or losses for the participants and their families. Noncostly-Reward trials gave participants the option to earn money without a cost to the family (e.g., YOU +\$3.00 FAM -\$0.00) whereas Costly-Donation trials gave participants the option to give money to their family at a cost to themselves (e.g., YOU -\$1.00 FAM +\$3.00). Participants and their families were paid in cash according to their choices on the task. We examined brain activation during the Costly-Donation and Noncostly-Reward trials, which allowed us to focus on neural activation when making a donation to the family that involves self-sacrifice, a behavior that most closely approximates family obligation behaviors. Costly-Donation trials were contrasted to pure cash gains for oneself, which have been shown to be a hedonistically rewarding experience that is associated with activation in the ventral striatum (Moll, et al., 2006).

Consistent with our previous work (e.g., Telzer et al., 2010; Telzer et al., 2011), we found that costly donation decisions to the family engaged the reward network. Although the ventral striatum was significantly active during both costly donation and noncostly reward decisions, decisions to contribute to the family engaged the ventral striatum more so than did personal noncostly reward decisions (Figure 4a). However, the extent of this activation varied depending on youth's family obligation values, showing that those with the strongest values had the greatest ventral striatum activation during costly donations towards their family (Figure 4b). These findings suggest that among Mexican youth who strongly value family obligation, decisions to make sacrifices for the family are meaningful, rewarding decisions. Thus, family relationships that are culturally meaningful provide adolescents with a sense of reward, and this reward may be protective and lead to positive, healthy outcomes.

To examine whether the rewarding nature of family obligation relates to youths' health risk behaviors, 32 of these adolescents were followed for one year after the scan session. Adolescents completed the Rule-Breaking subscale of the Youth Self-Report form of the Child Behavior Checklist (Achenbach, 1991). At the time of the scan and one year later, adolescents indicated whether they engaged in a range of risky behaviors, such as associating with deviant peers, lying, stealing, drinking alcohol without parental approval, using drugs, and skipping school. Results indicated that increased neural response in the ventral striatum during costly donations compared to noncostly reward trials was significantly associated with longitudinal decreases in risky behaviors (see Figure 4c; Telzer et al., 2013a). The more striatum activation youth showed when providing assistance to their family the more their risk taking behaviors decreased over the high school years. These data suggest that the meaningful and rewarding nature of family obligation is protective for Mexican-origin youth.

[Figure 4 here]

Family Obligation and Neural Sensitivity to Risk Taking. To test how family obligation relates to reward activation during risk taking, we scanned 48 Mexican-origin adolescents as they engaged in a risk taking task, the Balloon Analogue Risk Task (BART; Lejuez et al., 2002). On each trial of the task, participants are shown a virtual red-colored balloon and given the option to inflate the balloon, which can either grow larger or explode. The larger the balloon is inflated, the greater the monetary reward but the higher the probability of explosion. Participants press one of two buttons to either inflate (pump) the balloon or to “cash-out.” Importantly, the probability of risk on each trial is unknown, much like risk taking in the real world. Participants received a payoff (25 cents) for each pump on which the balloon was successfully inflated and could stop inflating the balloon at any point and keep the accumulated

payoff. If the balloon exploded, the participant received no payoff for that trial, but earnings from previous trials were unaffected.

We examined how family obligation values were associated with risk taking and neural activation during the BART. Behaviorally, adolescents with greater family obligation values had lower mean pumps ($\beta = -.31, p < .05$; Telzer et al., 2013b). In other words, adolescents who placed greater value on helping and supporting their family pumped the balloons less, an index of less risky behavior. At the neural level, family obligation values were negatively correlated with activation in the bilateral ventral striatum during cash-out trials (see Figure 5a). Thus, adolescents with the strongest family obligation values demonstrated the lowest levels of ventral striatum activation during the acquisition of rewards.

To demonstrate that this reduced striatum sensitivity is protective, we examined how ventral striatum activation relates to health-compromising risk taking behavior. Adolescents completed a modified version of the Adolescent Risk Taking Scale (Alexander et al., 1990), which measures the frequency of engaging in risky behavior, including stealing or shoplifting, driving in a car without wearing a seatbelt, and having sex without using protection. As predicted, we found that decreased ventral striatum activation was associated with less risk taking behavior (Figure 5b; Telzer et al., 2013b). These findings suggest that adolescents who value family obligation more show reduced reward sensitivity during risk taking, and this reduced reward sensitivity predicts lower rates of health-compromising risk taking in youths' daily lives.

[Figure 5 here]

Family Obligation, Cognitive Control, and the Brain. We next sought to examine whether family obligation was associated with increased cognitive control. The same 48-

Mexican adolescents described above completed a standard cognitive control task, the Go-NoGo (GNG). Participants were presented with a series of rapid trials (1 second each), each displaying a single letter, and were instructed to respond with a button press as quickly as possible to all letters except for X. The X occurred on 25% of trials. Thus, participants develop a pre-potent response to press (go) upon stimulus onset, and must inhibit the go response on X trials (no-go). Response inhibition was operationalized as successful no-go trials (i.e., overriding the pre-potent “go” response) compared to go trials. We found that higher family obligation values were positively correlated with activation in the left dorsolateral prefrontal cortex (DLPFC), a brain region involved in cognitive control (Figure 6a). In other words, adolescents with the strongest family obligation values demonstrated the highest levels of DLPFC activation during behavioral inhibition. Thus, greater family obligation values may relate to a more mature use of the cognitive control system; these adolescents may be more motivated to engage in self control.

To demonstrate that this heightened DLPFC activation is protective, we examined how DLPFC activation relates to adolescents’ self reported decision making skills. Adolescents completed the Flinders Adolescent Decision Making Questionnaire (Mann et al., 1989) which measures decision making vigilance (e.g., “I take a lot of care before I make my choice” and “I like to think about a decision before I make it”) and decision making avoidance (e.g., “I avoid making decisions” and “I put off making decisions”). As we predicted, higher DLPFC activation was associated with better decision making skills (Figure 6b; Telzer et al., 2013b). Together, these findings suggest that family obligation may reduce risk taking by decreasing the neural imbalance during adolescence, helping adolescents better able to regulate emotional decisions and impulses.

[Figure 6 here]

Family Obligation as a Unique Cultural Resource. Next, we examined whether adolescents' reports of family cohesion show similar patterns as those found for family obligation values. We ran the same analyses as those described above, this time correlating family cohesion and support with brain activation during risk taking and cognitive control. Interestingly, family cohesion did not correlate with activation during the BART or the Go-Nogo task. Importantly, family obligation continued to predict neural activation above and beyond the effects of family cohesion. Therefore, family obligation represents a unique aspect of family relationships, suggesting that it is not necessarily about being close to one's family or feeling support from them. Rather, these findings suggest that it is more about engaging in a meaningful, culturally-important family relationship that is protective and relates to reduced sensitivity to rewards and increased cognitive control.

Do the Rewards of Family Obligation Offset the Rewards of Risk Taking? In our final set of analyses, we sought to examine whether the rewarding and meaningful nature of family obligation offsets the rewards of risky behavior. We correlated ventral striatum activation during the family assistance task with ventral striatum activation during the risk taking task. As shown in Figure 7, adolescents who demonstrated heightened ventral striatum activation during the family task showed dampened activation in the same brain region during the risk taking task. These findings suggest that the meaningful and rewarding nature of family obligation may make risk taking comparatively less rewarding. In addition, we correlated ventral striatum activation during the family task with DLPFC activation during the cognitive control task. Greater ventral striatum activation was associated with greater DLPFC activation, corroborating that the rewarding and meaningful nature of family obligation is associated with increased cognitive control-related neural activation.

[Figure 7 here]

Putting All the Pieces Together

Previous reports have shown that increased family obligation values are associated with decreased risk taking (e.g., German et al., 2009; Gil et al., 2000; Kaplan et al., 2001; Ramirez & de la Cruz, 2003), but the neural mechanism underlying this relationship remained elusive. Placing all of our findings within our framework (Figure 3), we found that (1) family obligation is related to lower levels of substance use; (2) family obligation is associated with increased ventral striatum activation during a family donation task, highlighting the meaningful and rewarding nature of the activity; (3) family obligation is also associated with lower ventral striatum sensitivity during a risk taking task and increased cognitive control-related brain function during a cognitive control task, suggesting that reward sensitivity and self-control may be altered by adolescents' motivation to avoid risk taking; (4) ventral striatum activation during the family donation task predicted lower levels of ventral striatum activation during the risk taking task and greater DLPFC activation during the cognitive control task; and (5) all these neural activation predict lower levels of risk taking behavior (see Figure 8).

[Figure 8 here]

Together, our findings suggest that family obligation is a rewarding and meaningful family relationship that is unique from other types of close family relations (e.g., cohesion). The culturally meaningful nature of family obligation may provide adolescents with the motivation to avoid health-compromising risks. Such motivation is manifested in reduced reward sensitivity to risk taking and increased cognitive control, thereby reducing the neural imbalance that is thought to underlie adolescent risk taking. This framework and interpretation is nicely depicted by the

following quote from a 15-year-old adolescent from a Mexican immigrant family who is talking about her family:

“Because they did a lot for me, like, they’ve given me this, that, and just like, I don’t know. I guess just, get grades for them. Like make them proud. Um, get good grades, no drugs, no gangs, um, just being, mellow. Well not mellow, but like just staying out of trouble.”

As this adolescent nicely explains, her parents have made significant sacrifices for her. To pay them back for doing so much for her, she is actively trying to stay out of trouble. She is motivated to avoid risks for the sake of her family.

Implications for Closing the Gap in Population Health Disparities

Family Obligation, Risk-taking, and Mental Health. Results of our work have significant implications for reducing risk taking among adolescents. Our findings indicate that family obligation is a unique aspect of family relationships that reduces risk taking above and beyond the effects of more general family cohesion. Therefore, family obligation is an important type of family connection that may provide a larger sense of purpose and meaning, in that adolescents have responsibilities to others. Thus, family relationships that foster self-regulatory skills and an avoidance of behaviors that could have negative consequences may be particularly protective against adolescent risk taking. These findings suggest that interventions designed to increase family cohesion and support may not have lasting effects on adolescent risk taking. Instead, interventions should be designed to target relationships that allow adolescents to practice self control, to put the needs of others before their own, and to increase the perception that their behaviors can impact others in negative ways.

Secondly, family obligation is a meaningful and rewarding activity for adolescents, and the extent of this reward is associated with reduced risk taking over the high school years.

Adolescents who showed greater ventral striatum activation when providing assistance to their family showed longitudinal declines in risk taking. The meaningful nature of family obligation is perhaps the most distinctive aspect of this type of family relationship. Indeed, in our prior work, we have found that adolescents who help their family feel that they are fulfilling important roles within their family and this relates to higher levels of happiness (Telzer & Fuligni, 2009). Thus, the meaning attained from this activity appears to be particularly protective. These findings are consistent with work highlighting how eudaimonic well-being is adaptive and relates to long-term well-being. Eudaimonic behaviors, such as family obligation, are thought to be intrinsically meaningful, inherently good for the individual, and congruent with ones personal values, therefore leading to long-term well-being (Steger et al., 2008). Thus, adolescents with high levels of eudaimonic rewards may develop long lasting psychological and social resources, leading to more resilience and better well-being. These findings suggest that interventions should direct adolescents towards meaningful activities. If adolescents engage in behaviors that are personally meaningful and rewarding, they may be less inclined to engage in risk taking.

The Rewards versus Burdens of Family Obligation. Although family obligation is a rewarding and meaningful aspect of family relationships, it is not always a protective factor. For instance, family obligation behaviors (i.e., providing support and assistance to ones family by helping around the house, taking care of siblings, running errands) within high conflict homes are related to heightened substance use (Telzer, Gonzales, & Fuligni, 2013). Moreover, we have found that family obligation values are experienced as demanding (Telzer & Fuligni, 2009), relate to declines in the academic performance of Mexican American youth (Telzer & Fuligni, 2009b), and put a toll on adolescents' physical health (Fuligni, Telzer, et al., 2009). Thus, family obligation may be stressful for some adolescents due to the burden of taking on extensive

household tasks in the face of competing demands such as socializing with friends and studying for school. The stress associated with family obligation can be significant because adolescence is a developmental period during which individuals may be particularly reactive to stressors (Romeo & McEwen, 2006; Gunnar, et al., 2009; Romeo et al., 2007). Therefore, family obligation values can be protective, but the translation of these values into actual behaviors can be burdensome. Interventionists, teachers, and clinicians should be aware of the important role that family assistance behaviors may play in adolescents' daily lives.

Cultural Context of Adolescent Decision Making. Dual systems models of adolescent development suggest that adolescents are predisposed towards risk taking due to an imbalance between the early maturation of limbic motivational and emotional systems, and a slower or later maturation of prefrontal cortical control (Casey et al., 2011; Steinberg, 2008). The dual systems model has offered promising ways to understand the development of risk taking during adolescence, but we know little about how social processes interact with these neural processes to impact risk taking (Crone & Dahl, 2012; Pfeifer & Allen, 2012). Results from the studies presented in this chapter provide evidence of the complexity of adolescent brain-behavior relationships and provide new ways to understand neural processes underlying adolescent risk taking.

Not all adolescents engage in maladaptive, health compromising risky behavior. Although risk taking may represent a normative developmental experience, there are significant individual differences in the severity of this risk taking. Some adolescents actively seek out thrilling experiences and engage in deviant behaviors whereas other adolescents avoid behaviors that can have negative consequences. Some adolescents experiment with and become addicted to drugs, whereas other adolescents choose to avoid substance use. A normative, one-size fits all

neural imbalance during adolescence cannot explain these individual differences in adolescent risk taking. The extent of the neural imbalance present during adolescence may vary across individuals depending upon the cultural context of decision making. Reward sensitivity may be high under some contexts for some adolescents (e.g., for youth high in family obligation values when engaging in family-oriented behaviors) but low during other contexts (e.g., for youth high in family obligation values when engaging in risk behavior).

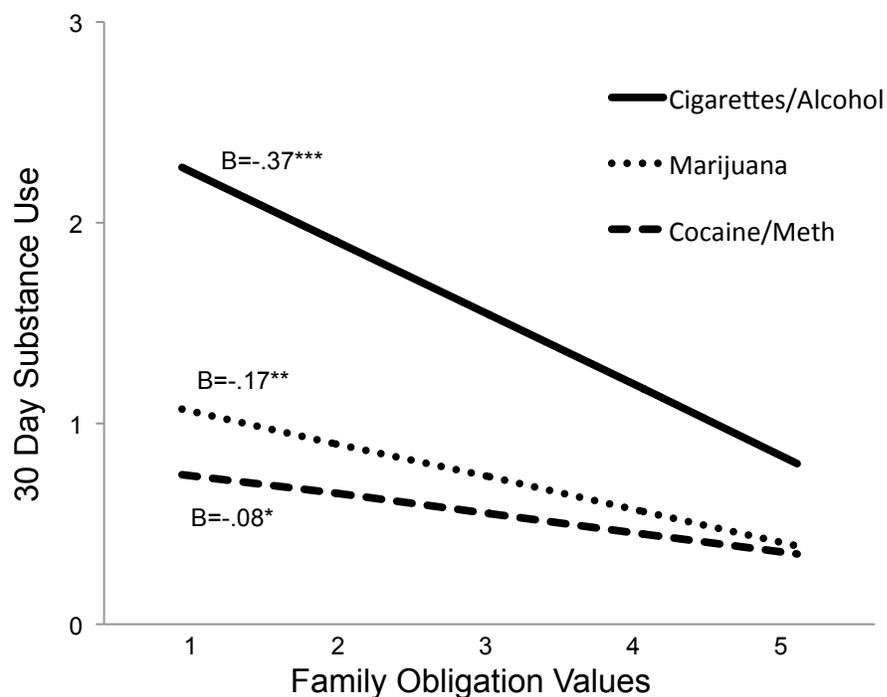
Together, the results of these studies suggest that the functional maturation of brain regions involved in reward and cognitive control can be altered by cultural experiences. By engaging in meaningful family relationships that provide adolescents the opportunity to practice self-control and place their family's values and needs before their own, adolescents may show maturation in functional brain development. However, given that these data do not examine brain function across time, it is also possible that adolescents whose brains differ in meaningful ways have developed stronger family obligation values as a function of that brain maturity.

Conclusions

Families from Latin American backgrounds represent the largest ethnic minority group in the United States, and adolescents within these families face substantial challenges to their behavioral adjustment. Results of our work indicate that traditional family values and practices play a critical role in shaping Mexican adolescents' risk for substance use and risk taking behaviors. We examined an aspect of family life that is culturally relevant to Mexican families. By using cultural neuroscience techniques, we were able to identify a cultural resource, highlighting the underlying neural mechanisms by which family obligation is protective. Importantly, family obligation is a fundamental aspect of family life among adolescents from Mexican backgrounds, is a meaningful and rewarding behavior, and thus has important

implications for risk taking and substance use. Mexican adolescents' decisions to engage in risk taking appear to depend, in part, upon their cultural values.

Figure 1. Higher family obligation values relate to lower levels of cigarette/alcohol, marijuana, and cocaine/methamphetamine use.



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

Note. For Alcohol/Cigarettes, the y-axis ranges from 0-6, where 0=0 days to 6=all 30 days in past month
 For Marijuana, the y-axis ranges from 0-5 where 0=0 times to 6=100 or more times in past month
 For Other Illicit/Prescription, the y-axis ranges from 0-5, where 0=0times to 5=40 or more times in past month

Figure 2 (a). Dual Systems Model of Adolescence (adapted from Casey et al., 2011). Neurobiological model depicting relatively earlier development of subcortical limbic regions (e.g. ventral striatum) relative to the protracted development of cognitive control regions (e.g., dorsolateral PFC). This neural imbalance in development is suggested to underlie risky decision-making behavior during adolescence. Note. The period of adolescence is depicted with a gray box. (b). Reducing the Neural Imbalance in Adolescence. Family obligation is predicted to relate to reductions in reward sensitivity and to increases in cognitive control during adolescence.

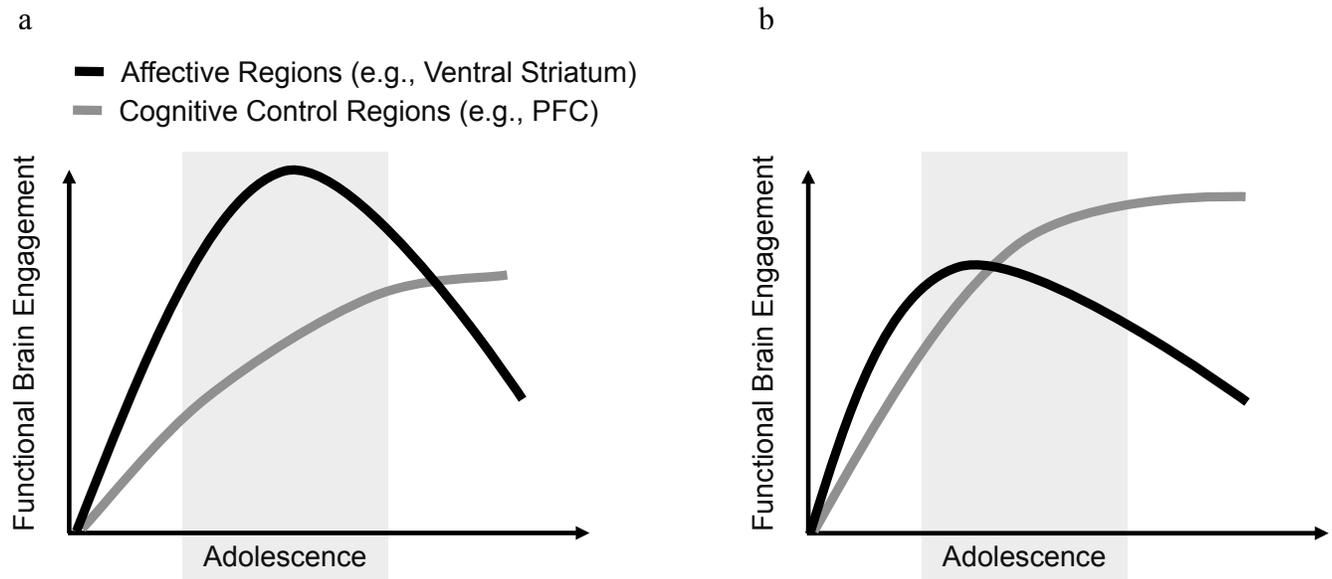


Figure 3. Research strategy for testing the neural mechanisms that may underlie the association between cultural resources (e.g., culturally important family relationships) and adolescent behavior.

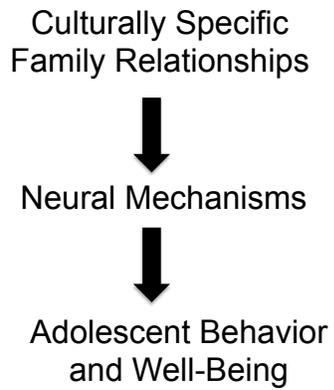


Figure 4. (a) Ventral striatum (VS) activation during the family task. VS activation is greater to costly donation decisions than to noncostly reward decisions. (b) Greater family obligation values are associated with increased VS activation when contributing to the family compared to gaining personal monetary rewards (c) Adolescents who show greater VS activation to costly donation decisions demonstrate longitudinal decreases in risk taking behavior. *Note.* Each axis title “Ventral Striatum Activation” represents percent BOLD signal change in the ventral striatum to Costly Donations > Noncostly Rewards.

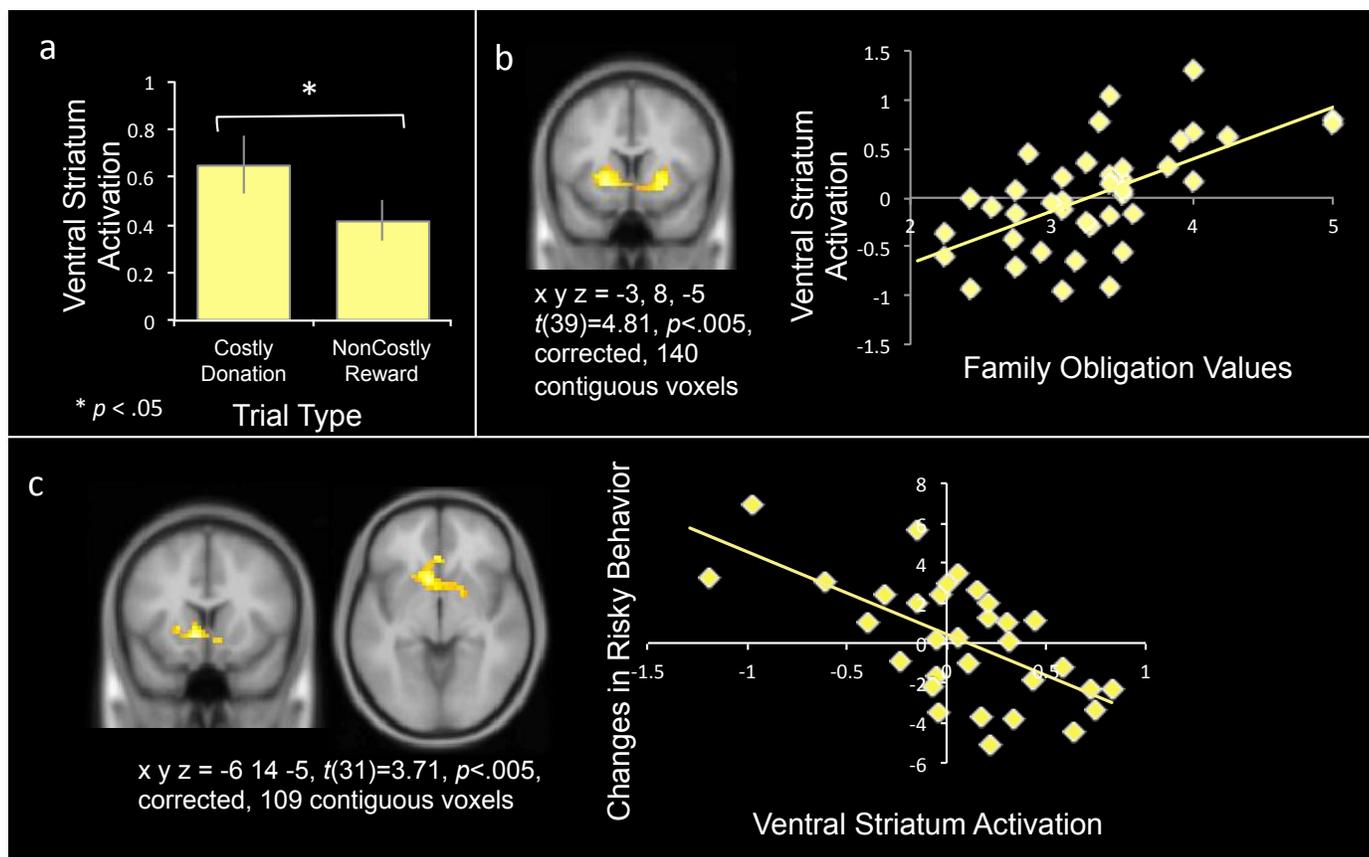


Figure 5. (a) Ventral striatum activation correlated negatively with family obligation values during Cash Outs on the BART (b) Lower ventral striatum activation was associated with lower levels of risk taking behavior.

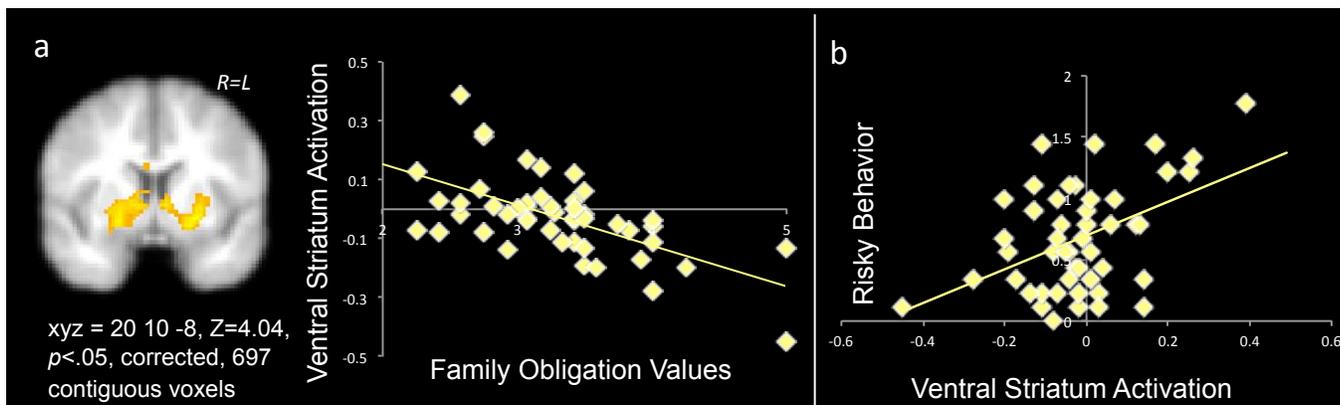


Figure 6. (a) Family obligation values correlated with increased DLPFC activation during cognitive control (Nogo>Go trials). (b) Greater DLPFC activation was associated with better self-reported decision making skills.

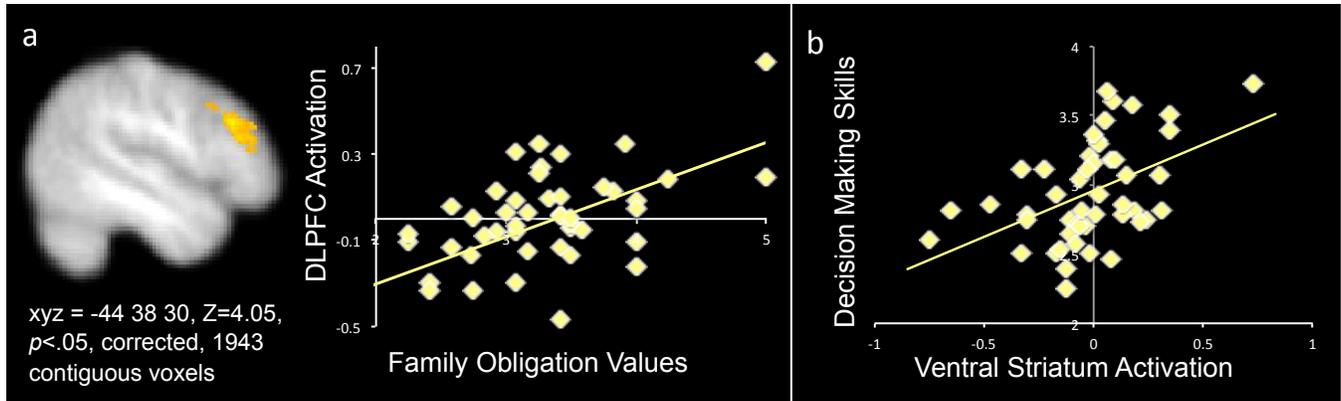


Figure 7. Ventral striatum activation during the family assistance task is associated with reduced ventral striatum activation during the risk taking task (upper plot) and increased DLPFC activation during cognitive control (lower plot).

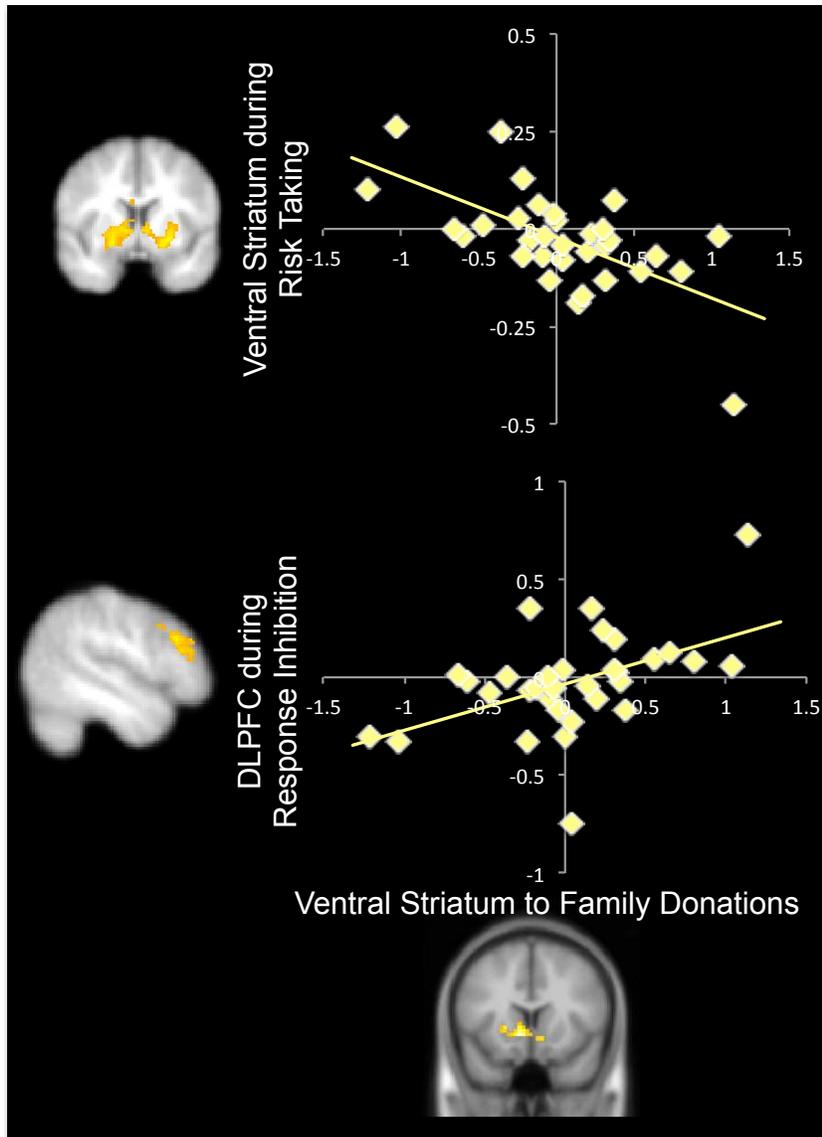
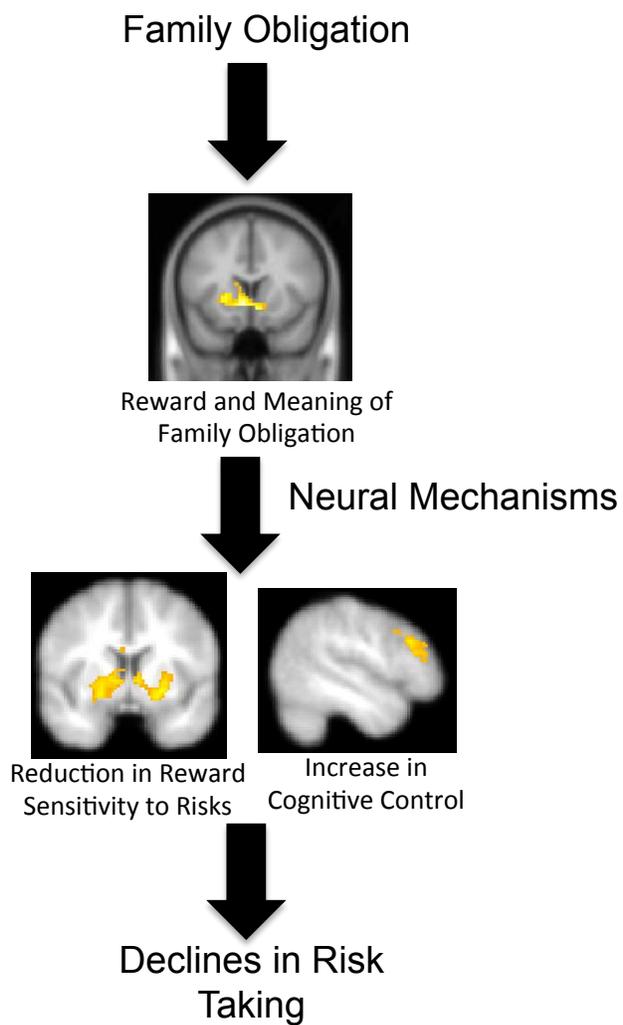


Figure 8.



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