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Gaining while giving: An fMRI study of the rewards of family assistance among White and Latino youth

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Family assistance is an important aspect of family relationships for adolescents across many cultures and contexts. Motivations to help family members may be driven by both cultural factors and early family experiences. Here, we used functional magnetic resonance imaging to examine (1) cultural differences in neural reward activity among White and Latino youth during online experiences of family assistance and (2) how prior family experiences related to neural reward activity when helping the family. Participants were scanned as they made decisions to contribute money to their family and themselves. Latino and White participants showed similar behavioral levels of helping but distinct patterns of neural activity within the mesolimbic reward system. Whereas Latino participants showed more reward activity when contributing to their family, White participants showed more reward activity when gaining cash for themselves. In addition, participants who felt more identified with their family and who derived greater fulfillment from helping their family two years prior to the scan showed increased reward system activation when contributing to their family. These results suggest that family assistance may be guided, in part, by the personal rewards one attains from that assistance, and that this sense of reward may be modulated by cultural influences and prior family experiences.

Keywords: Family assistance; Culture; fMRI; Reward; Social identity.

INTRODUCTION

Helping family members is an important and common aspect of family relationships that youth engage in across many cultures and contexts by caring for siblings, doing household chores, and providing financial assistance (Fuligni & Pedersen, 2002; Telzer & Fuligni, 2009a). During the transition to young adulthood, youth begin to place heightened value on family assistance (Fuligni & Pedersen, 2002). Although family assistance provides individuals with a sense of meaning, fulfillment, and connection to the family, it also may require youth to sacrifice their time, money, educational or career goals, or social relationships, thereby forcing them to consider the relative value of

helping their family (Fuligni, Yip, & Tseng, 2002; Suárez-Orozco & Suárez-Orozco, 1995; Telzer & Fuligni, 2009b). While altruistic behaviors may come at a cost to oneself, individuals may nonetheless help others because they gain a sense of personal and social reward from helping (Dunn, Aknin, & Norton, 2008; Fehr, Bernhard, & Rockenbach, 2008; Homans, 1958; Izuma, Saito, & Sadato, 2009; Weiss, Buchana, Altstatt, & Lombardo, 1971). Indeed, recent neuroimaging research has shown that altruistic behaviors, including giving to others, may be guided by feelings of reward (Harbaugh, Mayr, & Burghart, 2007; Izuma et al., 2009; Moll et al., 2006), and behavioral work has shown that youth gain a sense of happiness from taking care of their kin (Telzer & Fuligni, 2009a).

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Thus, the sacrifices associated with family assistance may be offset by the rewards one gains from helping the family. Given that the sense of reward individuals attain from helping their family may be driven by both cultural factors and early family experiences, the current study used functional magnetic resonance imaging (fMRI) to examine (1) cultural differences in neural reward activity during online experiences of family assistance and (2) how prior family experiences related to neural reward activity when helping the family.

The transition from adolescence to young adulthood marks an important developmental period when youth strive for autonomy and exploration. Coupled with their increased autonomy, young adults may gain an awareness of their social obligations (Arnett, 1998) and begin to explore the ways in which they can help their family. Indeed, a sense of family obligation increases during this time period, reaching levels higher than those in the adolescent years (Fuligni & Pedersen, 2002). In addition, youth transitioning into adulthood begin to help their family by providing financial support (Fuligni & Pedersen, 2002), something they may not have been able to do earlier in adolescence. Thus, the transition to young adulthood is an important developmental period when family relationships change, youth begin to place greater value on helping their family, and youth gain the independence and ability to provide substantial financial support.

Decisions to help the family are often driven by social and cultural factors (Bergstrom, 1996), with variations in assistance behaviors and values across cultural groups. For instance, youth from Latin American backgrounds place heightened value on helping their family, spend more time assisting their family, and are more likely to contribute financially to their family than are youth from European backgrounds (Fuligni & Pedersen, 2002; Hardway & Fuligni, 2006), suggesting that such behaviors are socially and culturally driven. Although Latino youth may help their family due to a sense of obligation (Suárez-Orozco & Suárez-Orozco, 1995), another possibility is that youth from these backgrounds actually value altruistic behaviors toward family members to such a degree that helping one's family may be *more* rewarding than is a personal gain. Thus, altruistic behavior towards family members may be guided by cultural differences in the reward one attains from helping.

In addition, early family experiences, through which youth acquire an understanding of the goals and values of their family, may affect how family assistance is experienced by youth. For example, social identification leads to the internalization of group values (Fuligni & Flook, 2005). Family membership serves as an important social identity for adolescents,

and youth who feel like valued members of their family are more likely to provide support to their family and gain a sense of wellbeing from that assistance (Hogg, 2003). Particularly during a developmental transition characterized by increased autonomy, youth who feel that their family is important to their sense of self may internalize the value of family assistance and, over time, may derive more reward when assisting their family. Further, the daily lives and routines of children reinforce the cultural values and goals of their family (Weisner, Matheson, Coots, & Bernheimer, 2005). Whether adolescents find helping the family to be an enjoyable and meaningful activity will likely affect how family assistance is experienced. For example, adolescents who assist their family and feel that they are fulfilling important roles within their family, such as that of a good son or daughter, have more positive psychological and physical well-being (Fuligni et al., 2009; Telzer & Fuligni, 2009b). Thus, rather than placing a burden on youth, family assistance may provide them with a sense of fulfillment and purpose and give meaning to their daily activities. This sense of meaning and fulfillment may be internalized by youth, reinforcing the cultural value of family support, and making family assistance a more rewarding activity over time.

In the current study, we used fMRI in order to examine neural responses during online experiences of family assistance. Because social sacrifices (e.g., time and money) may be offset by the experience of reward, we examined whether family assistance decisions were associated with reward system processes. Providing financial assistance is a key type of family assistance during late adolescence (Fuligni & Pedersen, 2002). Therefore, we examined whether decisions to provide monetary contributions to one's family recruited the mesolimbic reward system, brain regions consistently linked with the rewarding experience of helping others (Harbaugh et al., 2007; Izuma et al., 2009; Moll et al., 2006). For example, Moll and colleagues (2006) found that decisions to donate to charities recruited the ventral and dorsal striatum and ventral tegmental area. Similarly, Harbaugh and colleagues (2007) found that both mandatory and voluntary contributions to charities recruited the ventral and dorsal striatum. Finally, Izuma and colleagues (2009) reported that ventral striatum activity to charitable donations increased in the presence of others, suggesting that this region may be particularly sensitive to social rewards. Together, these findings suggest that the mesolimbic reward system, including the ventral and dorsal striatum and ventral tegmental area, may be involved in the rewards associated with helping and donating to others.

Given the cultural emphasis placed on family assistance among Latin American cultures, we examined whether Latino youth would show more reward system activation than White youth when assisting their family. If such decisions were driven only by feelings of obligation, we would not expect to see neural evidence of reward processing. In addition, to better understand the internalization and experience of family assistance across an important developmental stage, we examined the implications of earlier family experiences for reward system processing at the time of the scan. Specifically, we examined whether identification with the family and a sense of fulfillment from one's daily family assistance during the 12th grade would be associated with reward system activation when assisting the family two years later. During this developmental phase, youth are transitioning from secondary school to college or the workforce, and family relationships are often renegotiated (Arnett, 1998). Thus, the quality of family experiences during high school may play an important role in how family assistance is experienced as youth transition into young adulthood.

METHODS

Participants

In total, 28 participants completed the study. Two participants were excluded from the analyses due to movement (>2.5 mm) during the scan, and one participant was excluded due to a failure to provide sufficient data during the family assistance task (participant rejected or did not respond to 68% of trials). Our final sample included 14 Latino (7 female) and 11 White (6 female) participants (mean age = 17.7, $SD = .42$). At the time of the scan, one half of the Latino ($N = 7$) and White ($N = 5$) participants were living with their family, and nearly all participants were attending a 2- or 4-year college (Latino: $N = 11$, White: $N = 10$). All participants spoke and read English fluently. Participants completed written consent in accordance with UCLA's Institutional Review Board.

Procedures

During the spring of their 12th grade year, participants filled out a questionnaire and completed a daily diary each night for two weeks. The ability of the daily diary method to provide insights into adolescents' daily family assistance behaviors and feelings

of fulfillment made it a useful and unique method for answering the questions in this study. This method is less susceptible to recall biases and captures the daily lives of individuals (Bolger, Davis, & Rafaeli, 2003). The diary checklists were three pages long and took 5–10 min to complete each night. To monitor completion of the diary checklists, participants were given 14 manila envelopes and an electronic time stamper. The time stamper is a small, hand-held device that imprints the current date and time and is programmed with a security code so that the correct date and time cannot be altered. Participants were instructed to place their completed diary checklist into a sealed envelope each night and to stamp the seal of the envelope with the time stamper. At the end of the 2 week period, participants returned the materials to the school and received \$30 for participating. In addition, participants were told that they would receive two movie passes if inspection of the data indicated that they had completed the diaries correctly and on time. Two years later, during the spring and summer, participants came to UCLA to complete the fMRI portion of the study in which they completed a family assistance task. Participants were compensated with up to \$100 for themselves and up to \$100 for their family, depending on their responses during the task.

Behavioral measures

Family identity

To examine how family connection is associated with reward system activation while assisting one's family, we examined participants' self-reported family identity from 2 years prior to the scan. As part of the questionnaire in the 12th grade, participants completed a family identity measure (Hardway & Fuligni, 2006) in which they used a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree) to indicate whether their family was an important aspect of their identity: "My family is important to the way I think of myself as a person," "I feel a sense that I personally belong in my family," and "I do not feel like an important part of my family" (reverse scored). Family identity was used as a regressor in some of the fMRI analyses.

Family assistance fulfillment

To examine participants' sense of fulfillment from their family assistance, we assessed the daily association between family assistance and feelings of happiness and role fulfillment from 2 years prior to the

scan. As part of the daily diary in the 12th grade, participants completed three measures each evening for 2 weeks assessing their daily family assistance, feelings of happiness, and feelings of role fulfillment. For family assistance, adolescents indicated whether they had engaged in any of the following eight activities: helped clean the apartment or house, took care of siblings, ran an errand for the family, helped siblings with their schoolwork, helped parents with official business (for example translating letters, completing government forms), helped to cook a meal for the family, helped parents at their work, and other. In addition, adolescents used a five-point scale (1 = “not at all” to 5 = “extremely”) to indicate the extent to which they felt happy (items: “joyful,” “happy,” “calm”). Finally, participants reported their feelings of fulfilling their role as a good family member using a seven-point scale (1 = “not at all” to 7 = “extremely”) to response to the following two questions: “How much did you feel like each of the following today?” (good son/daughter and good sister/brother). Adolescents’ sense of role fulfillment was averaged across the two items each day.

From these three measures, we examined the daily association between family assistance and feelings of fulfillment. That is, on days when adolescents helped their family did they feel happy and like they were fulfilling their role as a good family member? Because of the nested nature of the data, we used hierarchical linear modeling (HLM; Bryk & Raudenbusch, 1992), which was designed to analyze nested data of the type that were collected for this study (i.e., daily level data nested within individuals). Adolescents’ daily levels of fulfillment (happiness and role fulfillment) were each predicted by whether they helped their family that day. The statistical model that was estimated for each fulfillment index was as follows:

$$\begin{aligned} &\text{daily fulfillment (happiness, role fulfillment)}_{ij} \\ &= b_{0j} + b_{1j}(\text{family assistance}) + e_{ij} \end{aligned}$$

Fulfillment on a particular day (i) for a particular adolescent (j) was modeled as a function of the average fulfillment of the adolescent across days (b_{0j}) and their family assistance (b_{1j}).

The empirical Bayes estimate for each participant over the 14 day diary was extracted from each of the statistical models. The empirical Bayes estimate is an optimally weighted average that combines the individual’s average slope and “shrinks” it towards the mean slope of the group (Diez-Roux, 2006). Each of these estimates was standardized and averaged to

create one index, *Family Assistance Fulfillment*, which is a measure of the extent to which youths’ daily family assistance is associated with their feelings of happiness and role fulfillment. This index was used as a regressor in some of the fMRI analyses.

Family economic status

In addition, we examined whether neural reward activity to family assistance depended on participants’ family economic status. Following the fMRI scan, participants completed a questionnaire assessing their family’s economic status. Using a five-point scale (1 = strongly disagree to 5 = strongly agree), participants indicated whether their family has had enough money to afford the kind of food, home, clothing, and medical care that they need. In addition, participants indicated whether their family has had difficulty paying their bills (1 = a great deal of difficulty to 5 = no difficulty at all) and whether their family has had money left over at the end of each month (1 = more than enough money left over to 5 = not enough to make ends meet). We took the average of these items to create a measure of *Family Economic Strain*. In addition, participants reported their *Family Income* by answering, “How much do your parents usually earn per year, before taxes and other deductions? Please include any overtime pay, commissions, and/or tips.” Participants used an 11-point scale, with each number indicating a \$10,000 increase (1 = less than \$10,000 to 11 = \$100,000 or more). Four Latino participants and one White participant did not know their family’s income. Participants also reported whether they *Contribute Financially* to their family by indicating Yes or No to the question, “Do you contribute to the financial support of your parents, brothers, sisters, grandparents, aunts, uncles, or other relatives, regardless of whether they live with you?”

fMRI paradigm

Participants completed a family assistance task adapted from Moll and colleagues (2006), in which they could earn money for themselves and contribute money to their family. Participants could earn as little as \$0 or as much as \$100 for themselves and their family on each of the two functional runs of the experimental task. Participants were told that one run would be randomly chosen and the amounts earned during this run would be paid to them and to their family in cash. Participants were instructed to think of their own and their family’s earnings separately. That is, participants were instructed that they could not

Noncostly-Reward	Costly-Donation	Jitter/fixation
YOU FAM +\$4.00 -\$0.00	YOU FAM -\$2.00 +\$5.00	YOU FAM

Figure 1. Task design. Participants were presented with payment options. The conditions of interest, displayed in the figure, included Costly-Donations (40 trials) and Noncostly-Rewards (24 trials). During each 3.5 s trial, participants were instructed to press one button to accept the offer and a second button to reject the offer. A jittered fixation was presented between each trial.

spend their earnings on their family and their family could not spend their earnings on the participant.

On each trial, participants were shown a payment option that affected their own and their family's endowment and were told to accept or reject each offer (see Figure 1). There were four types of payments: (1) *Noncostly-Reward* (e.g., YOU +\$3.00 FAM -\$0.00); (2) *Noncostly-Donation* (e.g., YOU -\$0.00 FAM +\$3.00); (3) *Costly-Reward* (e.g., YOU +\$3.00 FAM -\$1.00); and (4) *Costly-Donation* (e.g., YOU -\$1.00, FAM +\$3.00). These values ranged from -\$3.00 to +\$8.00 to reduce participant fatigue and heuristic responding (Andreoni & Miller, 2002; Harbaugh et al., 2007). The costly trials varied in terms of the ratio of the amount of gain to the amount of loss, in order to vary the difficulty of the decisions and obtain a wider range of individual differences in responses. The gain, however, was always greater than the loss. Participants were presented with 64 unique outcome sets, each presented once per run, totaling 128 trials. The *Noncostly-Reward* and *Noncostly-Donation* payments were each shown 24 times, and the *Costly-Donation* and *Costly-Reward* payments were each shown 40 times. Conditions were pseudorandomly ordered using a genetic algorithm to optimize design efficiency (Wager & Nichols, 2003). The stimuli remained on the screen for the entire 3.5 s trial. If participants did not make a decision in time, they were told it would count as a rejection. Each 3.5 s payment trial was followed by a fixation for an intertrial period with an exponentially distributed jitter (mean 1.5 s) to increase estimation efficiency. Participants were not shown the running total of their own or their family's endowments. Because participants were paid after the scan, costly decisions did not involve out-of-pocket money, but, rather, a decrease in the total possible endowment earned.

Two outcome types were used in the analyses presented in this paper: *Costly-Donations* and *Noncostly-Rewards*. *Costly-Donation* trials entailed a conflict

between participants' personal endowment and their decision to contribute to their family, whereas *Noncostly-Reward* trials entailed only a personal gain at no one's cost. We examined when and if making a costly contribution to one's family was more rewarding than gaining a personal reward.

fMRI data acquisition

Imaging data were collected using a 3 T Siemens Trio MRI scanner. The Family Assistance task was presented on a computer screen, which was projected through scanner-compatible goggles. A high-resolution structural T2*-weighted echo-planar imaging volume (TR = 4000 ms, TE = 34 ms, matrix size 128 × 128, FOV = 200 mm, 36 slices, 1.56 mm in-plane resolution, 3 mm thick) was acquired coplanar with the functional scans. Two functional scans each lasted 5 min, 33 s (echo planar T2*-weighted gradient-echo, TR = 3000 ms, TE = 25 ms, flip angle = 90°, 64 × 64 matrix, FOV = 200 mm; 36 slices, 3 mm voxel).

fMRI data analysis

All neuroimaging data were preprocessed and analyzed using Statistical Parametric Mapping (SPM5; Wellcome Department of Cognitive Neurology, Institute of Neurology, London). Preprocessing for each participant's images included slice-timing to adjust for temporal differences in slice acquisition within each volume, spatial realignment to correct for head motion, normalization into a standard stereotactic space as defined by the Montreal Neurological Institute and the International Consortium for Brain Mapping, and spatial smoothing using an 8 mm Gaussian kernel, full width at half maximum, to increase the signal-to-noise ratio.

The task was modeled as an event-related design. Using a two-level procedure, we conducted a random effects fMRI data analysis. First, linear contrasts were created for each planned condition comparison for each participant. Events were modeled with a 3.5 s duration beginning with the appearance of the payment screen. Next, the individual subject contrasts were submitted to random-effects, group-level analyses.

We examined activation in the mesolimbic reward system within three *a priori* regions of interest (ROIs) that have been consistently linked with the rewarding feelings experienced during the act of giving to others: the ventral striatum (VS), dorsal striatum (DS), and ventral tegmental area (VTA; Harbaugh et al., 2007; Izuma et al., 2009; Moll et al., 2006). The striatum was anatomically defined using the WFU Pick

Atlas with masks taken from the AAL (automated anatomical labeling) toolbox (www.fmri.wfubmc.edu; Maldjian, Laurienti, & Burdette, 2003; Maldjian, Laurienti, Kraft, & Burdette, 2003; Tzourio-Mazoyer et al., 2002). The ventral and dorsal striatum were separated at $z = 3$. The ventral tegmental area was defined as a sphere with a radius of 6 mm, centered at MNI coordinates $0 -20 -12 [x y z]$. These coordinates were based on those frequently reported in the literature (Moll et al., 2006; Krebs, Schott, & Duzel, 2009; Zald et al., 2008; Whittmann et al., 2005). Statistical analyses for these ROIs were performed using the MarsBaR ROI analysis tool in SPM (MARSeille Boîte À Région d'Intérêt; Brett, Anton, Valabregue, & Poline, 2002; <http://marsbar.sourceforge.net>), in which the activations for each of the voxels within the ROI were averaged to produce a single estimate of activity per ROI for each participant. ROI analyses were performed at a threshold of $p < .05$. Given our small number of *a priori* regions and our one contrast of interest, this threshold is consistent with the study-wide type I error rate found in typical behavioral science papers (Lieberman & Cunningham, 2009). All parameter estimates were extracted from the entire ROI.

RESULTS

Behavioral results

Family assistance decisions

To examine participants' personal and family earnings, we conducted a 2 (earnings: personal, family) \times 2 (ethnicity: Latino, White) analysis of variance (ANOVA). There was no interaction of ethnicity by trial-type, $F(1, 46) = 0.001$, *ns*, nor a main effect of ethnicity, $F(1, 46) = 0.62$, *ns*. There was, however, a significant main effect of earnings. Across both ethnic groups, participants earned significantly more money for themselves (\$77.51) than for their family (\$48.29), $F(1, 46) = 42.19$, $p < .001$.

Next, to examine participants' acceptance rates to the different trial-types, we conducted a 2 (trial-type: *Costly-Donation*, *Noncostly-Reward*) \times 2 (ethnicity: Latino, White) ANOVA. There was no interaction of ethnicity by trial-type, $F(1, 46) = 0.02$, *ns*, nor a main effect of ethnicity, $F(1, 46) = 0.003$, *ns*. However, there was a significant main effect of trial type. Across both ethnic groups, participants accepted more *Noncostly-Reward* ($M_{acceptance} = 99.2\%$) trials than *Costly-Donation* ($M_{acceptance} = 66.1\%$) trials, confirming that participants were sensitive to the trial types and cared about their personal endowment, $F(1, 46) = 52.92$, $p < .001$.

Finally, we examined participants' mean response times to the different trial-types by conducting a 2 (trial-type: *Costly-Donation*, *Noncostly-Reward*) \times 2 (ethnicity: Latino, White) ANOVA. There was no significant interaction of ethnicity by trial-type, $F(1, 46) = 0.433$, *ns*. A main effect of trial-type showed significantly longer response times while making *Costly-Donation* ($M_{rt} = 1.67s$) compared to *Noncostly-Reward* ($M_{rt} = 1.00s$) decisions, suggesting that the *Costly-Donation* decisions required more effort, $F(1, 46) = 72.76$, $p < .001$. There was also a main effect of ethnicity, such that Latino participants took longer to respond overall than did White participants, $F(1, 46) = 11.58$, $p = .001$.

Family economic status

Latino participants reported more economic strain, $t(25) = 2.84$, $p < .01$ and lower family income, $t(18) = 2.19$, $p < .05$, than did White participants. Whereas 50% ($N = 7$) of Latino participants contributed financially to their family, 27.3% ($N = 3$) of White participants reported contributing financially to their family. Participants who contributed financially to their family were no more likely to come from families with lower incomes, $t(18) = 0.79$, *ns*, or more economic strain, $t(23) = 0.43$, *ns*. Participants' decision to accept *Costly-Donation* trials was not related to their family's economic strain ($r = .14$, *ns*) or family income ($r = -.19$, *ns*). However, participants who contributed financially to their family were more likely to accept *Costly-Donation* trials, $M_{acceptance} = 80\%$, than were participants who did not report contributing to their family, $M_{acceptance} = 57\%$; $t(23) = 2.98$, $p < .01$. These findings suggest that participants do not necessarily contribute to their family due to economic need, and those who contribute to their family in real life are more likely to contribute to their family during the family assistance task, suggesting that this task is ecologically valid.

Prior family experiences

Latino participants tended to score higher on Family Identity ($M = 4.16$, $SD = .66$) and Family Assistance Fulfillment ($M = .21$, $SD = .78$) than did White participants ($M = 3.74$, $SD = .83$ and $M = -.17$, $SD = .56$, respectively), $t(23)$ values = 1.38–1.41, p values $< .09$, one-tailed. Family Identity and Family Assistance Fulfillment were not associated with participants' acceptance rates for *Costly-Donations*, and this did not vary by ethnicity.

Neuroimaging results

Cultural differences

Although Latino and White participants contributed to their family at the same rate, they exhibited distinct neural response patterns within the mesolimbic reward system when contributing to their family. As expected, White participants showed more activity within all three reward-related regions when they gained a monetary reward compared to making costly contributions to their family, VS: $t(10) = 2.38, p < .05$; DS: $t(10) = 2.08, p < .05$; VTA: $t(10) = 2.20, p < .05$, whereas Latino participants showed similar, VS: $t(13) = -0.34, ns$, or increased, DS: $t(13) = 2.31, p < .05$; VTA: $t(13) = 1.48, p = .08$, activity during costly donations to their family compared to their own gain. The degree of reward activity to costly donations relative to personal gains differed significantly by ethnic group, VS: $t(23) = 2.18, p < .05$; DS: $t(23) = 3.08, p < .01$; VTA: $t(23) = 2.53, p < .01$; see Figure 2.

Family economic status

The ethnic differences in reward system activation are not explained by family economic status. Latino participants came from families with lower socioeconomic statuses, yet family economic strain, family income, and contributing financially to one's family were not associated with activation within the VS, DS, or VTA, r values = $-.26$ – $-.31, ns$, and these associations do not differ for White and Latino participants. This suggests that the ethnic differences in reward

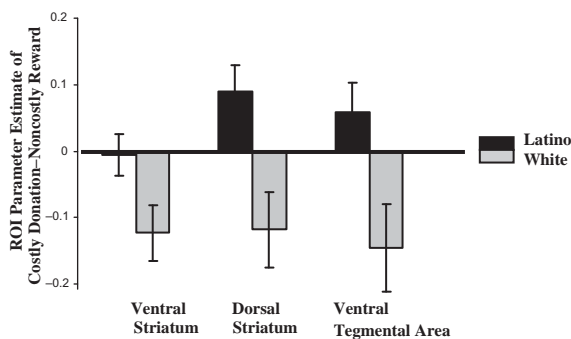


Figure 2. Brain activity within each ROI as a function of participant ethnicity to Costly-Donation versus Noncostly-Reward trials. Results are in terms of parameter estimates of signal intensity to Costly-Donations relative to Noncostly-Rewards in ROIs in the VS, DS, and VTA. A negative mean value indicates *more* neural activity to Noncostly-Reward trials relative to Costly-Donations, a mean value of 0 indicates no difference, and a positive mean value indicates *more* activity to Costly-Donation trials relative to Noncostly-Rewards. Error bars represent *SEM*.

system processing while contributing to the family are not due to families' financial needs and may be driven by cultural differences.

Prior family experiences

To examine how the quality and experience of individuals' prior family relationships were associated with reward system activation when assisting one's family, we examined self-reported family experiences from 2 years prior to the scan. Adolescents who identified more with their family and who derived more fulfillment from helping their family 2 years earlier showed more reward activity within each ROI when making costly donations to their family compared to gaining a reward (Figure 3). These correlational patterns did not differ across cultural groups.

DISCUSSION

This study extends our knowledge of the neural bases of altruism and the reward associated with giving (Harbaugh et al., 2007; Izuma et al., 2009; Moll et al., 2006) and extends this model to the family, the first and primary social group to which most people belong. Our findings suggest that decisions to help others may be guided by cultural factors. Although Latino and White participants contributed to their family at the same rate, their neural reward systems responded in distinct ways to the same behavior, suggesting that the meaning of family assistance may vary across cultural groups. While White participants showed more reward activity when gaining cash for themselves, Latino participants showed more reward activity when contributing to their family. These findings are consistent with the cultural emphasis placed on family obligation and assistance among families from Latin American backgrounds (Hardway & Fuligni, 2006). Although it is possible that Latinos assist their family partly out of a sense of obligation (Suárez-Orozco & Suárez-Orozco, 1995), our findings suggest that they also may find family assistance to be personally rewarding. Given the large body of previous work linking these regions to the experience of reward, it is possible that the high level of previously observed family assistance among Latino families may be driven, in part, by the rewarding nature of the activity.

Another possibility for these cultural differences is that Latino youth may associate themselves more closely with their family and thus may experience money earned by their family as personally rewarding. That is, Latino participants in the current study

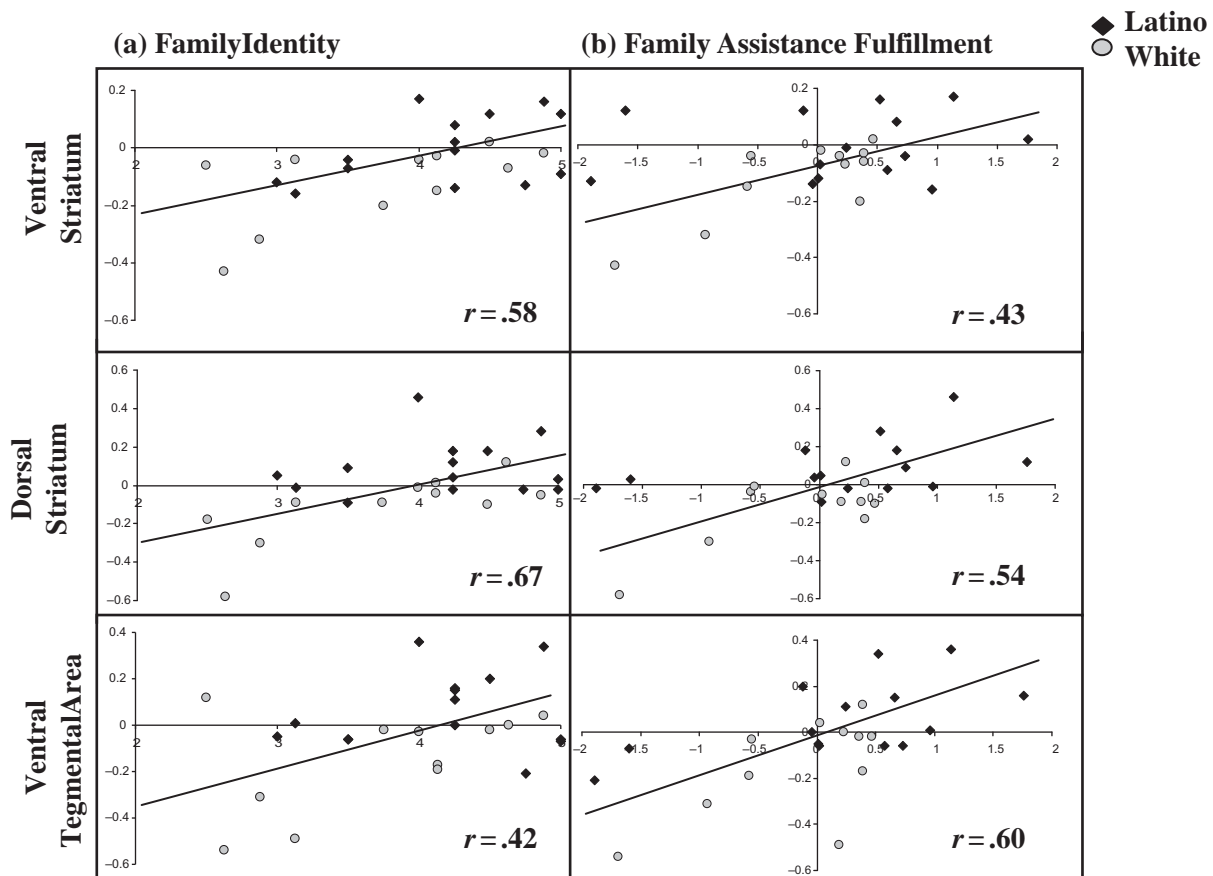


Figure 3. Brain activity within each ROI as a function of prior family experiences. VS, DS, and VTA activity to Costly-Donation versus Noncostly-Reward trials that correlated positively with (a) Family Identity and (b) Family Assistance Fulfillment is shown. The y-axis represents parameter estimates of signal intensity within each ROI. The correlational patterns do not differ significantly across cultural groups. All correlations are significant at $p < .05$.

tended to have a stronger sense of family identity in which they felt that their family was important to their sense of self. Thus, for Latino participants, it may have been more difficult to disentangle rewards for the self vs. rewards for the family than for White participants.

Our findings are consistent with a broadening area of research linking the experience of giving to others with activation in the reward system (Harbaugh et al., 2007; Izuma et al., 2009; Moll et al., 2006) and add to this literature by showing that the rewards one attains from helping others may be driven by cultural factors. In contrast to these previous studies, which examine donating to charities, we found that White participants show increased reward activity when gaining a personal reward rather than when making costly contributions. Charitable donations differ in important ways from donating to one's family. Charities are often seen as in need of financial help, and one's behaviors can directly help those who are in need, whereas fam-

ily assistance is often guided by cultural values and not always by need. As we show, financial need was not associated with assisting the family or deriving reward from that assistance. Thus, the meaning of family assistance may differ across cultural groups (Fuligni & Flook, 2005), and the White participants in the current study may not have shown reward system activation when contributing to their family because it was not as important a cultural value for them. These findings highlight the importance of cultural values and socialization in influencing culturally driven behaviors.

In addition, prior family experiences were associated with reward system activation when assisting the family two years later, suggesting that youth may internalize the values and goals of their family, and the reward one attains from helping the family may be driven by the quality of those earlier relationships. In support of social identity theory (Hogg, 2003), our results suggest that youth who experienced stronger

feelings of family identity may be more likely to internalize the values of their family, leading to greater reward system engagement when they assist their family later. Furthermore, our data suggest that youth's daily routines and family experiences may reinforce the cultural values of their family. In high school, those who gained more fulfillment from helping their family on a daily basis showed more reward system activation when assisting their family 2 years later. A sense of fulfillment from helping their family likely made family assistance a more meaningful and important activity for the youth, leading to a greater sense of reward when assisting their family later. Thus, prior family experiences are associated with later reward system activation, which may be one reason why youth continue to assist their family throughout the life course (Fuligni & Pederson, 2002).

These data further highlight how family socialization can affect the experience of family assistance during the transition to young adulthood, a time when many youth are gaining independence from their family. Consistent with Arnett's (1998) suggestions, autonomy during this developmental period may be coupled with a deeper understanding of social responsibilities, such as supporting one's family, which may result in these responsibilities being more rewarding. Those who felt a closer social connection to their family and greater fulfillment from helping their family in high school may have been more likely to develop a deeper sense of meaning from helping their family. Further research should continue to disentangle the role of socialization in adolescents' development across a wide age range in order to better understand how the rewards of family assistance change over time. Additionally, researchers should examine how family assistance is influenced by other socializing agents such as intrapersonal factors (one's attitudes, beliefs, and cultural values), interpersonal factors (peer influence, social norms, and parenting quality) and environmental factors (educational opportunities, school context, and neighborhood composition). During adolescence and the transition to adulthood, many of these factors often conflict with one another, such as youths' desire to spend time with friends vs. their obligation to help at home. Future research should examine how this sense of conflict may influence how family assistance is experienced.

As depicted in Figure 2, Latino participants showed similar ventral striatum activation to their own gain and to contributions to their family, whereas they showed significantly more reward activity within the dorsal striatum and VTA when contributing to their family. Perhaps the ventral striatum is more sensitive to social rewards, such as the presence of others

(Izuma et al., 2009). Future work should examine how the experience of family assistance is affected by the presence of family members.

Interestingly, we did not find behavioral differences between Latino and White participants but did find neural differences as they contributed to their family. The absence of behavioral differences can be considered a strength of our findings because it allows us to examine activation differences for the same level of behavior. Had we found behavioral differences between cultural groups, any neural differences could be due to a greater acceptance rate for one group rather than to the meaning that that group derived from assisting their family. We acknowledge that we are inferring meaningful neural differences in the absence of behavioral differences. Yet inferences based on the intersection between neuroimaging data and behavioral data (such as previous family experiences as we found in the current study) are often essential for forming new hypotheses about processes and mechanisms that may be undetectable at the conscious or behavioral level. Efforts to generate future testable hypotheses are an important step in directing the field of developmental social neuroscience, despite the likelihood that these will rely more heavily on reverse inferences (Pfeifer et al., 2009). Our findings suggest one potential mechanism for sociocultural behaviors that needs to be directly tested in future work.

Finally, we acknowledge our small sample size, particularly among the White group for which we lost three participants (two due to motion exceeding 2 mm during the fMRI task and one who failed to respond to the task). However, because of the longitudinal nature of our data, we are unable to increase the sample size. Future studies should examine cultural group differences in the experience of family assistance across other groups who value familism, such as youth from Asian backgrounds who traditionally emphasize the importance of family membership, respect, and solidarity (Ho, 1981).

In summary, our findings suggest that family assistance may be guided, in part, by the personal rewards one attains from that assistance. Cultural differences in the experience of family assistance and early family experiences may moderate neural reward responses to those behaviors. Although helping one's family may create a sense of conflict for some youth, the rewarding nature of this activity may offset the sacrifices one may make. Cultural differences in the sense of reward individuals attain from helping their family and the role of early family experiences may be one reason why family assistance values and behaviors are sustained within cultures, throughout the life-course, and across generations.

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