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ARTICLE

Testing a rational choice model of "desistance:" Decomposing changing expectations and changing utilities*

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Abstract

We argue that a rational choice framework can be used to explain declines in offending from adolescence to young adulthood in two ways. First, subjective expectations of offending can be age graded such that perceptions of rewards decrease and perceptions of risks and costs increase. Second, the marginal (dis)utility of crime may be age graded (e.g., preferences for risks, costs, and rewards). We examine changes in offending from adolescence to young adulthood among a subset of individuals from the Pathways to Desistance Study (N = 585) and employ a nonlinear decomposition model to partition differences in offending attributable to changing subjective expectations (X) and changing marginal utilities (β). The results indicate that both have direct and independent effects on changes in offending over time. The results of a detailed decomposition on the subjective expectations also indicate that differences exist across the type of incentives. That is, the effect of changing expectations is attributed mainly to changes in perceived rewards (both social and intrinsic). Changing expectations of social costs and risk of arrest from offending have weak effects on changes in criminal behavior, which suggests that they must be accompanied by increases in the weight placed on these expectations to promote appreciable declines in offending.

KEYWORDS

decomposition, life course, rational choice

That criminal activity varies over the life course is an established fact in the social sciences (Hirschi & Gottfredson, 1983; Steffensmeier, Allan, Harer, & Streifel, 1989). Of particular note is the seemingly sharp decline in offending from adolescence to early adulthood. Numerous theories have been proffered to explain such changes in offending (Agnew, 1997; Akers, 1998; Giordano, Cernkovich, & Rudolph, 2002; Moffitt, 1993; Sampson & Laub, 1993). In much of this literature, scholars have emphasized the importance of life-course transitions, identity transformation, and the role of emotions in the desistance process (Giordano et al., 2002; Giordano, Schroeder, & Cernkovich, 2007; Laub & Sampson, 2003; Maruna, 2001; Sampson & Laub, 1993; Warr, 1998). Although most of these perspectives incorporate an element of "choice," it is usually treated as a narrow by-product of "human agency," invoked to explain residual fluctuations in offending trajectories not captured by key processes proposed by a given theory (Paternoster, 2017). Mostly absent from this literature is a formal treatment of the decision-making processes that underpin developmental differences in offending across the life course (cf. Gartner & Piliavin, 1988; Paternoster & Bushway, 2009; Steinberg, 2008).

Rational choice theorists traditionally view offending decisions as a function of both subjective expectations and marginal utility, with the former representing the perceptions of rewards, costs, and risks that go into the decision calculus and the latter reflecting how those expectations are weighted (Watkins, 1915).[1] In drawing on this distinction, differences in offending between adolescence and young adulthood can be explained through a decision-making perspective in multiple ways. First, subjective expectations about the risks, costs, and rewards of offending may be age graded. A common theme in theories of desistance is that the perceived risks and costs of crime increase as individuals enter adulthood (Sampson & Laub, 1993). Less theoretical attention has been focused on how rewards from crime vary over time; however, there are reasons to suspect that such incentives may change in ways that promote declines in offending (Giordano, Cernkovich, & Holland, 2003). From this view, the weight placed on rational inputs may be similar over time but individuals perceive the benefits of crime as greater than the costs in adolescence relative to adulthood (Becker, 1968). A second possibility is that individuals weigh the inputs differently over time—that is, the marginal (dis)utility of crime is age graded (Paternoster & Bushway, 2009). Adolescents may be particularly concerned about the social and intrinsic rewards from crime but care less about such incentives by the time they reach young adulthood (i.e., the marginal utility of offending decreases with age; see Steinberg & Monahan, 2007). Similarly, in adulthood individuals may be more risk averse or increasingly sensitive to the negative social costs of crime (e.g., loss of job). In this way, it may be the changes in the weights placed on arrest risk and social costs of offending—rather than the changes in the perceptions of these inputs—that explains declines in crime in young adulthood (i.e., the marginal disutility of offending increases with age). These two processes can operate in tandem, with changes in both contributing to the decline in criminal behavior from adolescence to young adulthood.

Although changes in subjective expectations and changes in marginal utility are both consistent with a decision-making framework, determining the extent to which reductions in offending from adolescence to early adulthood are a result of changes in subjective expectations or the utility derived from these expectations is of theoretical importance. A fundamental disagreement among prominent desistance theories concerns the extent to which declines in offending are a result of changes in perceptions of risks, costs, and rewards from crime (Akers, 1998; Sampson & Laub, 1993), changes in preferences that affect the weight that individuals place on these (dis)incentives (Paternoster & Bushway, 2009), or some combination of both (Giordano et al., 2002). Indeed, several scholars have highlighted the importance of disentangling the relative contributions of changing perceptions and changing preferences for

[1]Marginal utility is more formally defined as $\partial U / \partial x$ or the change in expected utility (U) given changes in some subjective input x.

understanding declines in offending (Doleac, 2019; Giordano et al., 2003; Paternoster, Bachman, Bushway, Kerrison, & O'Connell, 2015; Weaver, 2015).

We detail how changes in offending over time can be understood through a decision-making framework—specifically, through age-graded expectations and age-graded marginal utilities. In doing so, we draw attention to the theoretical importance of delineating these two processes for understanding desistance. We then describe an empirical method to decompose the overall contributions of changes in offending that are attributable to changes in mean levels of subjective expectations ($\bar{X}_i$) from those attributable to changes in the weights placed on subjective expectations (the regression coefficients, β_k). We demonstrate the utility of this approach by applying our empirical model to changes in self-reported offending among a subset of serious juvenile delinquents from the Pathways to Desistance study ($n = 585$) from adolescence (16 and 17 years of age) to young adulthood (23 and 24 years of age).

1 | RATIONAL CHOICE THEORY AND CRIMINAL BEHAVIOR

By drawing on Becker's (1968) subjective expected utility model, a rational choice theory of crime can be estimated through a general regression framework by predicting individual *i's* rate of offending (Y_i) through the model (Loughran, Paternoster, Chalfin, & Wilson, 2016; Matsueda, Kreager, & Huizinga, 2006):

$$Y_i = \beta_0 + \beta_1 PersRewards_i + \beta_2 SocRewards_i + \beta_3 P_i + \beta_4 SocCosts_i + e_i \quad (1)$$

This model represents an unobserved utility function that incorporates two components of offending decisions. The first are the *subjective expectations* identified by rational choice theorists as important in the offending calculus (Loughran et al., 2016). *PersRewards* reflect the intrinsic rewards of offending, such as expectations of thrill and excitement (Katz, 1988; Shover, 1996). *SocRewards* are the anticipated social rewards and status gains from peers and other individuals resulting from rule violation (Matsueda et al., 2006). *P* is the perceived probability of detection when offending (e.g., arrest). Finally, *SocCosts* are a utility cost that reflect the negative informal consequences (e.g., parental disapproval and loss of job) that offending incurs (Grasmick & Bursik, 1990; Paternoster, 1989). It is the sum of these rewards (additive) and the risks and costs (subtractive) that determine one's likelihood of offending: Individuals are expected to offend at a greater rate to the extent that the expectations of rewards from crime exceed the expectations of risks and costs.

Second, the coefficients (β_k) highlight the marginal effects of the subjective expectations on offending and act as a proxy for how a change in $\boldsymbol{X}$ affects marginal changes in latent utility (U^*), which is assumed to influence one's rate of offending. Given that criminological researchers often rely on nonlinear models, the utility function is not quantified, but the direction of the marginal effects has implications for the *marginal (dis)utility* that individuals place on the respective rational inputs when making offending decisions. Positive, statistically significant estimates of the rewards to crime (β_1 and β_2) and negative, statistically significant estimates of the risks/costs (β_3 and β_4) are evidence that individuals are responsive to incentives and that offending is, in part, rational (Paternoster, 2010).[2] As with expectations, it is the joint effects of these coefficients that are important: The greater utility

[2]In classic linear models, both the marginal effects and the marginal utilities are captured by the coefficients, but this is not the case in nonlinear models. Nevertheless, given that the specified functional form in this article will be the same for adolescence and young adulthood, we can compare the marginal effects of predictors between adolescence and young adulthood.

individuals receive from the rewards to crime and the lower the disutility from risk and costs, the higher the predicted rate of offending.

In the extant research—in both criminology and economics—scholars have supported the responsiveness of potential offenders to rational considerations (Ehrlich, 1973; Grogger, 1998; Lee & McCrary, 2017; see also Nagin, 1998; Paternoster, 2010; Witte & Witt, 2002). Subjective expectations of offending have been shown to be predictive of adolescent (Paternoster, 1989) and adult (Piliavin, Gartner, Thornton, & Matsueda, 1986) offending, among both general (Grasmick & Bursik, 1990; Lochner, 2007) and high-risk (Loughran et al., 2016; Matsueda et al., 2006; Viscusi, 1986) samples, as well as for a wide range of crime types (see Cornish & Clarke, 1986). These findings ultimately led Loughran and colleagues (2016, p. 107) to conclude that "unambiguously … rational choice is as general a theory of crime as social learning, social control, and strain theories."

Despite the marked growth in criminological research aimed at examining rational choice and offender decision-making (Anwar & Loughran, 2011; Loughran et al., 2016; Loughran, Paternoster, Piquero, & Pogarsky, 2011; Loughran, Paternoster, & Weiss, 2012; Pickett, Roche, & Pogarsky, 2018; Pogarsky, Roche, & Pickett, 2018), few have examined how decision-making processes account for changes in offending from adolescence to young adulthood (Paternoster et al., 2015). This gap is conspicuous given that a common theme across prominent life-course theories is the role of *choice* in the desistance process. Sampson and Laub's (1993) description of "turning points" is rooted in the idea that life transitions such as employment and marriage increase the informal social costs of crime. In fact, based on the responses they received from their qualitative interviews with the Glueck men, Laub and Sampson (2003, p. 141) were led to conclude that "[w]hat is most striking in the narratives we collected is the role of … choice … in desistance from crime and deviance." Giordano and colleagues (2002) argued that "hooks for change" (e.g., a spouse) affect the perceived costs and rewards from crime, and that cognitive transformations toward noncriminal identities reduce individuals' motivation and preferences for offending. Finally, Paternoster and Bushway (2009) argued that crime declines in adulthood because individuals come to fear the potential negative consequences of a continued criminal lifestyle, motivating change toward a life of conformity. In other words, individuals' preferences for rewards, risks, and costs change as one's identity changes, which results in the disutility of crime exceeding the utility.

Indeed, several theorists have explicitly stated that their respective explanations are "compatible" with a rational choice perspective (Akers, 1990; Giordano et al., 2007; Laub & Sampson, 2001; Paternoster & Bushway, 2009). Yet, these theories often differ in the extent at which declines in offending in adulthood are attributed to changing expectations versus changing marginal utilities. For example, Sampson et al. argued that the formation of social bonds in adulthood promotes desistance by acting as a "restraint that imposes significant costs for translating criminal propensities into action" (Sampson, Laub, & Wimer, 2006, p. 467). Similarly, Akers (1998, pp. 53–54), attributed cessation in offending to changes in the anticipated reinforcements and punishments associated with crime. In both perspectives, although differing in important respects, scholars attribute desistance primarily to changes in the subjective expectations of offending that shift the overall reward–cost balance.

Paternoster and Bushway (2009), on the other hand, emphasized how identity changes in adulthood bring about changes in preferences "*such that causal factors have a different impact on the person now than in the past*" (p. 1106, emphasis added). As a result of this perspective, they stressed the importance of changes in the overall marginal utility of offending that comes from internal changes to identity (Paternoster et al., 2015). As they noted, if preferences "shift overtime in meaningful ways … we can have a situation where *the same inputs … lead to different behaviors"* because individuals are weighing (dis)incentives for offending differently over time. Giordano and colleagues (2002, 2003) offered more of a "middle ground," attributing desistance to both life transitions that affect individuals'

perceptions of the risks, costs, and rewards of crime, as well as cognitive transformations that impact the marginal (dis)utility associated with offending.

Given these differences, we believe it is informative to examine how the components of the decision-making process account for changes in offending over time (Furby & Beyth-Marom, 1992; Gartner & Piliavin, 1988; Shover, 1985). Our intention is not to refute theorizing on life-course offending in which the importance of social structure, institutional constraints, and life-course transitions are emphasized. Instead, we attempt to "move choice to the center stage" (Nagin, 2007) and to illuminate the more proximate mechanisms through which such broad turning points presumably operate (see McCarthy, 2002). From this vantage point, we build on the central, but theoretically underdeveloped, process of "choice" in explaining crime over the life course (Paternoster et al., 2015).

2 | RATIONAL CHOICE AND CRIME OVER THE LIFE COURSE

An implicit assumption of rational choice theory is that the general structure of the decision calculus employed by potential offenders is the same across different stages of the life course (Paternoster, 1989). In building on this assumption, we can apply equation (1) to describe an individual's offending behavior in adolescence (a) through the decision-making model:

$$Y_i^a = \beta_0^a + \beta_1^a PersRewards_i^a + \beta_2^a SocRewards_i^a + \beta_3^a P_i^a + \beta_4^a SocCosts_i^a + e_i^a \quad (2)$$

And the same individual's offending behavior in young adulthood (A) as follows:

$$Y_i^A = \beta_0^A + \beta_1^A PersRewards_i^A + \beta_2^A SocRewards_i^A + \beta_3^A P_i^A + \beta_4^A SocCosts_i^A + e_i^A \quad (3)$$

Research findings indicate that, on average, an individual's offending levels in young adulthood are lower when compared with adolescence (Hirschi & Gottfredson, 1983), such that:

$$Y_i^a > Y_i^A$$

By comparing the right-hand sides of equations (2) and (3), we can see that reductions in offending from adolescence (Y_i^a) to young adulthood (Y_i^A) can be explained by overall changes in the mean values of the subjective expectations of offending (e.g., *PersRewards* and *SocCosts*), overall changes in the joint marginal effects (i.e., utility) of the subjective expectations (β_k^T), or some combination of both.

2.1 | Age-graded subjective expectations of offending

Subjective expectations of offending—*PersRewards, SocRewards, P,* and *SocCosts*—can be age graded in ways that shift the rewards–costs balance and thus decrease criminal behavior (Gartner & Piliavin, 1988; Shulman, Monahan, & Steinberg, 2017). That the anticipated social costs of offending increase in adulthood is pervasive in almost every life-course theory of crime. As individuals enter adulthood, they form relationships with significant others or hold gainful employment that can be compromised by arrest and, in turn, hold higher perceptions of the social costs from offending. Furthermore, individuals may "knife-off" relationships with criminal associates and begin associating with individuals who view crime as immature and undesirable (Kirk, 2012; Moffitt, 1993). This observation is central in both Sampson and Laub's (1993) age-graded theory of informal social control and Giordano et al.'s (2002, 2003) concept of "hooks for change." It follows that the anticipated social costs of arrest are higher in young adulthood than in adolescence ($SocCosts_i^a < SocCosts_i^A$).

A second common observation is that offending declines in young adulthood because perceptions of the risk of arrest increase as individuals age (Hjalmarsson, 2009), which may occur through direct contact with police that leads to risk updating (Anwar & Loughran, 2011) or through the indirect experiences of family or friends (Stafford & Warr, 1993; Wilson, Paternoster, & Loughran, 2017). This is consistent with Shover and Thompson (1992, p. 92), who argued that as "age increases the perceived legal risk of criminal participation increases, and that increases the odds of desistance," as well as with Cusson and Pinsonneault (1986, p. 76), who stated that, "[W]ith age, criminals raise their estimates of the certainty of punishment." In this instance, increases in the perceived risk of arrest ($P_i^a < P_i^A$) may contribute to declines in offending in young adulthood.

The extent to which declines in offending are a result of changes in the perceived rewards has received considerably less theoretical and empirical attention. One possible reason for this is that Sampson and Laub (1993)—in their prominent life-course theory—assumed that intrinsic rewards to offending were innate and universal, and they downplayed the significance of social rewards (see Giordano et al., 2002). Still, there are reasons to suspect that the anticipated rewards from crime may decrease over time. Both Adler and Adler (1983) and Shover (1985), in their qualitative works, showed that as individuals entered adulthood, they reported that criminal activity did not provide as much excitement as it did in adolescence ($PersRewards_i^a > PersRewards_i^A$). Others have postulated that individuals are more likely to view crime and deviance as behaviors that accrue greater social rewards and status in adolescence relative to adulthood ($SocRewards_i^a > SocRewards_i^A$). Matza (1964) suggested that adolescents possess a "shared misunderstanding" of the erroneous belief that their peers are committed to and reward deviant conduct. Upon entering adulthood, however, most individuals recognize that this belief is faulty and come to view crime as eliciting little in terms of social rewards. Warr (1993) showed that exposure to delinquent peers decreases from adolescence to early adulthood—which would reduce perceptions of social rewards (Akers, 1998)—and that this, at least in part, explains differences in offending over time.

Put simply, the perceptions of the crime-incentivizing rewards may decrease as individuals enter adulthood, whereas the perceptions of the deterrence-promoting risks and costs may increase. As a result, overall expectations concerning the reward–cost balance may be age graded in a way consistent with a rational choice explanation of desistance: Whereas individuals may hold high perceptions of reward and low perceptions of risks/costs in adolescence, in young adulthood, they may begin to view crime as less rewarding and more risky/costly. This leads to our first hypothesis:

Hypothesis 1: Subjective expectations about the costs, risks, and rewards of crime will change in a manner consistent with a rational choice theory of desistance. Perceptions of social costs and arrest risk will increase, and perceptions of social and intrinsic rewards will decrease from adolescence to young adulthood.

2.2 | Age-graded marginal utilities of subjective expectations

The right-hand side of equations (1)–(3) include two sets of values that impact the predicted values of Y_i: the subjective expectations of offending (e.g., *PersRewards, SocCosts*) and the marginal utilities of these expectations, reflected in the respective coefficients (β_k). These latter parameters reflect how, on average, predicted offending behavior changes with an increase (or decrease) in the perceived risks, costs, and rewards for offending. As Paternoster and Bushway (2009) noted, offending behavior can decline from adolescence to young adulthood even if the mean levels of perceived risks, costs, and rewards to crime remain mostly stable, so long as the influence that these expectations have on offending changes over time. Changes in marginal utilities are internally consistent with interactionist

explanations of desistance. For example, Matza (1964) suggested that maturational reform shifts the weight that individuals place on different (dis)incentives, from the immediate and social rewards of crime in adolescence to the risks and costs in adulthood. Similarly, recent studies aimed at examining cognitive development across the life course have observed that structural and functional changes, particularly in the prefrontal cortex, can shape the weight that individuals place on the various (dis)incentives for risky behaviors (see Steinberg, 2008).

There are some research findings that demonstrate support for the age-graded weighting of rational inputs proposed here. The immediate personal rewards from crime (e.g., thrill and excitement) are often weighed against the longer term social costs of offending (e.g., disappointing others). Researchers have shown that adolescents are more oriented toward immediate considerations (i.e., reward-seeking) and tend to discount future consequences when compared with adults (Steinberg et al., 2009). The neurocognitive changes that occur from adolescence to young adulthood simultaneously make individuals less reward-seeking and more cost-averse (Cauffman et al., 2010; Steinberg, 2008) resulting in two potential consequences. First, the marginal utility of the intrinsic rewards to offending may be larger in adolescence than in young adulthood ($\beta_1^a > \beta_1^A$). Second, the social costs of offending may weigh more heavily in young adulthood than in adolescence, which suggests that the marginal disutility from offending increases over time ($\beta_4^a < \beta_4^A$).

The marginal disutility of perceived arrest risk may increase in young adulthood if individuals become more risk averse as they get older (Paternoster & Bushway, 2009). Individuals can be risk tolerant—meaning that changes in risk have little impact on behavior—or risk averse—meaning that "risk" is noxious and changes to perceived risk have large effects on behavior. Criminal behavior is inherently risky. During adolescence, individuals may be more tolerant of the risk associated with offending or may even engage in the behavior precisely because it is risky. Paulsen, Platt, Huettel, and Brannon (2012) demonstrated a linear decline in tolerance for risk from adolescence to adulthood. Tymula, Glimcher, Levy, and Rosenberg Belmaker (2012) also found evidence that adolescents are more tolerant of risk when compared with adults, and they argued that this tolerance is responsible for the high rate of risky behaviors during adolescence (see also Burnett, Bault, Coricelli, & Blakemore, 2010). Steinberg (2008) attributed changes in risk preferences to the full maturation of individuals' "cognitive control" system, which improves reasoning and self-regulation. In terms of explaining reductions in offending, this would imply that $\beta_3^a < \beta_3^A$, meaning that the marginal disutility in perceived arrest risk increases from adolescence to young adulthood.

Individuals may also become more sensitive to the potential negative consequences of offending from adolescence to young adulthood, which indicates that the weight placed on the social costs of offending is age graded. Disappointing family and significant others, social exclusion, and reductions in employment prospects are all costs that may result from law violation (Paternoster, 1989). In adolescence, these costs may be readily dismissed but could weigh more heavily as people age. This may occur through changes in identities (Paternoster & Bushway, 2009) or through cognitive developments that affect the ways individuals evaluate the relative costs of crime (Beyth-Marom, Austin, Fischoff, Palmgreen, & Jacobs-Quadrel, 1993). Indeed, Cauffman and colleagues (2010) found a linear increase in cost aversion from adolescence to adulthood, which indicates that individuals become more sensitive to the potential costs associated with behavior as they age (see also Figner, Mackinlay, Wilkening, & Weber, 2009). Therefore, $\beta_4^a < \beta_4^A$, and criminal offending would likely decrease from adolescence to young adulthood.

Finally, criminal behavior may decrease if the marginal utility of the social rewards from offending decreases over time. Consistent with this are the findings that adults are better able to resist peer influences when compared with adolescents. Gardner and Steinberg (2005) conducted an experiment assessing how the presence of peers affects the decision to engage in risky behaviors and found that

peer effects were twice as large for adolescents as for young adults. Importantly, the mean level of peer pressure was the same for both adolescents and young adults, which indicates that there are developmental differences in the *salience* of social rewards beyond any differences in the perceptions of social rewards. Chein, Albert, O'Brien, Uckert, and Steinberg (2011) demonstrated that the presence of peers activates reward regions of the brain for adolescents. Adults, however, were less sensitive to the social rewards provided by peers (Chein et al., 2011). That individuals' cognitive capacity in adulthood makes them better able to self-regulate and resist peer influences has received considerable empirical support (see Steinberg, 2008), and it has been put forth as an explanation for the decline in risky behaviors from adolescence to young adulthood (Sumter, Bokhorst, Steinberg, & Westenberg, 2009). Thus, one possible explanation for the decline in crime is a decrease in the marginal utility of the social rewards to offending ($\beta_2^a > \beta_2^A$).[3] Taken together, the weight placed on the (dis)incentives associated with offending are likely age graded. The marginal utility associated with the rewards to crime may decrease while the marginal disutility associated with the risks and costs increase. This leads to our second hypothesis:

Hypothesis 2: The marginal (dis)utilities associated with the risks, costs, and rewards will change in a manner that is consistent with a rational choice theory of desistance. The magnitude of the coefficients associated with the social costs and arrest risk should become stronger, and the magnitude of the coefficients on social and intrinsic rewards should become weaker.

In summary, there is a theoretical distinction between subjective expectations and the marginal (dis)utility of those expectations at the core of competing theories of desistance, with some emphasizing the importance of changing mean expectations (e.g., Sampson & Laub, 1993) and others emphasizing changing preferences and marginal utility (Paternoster & Bushway, 2009). Although research findings indicate that both may explain differences in offending between adolescence and adulthood (Gardner & Steinberg, 2005; Giordano et al., 2003; Sampson & Laub, 1993; Steinberg & Monahan, 2007), determining the relative contributions of the two is not immediately clear in prior works because in traditional regression models used to explain changes in offending over the life course, the effects of the two processes are necessarily intertwined. Not surprisingly, Paternoster and Bushway (2009, pp. 1144–1147) called for empirical work to disentangle the degree to which declines are attributable to changing expectations versus changing marginal utility (i.e., coefficients).

3 | DECOMPOSING THE EFFECTS OF CHANGING EXPECTATIONS AND CHANGING UTILITY

Disentangling subjective expectations from marginal utility is a specialized version of a more general problem in regression-based designs: Identifying the extent to which differences in rates across groups or changes in one group over time reflects differences in composition versus differences in slopes (Even & Macpherson, 1993; Nielsen, 1998). The classic economic example is gender disparity in wages (Roos & Gatta, 1999), whereby males may have higher earnings, on average, compared with females as a result of either observable characteristics such as more education ($\bar{X}_m > \bar{X}_f$) or higher marginal

[3]We are not suggesting that the estimated coefficients for the rewards to crime are only significant in adolescence, nor that the coefficients from the costs of crime are only significant in adulthood (e.g., we do not mean that $\beta_1^a > 0$ but $\beta_1^A = 0$). Rather, the marginal (dis)utility from offending is age graded in such a way that the coefficients can be thought of as rank ordered. Thus, for personal rewards, we suggest that $\beta_1^a > \beta_1^A > 0$, and for social costs, we would expect that $\beta_4^A < \beta_4^a < 0$.

returns on education ($\beta_m > \beta_f$). The former would suggest that males are receiving higher earnings for justifiable reasons, but the latter implies some sort of discrimination that reduces the beneficial effects of education for females.

Blinder (1973) and Oaxaca (1973) proposed a straightforward means to address this problem. In a standard regression framework, such as that presented in equations (2) and (3), they presented a method to disentangle empirically the degree to which group-based differences are attributed to differences in levels and differences in slopes. In the current application, in which the Blinder–Oaxaca model is employed to changes within a fixed-sample over time (Even & Macpherson, 1993), differences in levels is the analog to changes in the overall average subjective expectations associated with offending between adolescence and young adulthood, whereas differences in slopes is analogous to changes in overall marginal utilities over time.

We begin by expressing differences in offending between adolescence and young adulthood as follows:

$$(\hat{Y}_i^a - \hat{Y}_i^A) = \left(\beta_0^a + \beta_1^a PersRewards_i^a + \beta_2^a SocRewards_i^a + \beta_3^a P_i^a + \beta_4^a SocCosts_i^a\right) - \left(\beta_0^A + \beta_1^A PersRewards_i^A + \beta_2^A SocRewards_i^A + \beta_3^A P_i^A + \beta_4^A SocCosts_i^A\right) \quad (4)$$

We can expand this equation into the Blinder–Oaxaca decomposition, where the difference is expressed as the sum of the following:

$$\begin{aligned}
A &: \beta_1^a\left(\bar{\mathbf{x}}_{PersRewards}^a - \bar{\mathbf{x}}_{PersRewards}^A\right) + \bar{\mathbf{x}}_{PersRewards}^A\left(\beta_1^a - \beta_1^A\right) + \\
B &: \beta_2^a\left(\bar{\mathbf{x}}_{SocRewards}^a - \bar{\mathbf{x}}_{SocRewards}^A\right) + \bar{\mathbf{x}}_{SocRewards}^A\left(\beta_2^a - \beta_2^A\right) + \\
C &: \beta_3^a\left(\bar{\mathbf{x}}_P^a - \bar{\mathbf{x}}_P^A\right) + \bar{\mathbf{x}}_P^A\left(\beta_3^a - \beta_3^A\right) + \\
D &: \beta_4^a\left(\bar{\mathbf{x}}_{SocCosts}^a - \bar{\mathbf{x}}_{SocCosts}^A\right) + \bar{\mathbf{x}}_{SocCosts}^A\left(\beta_4^a - \beta_4^A\right) \\
E &: \left(\beta_0^a - \beta_0^A\right)
\end{aligned}$$

The mean values ($\bar{\mathbf{x}}_k^T$) represent the average subjective expectations for offending at each time point (e.g., average perceptions of the social rewards in adolescence [$\bar{\mathbf{x}}_k^a$] and young adulthood [$\bar{\mathbf{x}}_k^A$]). The slopes (β_k^T) highlight the average marginal effects of the respective expectations (e.g., the average marginal utility of the social rewards in adolescence [β_2^a] and young adulthood [β_2^A]. Thus, in the Blinder–Oaxaca model, an empirical strategy is offered to estimate the predicted differences in the rate of offending over time if the average expectations and marginal utilities were equivalent from adolescence to adulthood (see Fortin, Lemieux, & Firpo, 2011).

To be sure, the first components β_k^a ($\bar{\mathbf{x}}_k^a - \bar{\mathrm{x}}_k^A$) represent the difference in subjective expectations weighted by the marginal effects of said expectations during adolescence. This value represents how the differences in the rate of offending over time would decrease *if the distribution of subjective expectations for offending was equal from adolescence to young adulthood and the predicted marginal utility was stable over time.* More specifically, these components can be used to estimate the proportion of the difference in offending between adolescence and adulthood attributed to changes in average subjective expectations overtime. The second component $\bar{\mathbf{x}}_k^A$ ($\beta_k^a - \beta_k^A$) represents the differences in marginal effects weighted by subjective expectations in adulthood. These components represent how the differences in the rate of offending between adolescence and adulthood would decrease *if the marginal utility for offending were the same in adulthood as in adolescence,* and they can be interpreted as the contribution of changes in marginal utilities to changes in offending overtime (i.e., the overall differences

in offending attributed to changing regression slopes plus changing intercepts[4]). Finally, expression *E* highlights the differences in the predicted intercepts over the two time points. Quantifying each of these components as a proportion of the raw difference in predicted levels of offending ($\hat{Y}_i^a - \hat{Y}_i^A$) provides a means to assess the extent to which changes in subjective expectations and marginal utility contribute to the predicted changes in criminal conduct over time.[5]

We begin by decomposing the overall contributions of changing expectations and changing utilities to changes in offending over time. From here, we provide a detailed decomposition of changing expectations on the change in offending from adolescence to young adulthood, which allows for us to disentangle more fully how changing rewards and changing risks/costs influence the desistance process over time. As most prior research has been focused on the shifts in costs of offending overtime (e.g., age-graded informal control), this provides a first attempt to explicate more fully the relative contribution of rewards to the decision-making process. Given a well-known scaling issue (Jones, 1983), we cannot provide an analogous detailed decomposition of the changing utilities. We instead use a series of equality of coefficients tests to determine whether and how changes in utility influence the decision-making process over a circumscribed period of the life course. Taken together, the overall decomposition and the detailed decomposition of the perceived risks, costs, and rewards of offending provide a rigorous assessment of an age-graded theory of rational choice.

4 | DATA

We use data from the Pathways to Desistance study, a longitudinal investigation of the transition from adolescence to young adulthood among serious juvenile offenders (Mulvey et al., 2004). Participants are adolescents who were found guilty of a serious offense (mostly felonies) in Maricopa County, (Phoenix) AZ, or Philadelphia County, PA. At the baseline interview, participants were 14 to 17 years of age. In total, 1,354 individuals enrolled in the study. Data were collected at a baseline interview and at ten consecutive follow-up interviews, the first six of which were 6-month observational periods, and the last four were yearly observational periods. The overall Pathways sample is not representative of the general population as it is mostly non-White (44 percent African American, 29 percent Hispanic), and male (86 percent male).

The purpose of this study is to decompose the subjective expectations and marginal utilities of offending at two time points: the peak crime years and when individuals have displayed evidence of substantial declines in crime. Monahan and colleagues (2009) demonstrated that criminal behavior peaks at ages 16 and 17 and begins to decrease thereafter, and Eggleston, Laub, and Sampson (2004) found that most individuals have shown clear signs of desistance by their mid-20s (see also Rocque, 2017). Accordingly, an ideal sample for our study would observe individuals at ages 16 and 17 years old (peak crime ages during adolescence) and follow the same individuals into their mid-20s. To restrict our analytic sample to match these a priori criteria, we make several sample restrictions and rely only on a subset of the Pathways respondents for our analyses. We eliminate respondents who were 14 and

[4]As Jones (1983) noted, both changing slopes and changing intercepts are necessarily incorporated into the unobserved (or discrimination) component in the Blinder–Oaxaca approach. As we note, however, we have good reason to suspect that changing slopes (i.e., marginal utilities) contributes nontrivially to changes in offending.

[5]To be clear, the decomposition procedure is a means to partition predicted differences derived from a regression model into components attributed to changing *slopes* and changing *means*. The procedure itself is model driven, thus, allowing us to determine the extent to which *predicted* differences in offending over time are attributable to overall changes in the mean subjective expectations of offending from adolescence to adulthood versus overall changes in the utilities associated with these incentives. The ratio of these components to the total difference is not analogous to a coefficient of determination.

TABLE 1 Descriptive characteristics of full and analytic sample from the pathways to desistance measured at baseline

	Full Sample (N = 1,354)		Analytic Sample (n = 585)	
Variable	**Mean**	**SD**	**Mean**	**SD**
Crime Variety	1.908	(3.504)	2.109	(3.025)
Personal Rewards	2.361	(2.418)	2.589	(2.452)
Social Rewards	1.003	(.444)	1.008	(.448)
Arrest Risk	5.279	(2.903)	5.234	(2.885)
Social Costs	1.729	(1.763)	1.763	(.866)
Male	.864	(—)	.832	(—)
White	.204	(—)	.232	(—)
Black[a]	.414	(—)	.356	(—)
Hispanic	.335	(—)	.354	(—)
Other race/ethnicity	.048	(—)	.058	(—)
Phoenix[a]	.483	(—)	.568	(—)
Philadelphia[a]	.517	(—)	.432	(—)

[a]Indicates that the two proportions differ from the full and analytic samples at the $\alpha < .05$ level in a proportions test.

15 years of age at the baseline. These individuals were still in their early 20s at the time of the final interview schedule and, in some cases, were asked to report crimes that occurred when they were still in their late teens. We also listwise removed respondents who were missing information on rational inputs at the baseline and ninth follow-up periods, as well as those missing self-reported offending at follow-up periods one, two, and ten. Thus, to be included in the sample, individuals must have valid information on our key covariates of interest across both time periods. Removing respondents who were missing information across either of the two analytic periods ensures that the individuals captured in adolescence are the same individuals captured in adulthood and, thus, that any differences in offending over time were not a result of differential attrition or of time-stable unobserved heterogeneity. A total of 585 adolescents met this requirement (71 percent of the respondents who began the Pathways study at ages 16 and 17), and they composed our final sample. The sample is similar in characteristics to the overall Pathways sample both on our main variables of interest measured at baseline and in demographics, but respondents are slightly less likely to be African American and more likely to be from Phoenix rather than from Philadelphia (see table 1).[6]

4.1 | Measures

At each interview of the Pathways study, respondents were asked about their offending behavior, as well as about their subjective expectations of crime. The indices of risk, costs, and rewards used in the Pathways study are adapted from Nagin and Paternoster (1994). A full list of the included items, as well as the scale properties, are available at http://www.pathwaysstudy.pitt.edu.

4.1.1 | Self-Reported offending variety

Respondents were asked, at each interview, to self-report the number of crimes they committed during the recall period. Our analyses include the following 17 crime types: destroying property, arson, shooting someone, shooting at someone, beating someone up, burglary, shoplifting, use of an illegal

[6]Our full Stata .do file including coding of variables and model script is available upon request.

credit card, auto theft, receiving stolen property, carjacking, robbery with a weapon, robbery without a weapon, selling marijuana, selling other drugs, carrying a weapon, and driving drunk. These crimes are similar to those used in prior work in which rational choice theories were assessed with the Pathways data (e.g., Loughran et al., 2016).[7]

Although respondents were initially asked to report the frequency with which they engaged in each crime, using open-ended counts has serious measurement shortcomings (Osgood, McMorris, & Potenza, 2002; Sweeten, 2012). To alleviate these problems, variety scores were employed in our main analyses. Variety scores are created by coding each offending item as a binary indicator, where individuals who did not engage in crime *c* are assigned a value of 0 and individuals who committed the crime 1 or more times are assigned a value of 1. The binary indicators are then summed together to create a composite score that reflects the count number of crime types that an individual commits (i.e., his or her crime variety; Hindelang, Hirschi, & Weis, 1981).[8] Variety scores have fewer measurement problems than offending frequency and still accurately capture variation in criminal propensity (Sweeten, 2012). For this reason, they are commonly used to test criminological theories—and rational choice theories more specifically—as well as changes in offending over time (Loughran et al., 2016). As we note in the Supplementary Analyses section, we examined the robustness of our findings to various operationalizations of the dependent variable, and the results are consistent with those from the main analyses. Because the first several follow-up interviews are conducted every 6 months and the last several occur annually, we created a variety score that reflects the total variety of crimes that individuals committed between the 12 months from baseline to the second follow-up interview.[9] By doing this, the regression models estimated during adolescence and young adulthood highlight the same temporal span and are, thus, comparable.

4.1.2 | Perceived personal rewards to offending

Respondents were asked how much "thrill" or "rush" they would experience when committing seven types of crime. These crimes included assault, robbery, stabbing someone, breaking into a store or home, stealing clothes from a store, vandalism, and auto theft. If the respondent had not engaged in any of these acts, he or she is asked to report how much "thrill" or "rush" it would be to engage in such behavior. Response options ranged from *no fun or kick at all* (= 0) to *a great deal of fun or kick* (= 10). The mean across all items was taken at each observation period to create a single intrinsic rewards scale (alpha = .88 at baseline).

4.1.3 | Perceived social rewards from offending

Perceived social rewards were captured by asking respondents how similarly aged peers would react to them engaging in three different crimes: stealing (e.g., "*If I take things, other people my age will respect me more"*), fighting (e.g., "*If I beat someone up, other people my age will respect me more"*), and robbery (e.g., "*If I rob someone, people my age will be afraid to mess with me"*). Response options

[7]In the Pathways study, we did collect information on the commission of homicide and sexual assault, but we did not have access to these restricted data for our analyses.

[8]We opted for a general offending measure – rather than a crime specific outcome - because the data available to us for intrinsic rewards, perceived risk, and perceived social costs were crime-general measures, and thus, using a general offending outcome has first-order agreement with most of our predictors.

[9]Our coding strategy does not "double count" crimes that were committed between the two 6-month follow-ups. Individuals who reported committing one armed robbery in the first follow-up, and one armed robbery in the second follow-up, are given a variety score of "1" just as they would if there were one 12-month follow-up.

were coded to range from *strongly disagree* (= 0) to *strongly agree* (= 4). The mean of the items was constructed at each observation period for each individual (alpha = .82 at baseline).

4.1.4 | Perceived arrest risk

A central component of rational choice theory is that the certainty of arrest deters offending. At each observation period, respondents were asked how likely it is that they would be caught and arrested after committing the same seven crimes as those captured in the personal rewards measure. Response options ranged from *no chance* (= 0) to *absolutely certain to be caught* (= 10), with the values in between corresponding to a 10 percent increase in the likelihood of arrest (Anwar & Loughran, 2011). The mean arrest risk of the seven crimes was calculated at each observational period for each individual (alpha = .89 at baseline).

4.1.5 | Perceived social costs of offending

Perceived social costs were captured by asking respondents how likely it is, if they were arrested by police, they would: lose respect from close friends, lose respect from family members, be suspended from school, lose respect from neighbors and other adults, lose respect from a girlfriend or boyfriend and find it harder to get a job. Response options were coded to range from *very unlikely* (= 0) to *very likely* (= 4). The mean of the items is taken for each individual at each observation period (alpha = .76 at baseline).

4.1.6 | Controls

We estimate models in which we account for impulsivity and time spent incarcerated. One reason individuals may offend less in adulthood relative to adolescence is because they become less impulsive as they age (Gottfredson & Hirschi, 1990). Impulsivity is often defined as the inability to consider the long-term consequences of behavior (Paternoster & Pogarsky, 2009), and changes in impulsivity may co-vary with changes in rational choice inputs (both coefficients and means) in ways that affect our decomposition estimates. *Impulsivity* is captured through the mean of eight items (e.g., "I say the first thing that comes into my mind without thinking enough about it") derived from the Weinberger Adjustment Inventory (WAI; Weinberger & Schwartz, 1990). We measure this item on a 0–4 scale with higher values reflecting greater impulsivity. We also control for the proportion of time period spent on the streets (i.e., not incarcerated in prison or jail) to account for the fact that individuals may have differential opportunities to commit criminal acts between adolescents and young adulthood. Higher values correspond to a larger proportion of time incarcerated.[10]

5 | MODEL

Our analytic strategy unfolds in three steps. We first regress self-reported offending on the rational inputs separately for adolescents and young adults. Given the overdispersed, count-based nature of the offending variety score, we employ negative binomial models to generate the parameter estimates. In

[10] Although prior research findings have identified differences in the Pathways sample across site location (Pyrooz, Gartner, & Smith, 2017), we do not control for location site in our analyses given that our interest is in changing coefficients and means within the same individuals over time, and site location is time stable. As a sensitivity check we estimated our models both controlling for site location and separately for each site. Overall, 1) the coefficients and relative over time are similar; 2) changing means for site location contributes zero and changing slopes contributes close to zero in the decomposition; and 3) the decomposition results for rational choice variables are similar to the main analysis.

our model, coefficients can be interpreted as partial elasticities of *E(Y|X)* at different levels of *X* for each of our rational choice inputs (e.g., the impact of a one-unit change in *X* on a percent change in *Y*).[11] Because we estimate two separate models for the same individuals at different time points, we account for the interdependence across the equations by incorporating the covariance of the coefficients when testing the equality of model parameters to ensure our tests use the correct standard errors (Clogg, Petkova, & Haritou, 1995; Paternoster, Brame, Mazerolle, & Piquero, 1998).[12] Finally, we employ a multivariate nonlinear decomposition to partition the differences in self-reported offending into the components identified in equation (4) through the mvdcmp package available in Stata 14 (Powers, Yoshioka, & Yun, 2011). In this approach, the results of our multiple regression models are relied on and expressions *A* through *E* simultaneously are decomposed.

The modeling strategy employed here is not as common as other approaches to examine developmental changes in offending over time (e.g., growth curve modeling), but it is ideal for our purposes. First, running separate regressions at different time points for the same individuals is informative when the two time points capture distinct developmental phases. We capture individuals at two time points that are widely considered by social scientists as distinct developmental points—adolescence and young adulthood (see Arnett & Tanner, 2006)—and among criminologists in particular as a result of the sharp decline in offending that occurs between these ages (Monahan, Steinberg, & Cauffman, 2009). Furthermore, with the Blinder–Oaxaca model, we can consider the hypothetical state where the subjective expectations of the rewards, risks, and costs of crime are fixed from adolescence to young adulthood, and we can contrast this with the hypothetical state where the marginal utility of offending is the same over time. Thus, we offer the most straightforward modeling strategy to assess our research question of interest.

6 | RESULTS

6.1 | Age-graded subjective expecations

Table 2 demonstrates that offending behavior decreases from adolescence to young adulthood among our analytic sample. On average, the 585 individuals included in our analysis committed over two types of crimes at ages 16 and 17 ($\bar{x} = 2.11$, standard deviation [SD] = 3.03), and fewer than one crime at ages 23 and 24 ($\bar{x} = .687$, SD = 1.51), which is a 68 percent reduction in crime variety. The perceived intrinsic rewards from offending decreases by nearly half (42 percent), from a mean of 2.59 in adolescence to 1.51 in young adulthood, which indicates that individuals tend to find crime less exciting as they age. The perceived social rewards from offending also decrease over time, with a mean of 1.01 in adolescence and a mean of .79 in young adulthood—a 22 percent reduction. Thus, not only do individuals find crime less intrinsically exciting, but they also (on average) believe that engaging in criminal behavior will elicit less social approval in adulthood when compared with adolescence (Matza, 1964; Warr, 1993, 1998). Conversely, the risks and social costs associated with engaging in criminal behavior increase from adolescence to young adulthood. The mean perceptions of arrest risk increase from

[11] We used the term "marginal utility" throughout the article, but note here that the coefficients can be interpreted as "partial elasticities." It is worth highlighting that the two are closely related in microeconomics, with marginal utility/returns often being estimated using elasticities. The advantage of elasticities is that it is a unitless measure that is unaffected by scaling and eases the interpretation of model parameters.

[12] Given the within-individual research design, the assumption that (Cov b,w = 0) is untenable. Estimating the variance–covariance matrix can be used to correct the violated assumption and to assess differences in model parameters between equations.

TABLE 2 Mean differences in offending and subjective utility inputs in adolescence and young adulthood ($n = 585$)

Variable	Adolescence (16–17 years) Mean (SD)	Young Adulthood (23–24 years) Mean (SD)	Paired *t* test of differences
Crime Variety	2.109	.687	$p < .000$
	(3.025)	(1.508)	—
Personal Reward	2.589	1.514	$p < .000$
	(2.452)	(2.148)	—
Social Reward	1.008	.785	$p < .000$
	(.448)	(.536)	—
Arrest Risk	5.234	5.991	$p < .000$
	(2.885)	(3.000)	—
Social Cost	1.763	2.395	$p < .000$
	(.866)	(.963)	—

5.23 in adolescence to 6.00 in young adulthood, which corresponds to nearly a 15 percent increase in perceived risk of arrest. The perceived social costs from crime increases 36 percent, from 1.76 in adolescence to 2.40 in young adulthood, which indicates that individuals perceive greater negative social consequences when offending in young adulthood compared with adolescence. Results from paired *t* tests indicated that each of these differences is statistically significant. Consistent with hypothesis 1, then, the mean subjective expectations of the costs, risks, and rewards to crime change from adolescence to young adulthood in a manner that is consistent with a rational choice theory of desistance, as well as with other prominent criminological theories (Akers, 1998; Sampson & Laub, 1993).

6.2 | Age-graded marginal utilities

Table 3 presents the results of negative binomial regressions predicting self-reported offending variety in adolescence and young adulthood. Perceived personal rewards are a positive and statistically significant predictor of crime variety in adolescence in both models without (model 1: $b = .178$, $p < .001$) and with controls (model 3: $b = .149$, $p < .001$). It is also predictive of offending in young adulthood in models both without (model 2: $b = .154$, $p < .001$) and with controls (model 4: $b = .100$, $p < .05$). Perceived risk of arrest is also predictive of crime variety in both adolescence (model 1: $b = –.049$, $p < .05$; model 3: –.052, $p < .05$) and young adulthood (model 2: $b = –.092$, $p < .001$; model 4: $b = –.096$, $p < .001$). There are two notable differences in the regression results from adolescence to young adulthood. First, perceived social rewards to offending is a statistically significant predictor of crime variety in adolescence (model 1: $b = .693$, $p < .001$; model 3: $b = .570$, $p < .001$) but not in young adulthood (model 2: $b = .188$, $p = .285$; model 4: $b = .092$, $p > .50$). Second, the perceived social costs of offending is unrelated to delinquency in adolescence (model 1: $b = .023$, $p > .50$; model 3: $b = –.010$, $p > .50$), but it is a negative and statistically significant predictor of offending in young adulthood (model 2: $b = –.243$, $p < .05$; model 4: $b = –.203$, $p < .05$). Also of note, impulsivity is a statistically significant predictor of crime variety in both adolescence ($b = .297$, $p < .001$) and young adulthood ($b = .443$, $p < .001$), whereas the proportion of time spent in the street, although in the expected direction, was unrelated to offending at either time period.

The results mostly show support for the proposition that the marginal utility from the rewards and the marginal disutility from the risks and costs change in a direction that may account for a decline in

TABLE 3 Negative binomial regression results of rational choice inputs in adolescence and young adulthood ($n = 585$)

Variable	Model 1 Adolescence β (SE)	Model 2 Young Adulthood β (SE)	Model 3 Adolescence β (SE)	Model 4 Young Adulthood β (SE)
Choice				
Personal rewards	.178***	.154***	.149***	.100*
	(.028)	(.043)	(.027)	(.042)
Social rewards	.693***	.188	.570***	.092
	(.168)	(.175)	(.169)	(.173)
Arrest risk	−.049*	−.092***	−.052*	−.096***
	(.023)	(.030)	(.023)	(.030)
Social costs	.023	−.243*	−.010	−.203*
	(.076)	(.098)	(.075)	(.096)
Controls				
Impulsivity	—	—	.297***	.443***
	(—)	(—)	(.069)	(.093)
Street time	—	—	.160	.137
	(—)	(—)	(.165)	(.232)
Intercept	−.400	.217	−.879	−.633
	(.273)	(.347)	(.295)**	(.407)

offending over time. The coefficient on perceived intrinsic rewards changes modestly, decreasing by 13 percent in the no-controls model and 32 percent in the model that includes the controls. There are drastic changes in the effects of anticipated social rewards on offending from adolescence to young adulthood: In the no-controls model, the coefficient reduces by 72 percent, and in the models with controls the coefficient reduces by 84 percent. Thus, we find evidence that the weight placed on rewards from offending decreases from adolescence to young adulthood. Conversely, the magnitude of the effects of the risks and costs gets larger in young adulthood. The coefficient on perceived arrest risk nearly doubles from adolescence to young adulthood, increasing by 88 percent in the no-controls models and by 85 percent in the models with the control variables, indicating that individuals become more risk averse over time. Finally, we see stark increases in the weight placed on anticipated social costs. For example, the coefficient on informal social costs from arrest is *19 times* higher in young adulthood compared with adolescence in the model that includes the controls.

To examine whether the parameter estimates are significantly different between adolescence and young adulthood, we first conduct a global omnibus test to assess the null hypothesis of joint homogeneity against the alternative hypothesis in which the coefficients across the time periods were allowed to vary to improve model fit (see O'Donnell, van Doorslaer, Wagstaff, & Lindelow, 2008). For both the models with and without controls, we reject the null hypothesis at an alpha level of .001, which indicates that marginal (dis)utilities, overall, differ from adolescence to young adulthood. This is consistent with the explanation of desistance offered by Paternoster and Bushway (2009), who argued that identity changes shift preferences (e.g., for time, risk, and social relations), which in turn influence the weight that individuals place on the (dis)incentives associated with crime (see also Giordano et al., 2002). We next examined whether the individual coefficients were statistically distinguishable using the Paternoster test (Paternoster et al., 1998). The results demonstrate that the marginal utility from the

TABLE 4 Results of Blinder–Oaxaca model decomposing percent differences in offending as a result of changing expectations and changing utility

Overall Decomposition		
Observable Characteristics (Subjective Expectations)	45.814	50.791
Coefficients (Marginal Utility)	55.186	49.209
Detailed Decomposition of Subjective Expectations		
Personal Rewards	23.333	18.618
Social Rewards	18.781	14.685
Arrest Risk	4.487	4.608
Social Costs	–1.787	.774
Impulsivity	—	14.605
Street time	—	1.149

social rewards to crime is statistically different from adolescence to young adulthood in models both without and with controls ($p < .05$). Furthermore, the marginal disutility of social costs significantly differs at an alpha level of .05 in the no-controls model but, and despite the large substantive differences in coefficients, only at an alpha level of .10 in the model that includes controls. The coefficients for personal rewards to crime and perceived arrest risk, although changing in the expected direction, do not differ significantly from adolescence to young adulthood at conventional levels of statistical significance. The results provide general support for hypothesis 2: The coefficients change in the expected directions and are jointly different, although only the individual coefficients for social rewards and social costs are significantly different across time.

6.3 | Decomposing changing expectations and changing utilities

Table 4 presents the results of the Blinder–Oaxaca decompositions. The findings indicate that both changing subjective expectations and changing marginal utilities contribute similarly to declines in offending from adolescence to young adulthood. Differences in offending would be reduced by approximately 45 percent if individuals held the same expectations regarding the risks, costs, and rewards from crime in young adulthood as they did in adolescence. In other words, if individuals' overall expectations of the (dis)incentives remained stable over the panel, then we would expect the decline in offending to be reduced by almost half. In the classic decomposition framework, the remaining 55 percent is attributed to "unobservable" factors, and it is calculated as a combination of differences in utilities (i.e., coefficients) and differences in intercepts over time. In the current application, the "unobservable" component is the analog of Paternoster and Bushway's (2009) notion of changing latent propensities that act primarily through the marginal (dis)utilities of offending. Our findings indicate that approximately half of the changes in offending over time can be attributed to the changes that the impact that inputs have on offending behavior (plus the changing intercepts). When we control for impulsivity and proportion of time in streets, there is a slight increase in the overall differences that is attributed to the observable mean levels of the predictors (51 percent), which is driven mostly by mean changes in impulsivity over time, and in turn by a slight decrease (49 percent) to estimated contributions of the unobserved portion.

Although we cannot formally tease out how much of the unobserved portion is driven by changing coefficients on the key predictors (i.e., marginal utilities) versus changing intercepts, there are reasons to suspect that changes in marginal utilities play a nontrivial role in the decline in offending. First, the

coefficients from adolescence to young adulthood all changed in the expected directions, and the results of a global omnibus test indicated that the joint parameter estimates were significantly different over time. Indeed, with the exception of the slopes for personal rewards, the changes in coefficients were substantively large over time. Second, although the estimated intercepts do differ in the two models, it is the case that the estimated intercept (predicted value of Y when all X's are 0 plus residual error) is *higher* in young adulthood relative to adolescence. Thus, although we cannot quantify precisely the extent, we believe that the findings indicate that the changing marginal (dis)utilities associated with rewards, risks, and costs contribute importantly to the decline in offending from adolescence to young adulthood.

We next turn to the results of the detailed decomposition for the subjective expectations of offending. We begin with the effects that increasing social costs have on changes in offending over time—a notion that is central to the age-graded theory of informal social control (Sampson & Laub, 1993). Our decomposition results indicated that increases only in the perceptions of social costs of arrest have a near-zero impact on changes in offending in both models. That is, if the effect of anticipated social costs remained the same from adolescence to young adulthood and only perceptions of social costs changed, then this would have *little-to-no impact on one's offending behavior.* This does not mean that social costs do not contribute to changes in offending but that changing perceived social costs must also be associated with changes in the weight placed on anticipated social costs—indeed, we saw drastic differences in the size of the anticipated social cost effect between the two time periods.

Turning to arrest risk, we again see negligible effects. In models both with and without controls, changes in perceived risk of detection explains ~4 percent of the changes in offending from adolescence to young adulthood. That is, if the weight placed on perceived arrest remained the same from adolescence to young adulthood, simply changing the mean perceptions of arrest risk would reduce offending by less than 5 percent. As with anticipated social costs, this does not mean that arrest certainty does not contribute to desistance, just that changes in mean perceptions must also be accompanied by increases in the magnitude of the effects (e.g., individuals must become more risk and cost averse) to have meaningful impacts on behavior.

Conversely, we find evidence that the mean perceived rewards to crime—both intrinsic and social—have large impacts on changes in offending. If individuals held the same expectations of intrinsic rewards in adulthood as in adolescence, the predicted differences in offending across this time would reduce by ~20 percent (23 percent in the no-control models and 19 percent in the with-control models). The detailed decomposition results offer similar findings with regard to perceived social rewards. If individuals had the same subjective expectations for the social rewards to crime in adulthood as in adolescence, the differences in offending variety would reduce by approximately 15 percent to 19 percent in the no-control and with-control models, respectively. Thus, the tendency to perceive crime as less exciting and socially rewarding in young adulthood (relative to adolescence) seems to play an important role in the desistance process.

The results of the decomposition model point to two important conclusions. First, both changing subjective expectations and changing marginal utilities (as captured in regression coefficients) contribute to changes in offending over time. Furthermore, their impact seems to be comparable, with around half of the reduction in crime from adolescence to young adulthood attributed to changing expectations and the other half attributed to changing (dis)utilities. Second, and contrary to conventional beliefs in criminology, our detailed decomposition results indicate mean perceptions of informal social costs and perceived arrest risk have a small impact on changes in offending over time, but it is changes in the perceptions of the rewards to crime that drive the effect that changing subjective expectations have on "desistance."

6.4 | Supplemental analyses

We conducted supplemental analyses to assess the robustness of our findings. First, although variety scores are common in criminology, we recognize that scholars are often concerned about other elements of offending, such as frequency and seriousness. We estimated models in which offending frequency was the outcome and present the results in appendix A2. Each crime item was top-coded at 10 offenses (rather than given a percentile) to reduce skew and to be consistent across time points. The results are remarkably similar to the main analyses. Changes in subjective expectations account for approximately half of the differences in offending from adolescence to young adulthood, with changes in marginal utility explaining the other half. Furthermore, mean changes were driven primarily by changes in the perceptions of the personal and social rewards to crime, whereas changes in the mean levels of social costs and arrest risk had negligible impacts on declines in offending.

Offending severity can be addressed using item response theory models to account for "item difficulty" (Osgood et al., 2002). We used the binary items in the main analyses to estimate a Rasch model of criminal propensity. We then estimated Tobit models (Osgood et al., 2002) and decomposed the effects of means and coefficients in a linear Blinder–Oaxaca decomposition model. The results are presented in the appendix A3 and again indicate that ∼50 percent of the difference in offending is a result of changes in marginal utility, and that ∼50 percent is a result of changes in subjective expectations. Furthermore, we found that the detailed decomposition results for the subjective expectations were similar to the main analyses: The impact of changing subjective expectations was driven primarily by the rewards to crime, whereas anticipated social costs and perceived arrest risk had small estimated effects.

Finally, we re-estimated our main analyses using the full Pathways sample ($N = 1{,}012$). The results (presented in appendix A4) are consistent with those provided earlier: Both subjective expectations and marginal utility contribute to the differences in offending from adolescence to young adulthood. Overall, the findings from the supplemental analyses are consistent with the main findings.

7 | DISCUSSION

In prominent life-course theories, declines in offending in adulthood are attributed to external (e.g., marriage and employment) or internal (e.g., identity change) factors that alter one's considerations about the risks, costs, and benefits of crime. For this reason, almost every theorist has explicitly stated that his or her respective explanation is compatible with "rational choice" (Giordano et al., 2002; Maruna, 2001; Paternoster & Bushway, 2009; Sampson & Laub, 1993). With some exceptions (e.g., Gartner & Piliavin, 1988; Paternoster & Bushway, 2009; Shover, 1996; Shover & Thompson, 1992), few scholars have formally considered how decision-making processes might account for changes in offending over time (McCarthy, 2002; Paternoster et al., 2015). We add to this literature by distinguishing between two components of a traditional decision-making model—subjective expectations and marginal utility—and by empirically decomposing the relative contribution of each in explaining changes in offending from adolescence to young adulthood.

Several key findings emerged. First, we found evidence that the subjective expectations and marginal utility of offending are age graded and that both contributed to declines in offending. According to most life-course explanations, either changes in the perceived rewards/costs (Sampson & Laub, 1993) or changes in preferences that alter the weight placed on rational inputs are emphasized (Paternoster & Bushway, 2009). In fact, Paternoster and Bushway (2009) have explicitly argued that a point of distinction between structural desistance theories such as the age-graded theory of informal social control and

interactionist theories such as the identity theory of desistance are offered by these different emphases. Our results point to a more nuanced process. We found that the two have direct and independent effects on changes in offending from adolescence to young adulthood, which indicates that, over time, individuals change their perceptions of the rewards and costs associated with crime, as well as the (dis)utility that they derive from these expectations. Moreover, we found that changing perceptions of the risks, costs, and rewards of crime and changing magnitudes of the effects of these rational inputs similarly contribute to changes in offending over time, with each explaining approximately half of the declines in offending from adolescence to young adulthood.

Second, we found that the impact of changes in subjective expectations varied substantially between the rewards and costs of crime. In some of the most prominent explanations of desistance, scholars have emphasized increased perceptions of arrest risk and informal costs (e.g., Sampson & Laub, 1993), while downplaying the importance of changes in the perceptions of the rewards of crime (see Giordano et al., 2002). We found that mean changes in perceived risk of arrest and social costs of crime explained a small portion of the changes in offending from adolescence to young adulthood. Conversely, changes in the mean perceptions of the rewards to crime (both intrinsic and social) explained a larger portion of the differences in offending over time. During adolescence, individuals tend to find crime "exciting" and "thrilling," but such perceptions change as they age (Katz, 1988). Furthermore, whereas individuals view crime and delinquency as behaviors that elicit social status and respect during adolescence, this perception declines in adulthood (Matza, 1964). Put directly, changes in expectations about the rewards from crime contribute more to the decline in offending in adulthood than do the associated risks and costs. As such, we echo the call made by Giordano and her colleagues (2002) to take more seriously the role of changing reward systems in the desistance process (see also Loughran at el., 2016; Matsueda et al., 2006; Piliavin et al., 1986; Shulman et al., 2017).

Third, although we could not conduct a formal detailed decomposition of the effects of the individual inputs regarding the changing coefficients over time, our findings provide some insights into the changing (dis)utility of offending from adolescence to young adulthood. There was considerable variation in how the coefficients of the risks, costs, and rewards changed over time. The utility derived from the personal rewards to offending changed little. Thus, all else equal, to the extent that individuals hold similar perceptions about the "excitement" and "thrills" that come from offending across the life course, their offending behavior is likely to be similar. We also found that the marginal disutility associated with perceived arrest risk increased, which is consistent with the notion that individuals become more risk averse as they enter adulthood. Although individuals may tolerate a 10 percent increase in arrest risk in adolescence, such an increase may weigh more heavily on their decision to offend when they are adults. The largest differences, however, were through changes in the marginal utility derived from social rewards and the disutility from social costs of offending. The former finding indicates that individuals may care less about the social rewards from offending, a premise that is consistent with the findings from both Giordano et al.'s (2007) qualitative work, as well as with those from studies in psychology in which cognitive development in adulthood and its relationship to susceptibility to peer influence are assessed (Chein et al., 2011; Gardner & Steinberg, 2005; Steinberg & Monahan, 2007). It is important to reiterate that the detailed decomposition results showing that changing social costs and perceived arrest risk contribute little to changing offending over time do not necessarily indicate that mechanisms of formal and informal control are unimportant for the desistance process. Rather, the weak magnitude of these effects during adolescence demonstrates that changing perceptions of the risks and social costs of crime must also be accompanied by changes in the disutility associated with these factors for the inputs to have an appreciable effect on the desistance process (see also Cauffman et al., 2010). In some ways, then, these findings are consistent with interactionist theories such as those offered by Giordano et al. (2002) and Paternoster and Bushway (2009).

These findings add theoretical and empirical clarity to how the decline in offending from adolescence to young adulthood is consistent with a rational choice perspective. Nevertheless, we want to be clear that we do not intend for this to be a fully specified rational choice theory of desistance, nor do we believe that our findings refute existing life-course explanations. Moreover, although we suggested that changing expectations and changing utilities help explain the decline in crime from adolescence to young adulthood, we did not stake a claim as to *why* these decision-making components change over time. It is possible (if not likely) that the perceived rewards and costs change through "turning points" (Sampson & Laub, 1993) or "hooks for change" (Giordano et al., 2002), and that changing marginal utilities may result from identity transformations that affect preferences for risks and rewards (Paternoster & Bushway, 2009). The point is that although our framework was motivated by a rational choice perspective, it is not necessarily incompatible with other explanations of crime over the life course and that, in fact, a more comprehensive explanation may be achieved by further developing the decision-making processes that are embedded in other theories (McCarthy, 2002; Paternoster et al., 2015).

Certain aspects of our study should be considered when taking stock of our findings. We focused on the differences in offending from adolescence (16–17 years of age) to young adulthood (23–24 years of age) precisely because it is characterized by a drastic decline in offending (Eggleston et al., 2004; Moffitt, 1993). Indeed, in prior work, scholars have observed that most criminal behavior peaks around ages 16 and 17 and declines substantially by the mid-20s (Eggleston et al., 2004; Monahan et al., 2009). Thus, although the data used in our study cover a circumscribed cross section in the life courses of our sample, the ages of the respondents are ideal for our research question because it allows for us to focus on the point when crime is near its peak and the point at which most individuals have showed clear evidence of "desisting."

Nevertheless, we recognize the importance of understanding changes in offending across other phases of the life course. For example, researchers have drawn on rational choice principles to explain delinquency onset (Paternoster, 1989; Smith & Brame, 1994; Steinberg, 2008). Decomposing the relative contributions of subjective expectations and marginal utilities may offer insights into an important phase of the criminal career, and through such analyses, researchers may find different results than observed here. After all, criminologists have long recognized that the factors promoting declines in offending may not simply be the reverse of factors promoting increases in offending (Rutter, 1988; Uggen & Piliavin, 1998). We encourage future work to be aimed at the age-graded nature of subjective expectations and marginal utilities across a larger portion of the life course and for scholars to examine the relative influences over other stages of the criminal career.

Furthermore, respondents in the Pathways study were convicted of a serious offense as juveniles and are not representative of the general population. Scholars have argued that examining decision-making processes among high-risk samples should be of particular interest to criminologists for both theoretical and policy reasons (Anwar & Loughran, 2011; Loughran et al., 2016). Nevertheless, the extent to which our findings would be similar in a more general sample remains an empirical question, and we encourage future work to be focused on exploring this issue.

Finally, although the Blinder–Oaxaca model has been the most common approach used to decompose differences in outcomes attributed to mean levels versus coefficients (Fairlie, 2005), and we believe it is an appropriate way to test our question of interest, there are important things to consider when using this method (see Ospino, Vasquez, & Narvaez, 2010, for more detailed discussions). First, although commonly referred to as a "counterfactual" approach, we caution against a causal interpretation of our results. Rather, we view the decomposition model as a descriptive tool that can allow for an assessment of the relative contributions of changing expectations and changing utilities to explain differences in offending over time. It does so through the examination of the hypothetical scenario in

which individuals have the same perceptions of, and returns to, the rewards, costs, and risks of crime in adolescence and young adulthood.

Second, the results of decomposition models can be impacted by the choice of the reference group. As with most modeling decisions, the choice of the reference group should be theoretically driven. In our case, using young adulthood as the reference group makes intuitive sense. It allows for us to examine the hypothetical situation in which 1) the distribution of subjective expectations is equal across age periods and marginal utilities are fixed to adolescent levels and 2) the marginal utilities were equal from adolescence to young adulthood and the subjective expectations were fixed at young adult levels.[13]

In conclusion, our findings indicate that as people get older they view crime as less intrinsically rewarding and demonstrate an increasing aversion to the risks and costs associated with criminal activity. Furthermore, individuals tend to view crime as less socially rewarding and place less weight on the social benefit of offending. This finding adds to the growing literature in which the role of choice in the offending process is assessed (McCarthy, 2002; Nagin, 2007; Pogarsky et al., 2018). Also, through this finding, a fundamental question in life-course criminology is addressed: How do the (dis)incentives for crime and their associated marginal utilities change over time, and what influences do such changes have on the decline in offending from adolescence to young adulthood? To that end, we believe that our findings are an important contribution, and we urge scholars to consider more fully how decision-making processes can be applied to explain differences in offending across the life course.

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[13]One approach to this "reference group" problem is to run separate decomposition models using both groups as the reference and to average across the findings. We did this, and the findings are substantively similar to those presented in the text. These results are available by request.

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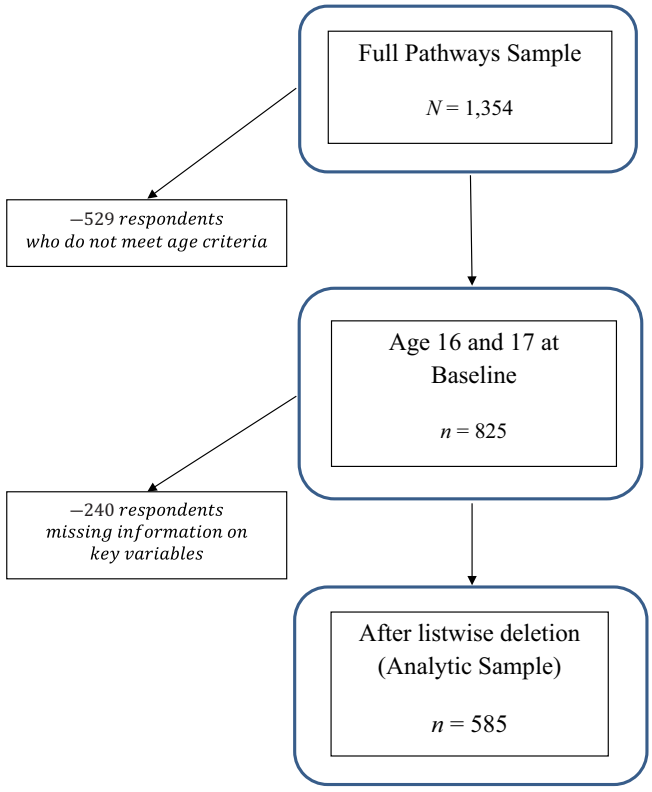
APPENDIX A

A1 A priori sample selection procedure

Our sample selection procedure is as follows. We begin with the full Pathways samples ($N = 1{,}354$). We then restrict our sample to respondents who are 16 and 17 years old at Baseline ($n = 825$). Finally, we require individuals to have valid information on the following items:

1) Crime variety at follow-up waves 1, 2, and 10.
2) Perceived personal rewards, social rewards, arrest risk, and social costs at Baseline and follow-up wave 9.

After listwise deletion on these variables, our final analytic sample is $n = 585$.
The following flow chart displays these sample selection criteria graphically:



A2 Results of Blinder–Oaxaca model decomposing percent differences in offending as a result of changing expectations and changing utility on offending frequency

Overall Decomposition		
Observable Characteristics (Subjective Expectations)	46.104	49.280
Coefficients (Marginal Utility)	53.896	50.720
Detailed Decomposition of Subjective Expectations		
Personal Rewards	21.439	18.837
Social Rewards	19.376	15.720
Arrest Risk	4.966	5.248
Social Costs	.322	1.243
Impulsivity	—	10.533
Street time	—	−2.301

A3 Results of Blinder–Oaxaca model decomposing percent differences in offending as a result of changing expectations and changing utility using rasch estimate of criminal propensity

Overall Decomposition		
Observable Characteristics (Subjective Expectations)	41.152	44.323
Coefficients (Marginal Utility)	58.848	55.677
Detailed Decomposition of Subjective Expectations		
Personal Rewards	20.784	17.543
Social Rewards	15.645	11.394
Arrest Risk	4.720	4.889
Social Costs	.003	2.575
Impulsivity	—	11.722
Street time	—	−3.800

A4 Results of Blinder–Oaxaca model decomposing percent differences in offending as a result of changing expectations and changing utility in full pathways sample

Overall Decomposition		
Observable Characteristics (Subjective Expectations)	37.553	48.459
Coefficients (Marginal Utility)	62.447	51.451
Detailed Decomposition of Subjective Expectations		
Personal Rewards	25.456	19.057
Social Rewards	12.386	7.525
Arrest Risk	4.343	3.922
Social Costs	−4.632	.705
Impulsivity	—	17.897
Street time	—	−.558