Original Article

Journal of Drug Issues
2023, Vol. 0(0) 1–16

DOI: 10.1177/00220426231159303
journals.sagepub.com/home/jod
SAGE

Adolescent Substance Use Outcomes in Response to Social Consequences of Use: The Role of Empathy

Drew E. Winters[1], Suena H. Massey[2], and Joseph T. Sakai[1]

Abstract

Evidence suggests empathy deficits have a temporal relationship with substance use severity by late adolescence theorized to decrease use via recognition of social consequences. However, this has yet to be tested empirically along with differences in cognitive and affective empathy. Adolescents admitted to substance use treatment (n = 3382) were followed through treatment and 12 months after treatment. Variable trajectories were fit using growth curve models; and cross-lagged effects of cognitive and affective empathy (interpersonal reactivity index) on response to social consequences of use were tested along with how response to social consequences affected the mean trajectory of substance use. Results indicate higher cognitive empathy predicted greater response to social consequences of use and response to these consequences at the end of treatment predicted a steeper decrease in substance use. This evidence highlights the importance of cognitive empathy for responding to social consequences of use for motivating less adolescent substance use.

Keywords

adolescence, cognitive empathy, affective empathy, substance use, treatment

While it is well known that substance use has a typical age-related pattern that peaks in late adolescence and drops rapidly as one moves into adulthood, a subset persist in substance use (Dennis & Scott, 2007). Recent theories aiming to understand what may separate those that persist in substance use suggest that social cognitive and affective functioning may play an important role (Cousijn, Luijten, & Feldstein Ewing, 2018; Massey, Newmark, & Wakschlag, 2017). These theories suggest empathy impairments underlie persistent use despite social consequences,

[1]Department of Psychiatry, University of Colorado School of Medicine, Anschutz Medical Campus, Aurora, CO, USA
[2]Department of Psychiatry and Behavioral Sciences, Northwestern University Feinberg School of Medicine, Chicago, IL, USA

Corresponding Author:
Drew E. Winters, Department of Psychiatry, University of Colorado School of Medicine, Anschutz Medical Campus, 13001 e. 17th place, Aurora, CO 80045-2559, USA.
Email: Drew.winters@cuanschutz.edu

whereas normative levels of empathy underlie a recognition of social consequences and motivation to change substance use – resulting in decreased substance use across varying stages of use (Massey et al., 2017); and that these responses to the social environment explain normative decreased use as adolescents transition into adult roles (Cousijn et al., 2018). Evidence demonstrates socio -cognitive and -affective functioning (e.g., empathy) in youth has a temporal association with substance use severity by late adolescence (For meta-analysis: Winters, Brandon-Friedman, Yepes, & Hinckley, 2021). However, it has yet to be examined how empathy predicts how the recognition of social consequences and related response to modify their use (i.e., response to social consequences of use) and how this predicts substance use over time. This is a critical next step for understanding empathic influences on substance use in adolescents. Thus, the present study tests how empathy from a prior timepoint predicts response to social consequences of substance use and how this impacts the trajectory of adolescent substance use.

The response to social consequences of substance use inspired by the work of Massey et al. (2017) involves two distinct components that motivate change in substance use and are equally important for defining the construct. The *first factor* is recognition of social consequences related to their use which includes consequences for themselves as well as recognizing the impact their use has on others. The *second factor* is engagement in doing something to reduce their substance use. Recognition that consequences exist for themselves and for others is a potential motivating factor, but, in and of itself, does not require a response to that recognition of a social consequence. It is the response to consequence recognition, such as treatment motivation, that defines both the recognition and motivation response of this construct. Massey et al. (2017) theorizes the response to consequences of substance use is driven by the ability to understand other's emotions (i.e., empathy; Decety, Bartal, Uzefovsky, & Knafo-Noam, 2016) or, in other words, response to social consequences of use indirectly accounts for (i.e., mediates) empathy's association with substance use. Empathy not only aids recognition of social information but also an understanding what others feel, which plausibly bridges the recognition and felt sense of loss of connection (whether self-focused or other-focused) motivating a reduced use response.

Social consequences are different at different levels of use involving different responses to consequences of substance use. For example, casual users with greater empathy would desist use because of the concern expressed by those they care about or loss of social roles that incur emotional costs to themselves; whereas those with problematic use or even full addiction that develop high levels of empathy would be deterred because of a loss of relationship significant to them or harm caused to their loved ones. On the other hand, those with low empathy would not be deterred by any of these consequences, and would be more likely to persist in use (Massey et al., 2017). Given that empathy is critical for bonding and responding to the social environment (Anderson & Keltner, 2002; Cliffordson, 2002; Eisenberg et al., 1996), it is plausible that those with lower empathy are less likely to respond to negative social signals related to their substance use. Additionally, empathy is under development through adolescence and into adulthood (Decety & Michalska, 2010; Eisenberg, 2005). Theory by Cousijn et al. (2018) suggests that neural development underlying the capacity to respond to the social environment drives normative decreased use as adolescents take on more adult roles – one may infer from this model that if this development is impaired, young adults may persist in use as their peers decrease use. These theories highlight the importance of social response and empathy relating to persistence in substance use, especially during adolescence.

Empathy is supported by distinct processes with different developmental trajectories – cognitive and affective empathy (Decety & Cowell, 2015; Singer, 2006; Smith, 2006; Walter, 2012). Cognitive empathy involves taking the psychological point of view of others (i.e., perspective taking) whereas affective empathy involves sharing other's emotions, which can include a response of concern for another's wellbeing (i.e., empathic concern) (Decety, 2011; Decety & Cowell, 2015). Cognitive and

affective empathy have distinct neural underpinnings in adolescence (Kral et al., 2017; Winters, Pruitt, et al., 2021) that are still under development with subcortical regions associated with affective empathy developing earlier whereas cortical regions involved in cognitive empathy do not fully mature until early adulthood (Blakemore, 2012; Singer, 2006). These distinct empathy processes likely have different roles when responding to social consequences. For example, cognitive empathy can cue one into messages from the social environment; whereas affective empathy can generate the affective resonance to understand the emotional concerns of others. These associations are likely different between adolescents and adults. Thus, examining adolescent empathy is critical for understanding the interplay between responding to social consequences and substance use.

The present study longitudinally examines how cognitive and affective empathy predicts response to social consequences of substance use and how the trajectory of this response is related to substance use over time amongst adolescents involved in substance use treatment. We hypothesize that (1) higher levels of both cognitive and affective empathy will predict higher levels of response to social consequences of substance use and (2) that greater levels of response to consequences of substance use at the end of treatment will mediate (i.e., indirect effects) cognitive and affective empathy prediction of decreased substance use trajectory over time. This study is critical for understanding social cognitive and affective factors that may contribute to future substance use patterns, which highlight novel factors to motivate changes in substance use.

Methods

Sample

We conducted a secondary data analysis of the Drug Abuse Treatment Outcome Studies for Adolescents data set (DATOS-A; Kristiansen & Hubbard, 2001) that was collected between November 1993 and November 1995. This data set recruited adolescents admitted into substance use treatment from six large American cities (n = 3382). Participants were assigned to either residential, short-term inpatient, or outpatient treatment. Those in residential treatment had the highest drug dependence and those in outpatient had the lowest drug dependence and the least risk on average (Kristiansen & Hubbard, 2001). All participants were followed through treatment at baseline (T1), 1 month (T2), 3 months (T3), and 6 months (T4) with a post-treatment follow up at 12 months post-treatment (T5).

The DATOS-A collection focused on broad factors influencing treatment outcomes at varying levels of substance use treatment. Therefore, we have no information on the types of interventions used during treatment only the level of service (i.e.; residential, inpatient, outpatient) assigned by level of immediate risk and severity of use (Kristiansen & Hubbard, 2001).

Measures

Measures were part of a structured interview adapted from the National Health Survey and National Institute of Mental Health's Epidemiological Catchment Area Studies for a measure specific to the DATOS-A (Hubbard, Craddock, Flynn, Anderson, & Etheridge, 1997). This structured interview is comprised of multiple other measures and some items were created for this specific measure. The descriptive statistics and amount of missing data for the examined variables are shown in Table 1.

Substance Use. Participants self-reported their use of different substances [i.e., alcohol, marijuana, cocaine, or hallucinogen (Questionnaire defined as "LSD, PCP, or any other hallucinogen")]. We used a dichotomous measure from these self-reports indicating if they had used any of the highest-reported

Table 1. Descriptive Statistics of Examined Variables.

Continuous variables	M ± SD	% missing	Reliability	Categorical variables	n (proportion)	% missing
Cognitive empathy				Substance use		
Wave 1	12.62 ± 5.33	2	.70	Wave 1	2904 (97% use)	14
Wave 2	13.37 ± 5.34	34	.73	Wave 2	2256 (13% use)	33
Wave 3	14.11 ± 5.46	67	.74	Wave 3	1116 (18% use)	67
Wave 4	14.70 ± 5.32	84	.73	Wave 4	530 (13% use)	84
Wave 5	13.76 ± 5.38	47	.75	Wave 5	1703 (77% use)	49
Affective empathy				Treatment modality		0
Wave 1	17.07 ± 5.07	2	.69	Residential	1627 (48%)	
Wave 2	17.36 ± 4.90	35	.70	Inpatient	929 (27%)	
Wave 3	17.40 ± 4.75	67	.68	Outpatient	826 (25%)	
Wave 4	17.74 ± 4.92	85	.68	Sex		0
Wave 5	17.56 ± 4.70	47	.70	Female	885 (26%)	
Social response				Male	2497 (74%)	
Wave 1	2.24 ± .36	34	.70	Race		0
Wave 2	2.47 ± .30	67	.67	White	1758 (52%)	
Wave 3	2.70 ± .35	84	.70	Black	807 (23%)	
Age at wave 1	15.75 ± 1.36	0	–	Hispanic	685 (20%)	
				Other	132 (3.9%)	

substances of use in the sample (alcohol, marijuana, cocaine, or a hallucinogen) over the previous 3 months (use = 1 no use = 0). Another option we could have chosen was to use a substance use variety score indicating the number of different substances participants endorsed. However, we chose against this as (1) it does not capture the severity of use of each substance endorsed and (2) we had no hypotheses related to variety of substance use – our hypotheses directly relate to whether substance use occurred or not. Given that there were a clear number of four substances that were endorsed by participants and all measures of substance use only indicate whether they used, we decided using the dichotomized use variable of the most used substances provided the variance necessary to answer the current research question.

Empathy. The perspective taking and empathic concern subscales of the Interpersonal Reactivity Index (Davis, 1980, 1983) were used to assess cognitive empathy and affective empathy, respectively. It is common practice to measure cognitive and affective empathy with these two subscales (Konrath, 2013), and to exclude other subscales (fantasy and personal distress) as they likely measure constructs that are beyond empathy (Baron-Cohen & Wheelwright, 2004). The perspective taking subscale (our measure of cognitive empathy; baseline $\alpha = .70$) consists of seven items that measure the disposition to adopt another's point of view (e.g., "I try to look at everybody's side of a disagreement before I make a decision"). The affective empathy subscale (baseline $\alpha = .68$) also consists of seven items that measure the disposition to share another's emotional experience and have concern for them (e.g., "When I see someone being taken advantage of, I feel kind of protective towards them"). Participants rate each item on this measure on how well each statement describes them on a five-point Likert scale from "does not describe me well" to "describes me well" (0–4). Higher scores indicate higher levels of dispositional cognitive or affective empathy. The IRI demonstrates convergent and divergent validity, shows a consistent factor structure across samples and nation of origin, (Konrath, 2013), and the factor structure of this measure has been confirmed in adolescents (e.g., Hawk et al., 2013).

The IRI was created as a measure of dispositional empathy. Previous ideas on empathy were that it was a trait-like function that remained static over time. However, our contemporary knowledge of empathy is that it is malleable and can be cultivated by training it – like a skill (Schumann, Zaki, & Dweck, 2014; Zaki, 2018). While the IRI is thought to measure dispositional empathy, it has been proposed to use it to observe changes in medical students training over schooling (Konrath, 2013) and this has been implemented by using the IRI to examine medical students change in empathy over 3 years of medical training (Shin, Park, & Lee, 2022). Therefore, we believe the IRI to be an adequate measure to measure both cognitive and affective empathy while also allowing the sensitivity to observe variation throughout the course of treatment.

As a measure of consistency of measurement across the different time periods, we calculated in intraclass correlation using the psych package in r. We found Cognitive empathy had an intraclass correlation of .79 and affective empathy had an intraclass correlation of .74.

Social Response to Substance Use Consequences. Inspired by theory by Massey et al. (2017), we selected items from the University of Rhode Island change assessment scale (URICA) and drug treatment questions created for the structured interview used in the DATOS. Items selected for inclusion from each measure are outlined in Table 2.

The URICA (McConnaughy, Prochaska, & Velicer, 1983) is a 24-item scale that measures one's stage of change (precontemplation, contemplation, action, and maintenance). Responses on this measure are rated on a 5-point Likert scale from strong disagreement to strong agreement (1–5). We selected items in this measure that captured 1) perceptions of treatment being worthwhile (suggesting a belief treatment will help) and 2) willingness to engage with treatment (suggesting active participation in changing substance use). We used items from the action subscale and reversed scored precontemplation scales to assess a participant's willingness to work on identified problems related to substance use. Higher scores indicate perceptions that treatment is worthwhile and a greater participation in addressing substance use problems.

The selected scale items created for the DATOS-A reflected recognition of substance use causing problems for themselves and others. These items were rated on a three-point scale from "not important" or "don't agree" to "very important" or "strongly agree" (0–2). Higher scores indicate identifying their substance use has caused significant problems for themselves and others and agreement that treatment will help.

Time-Invariant Control Variables. For control variables we used self-reported sex, age, site where data was collected, and assigned treatment modality. We controlled for sex to account for sex related differences observed in substance use (For review: McHugh, Votaw, Sugarman, & Greenfield, 2018). We controlled for age to account for age related patterns of use (Dennis & Scott, 2007). To control for differences in variation due to level of treatment, we controlled for inpatient and outpatient with residential as the reference category. We had no reason to believe ethnicity would drive differences in empathy or social response, thus we excluded ethnicity as a covariate.

Analysis

All analyses were conducted using R statistical language (Version 4.02; R Core Team, 2021). The "psych" package (Revelle, 2021) was used for factor analysis and "lavaan" was used for both confirmatory factor analysis (CFA) and growth curve modeling (Rosseel, 2012). Prior to our analysis we tested for distribution normality of residuals, autocorrelation, and multicollinearity, which we found no violations. All models were evaluated using criteria for adequate fit suggested by Hu and Bentler (1999) and Mulaik et al. (1989) (RMSEA $\leq$ .06, CFI & TLI $\geq$ .90).

Table 2. Items and Factor Analysis Loadings for Social Response to Substance Use Consequences.

Items	Factors			
	Not engaged. (reverse scored)	Drug use cause problems	Actively changing substance use	Treatment importance
URICA items				
I am doing something about my drug problem	[a]	[a]	.671	[a]
Being here is a waste of time – I am not the cause[b]	.506	[a]	[a]	[a]
I am working on my problems	[a]	[a]	.577	[a]
I am doing something about changing myself	[a]	[a]	.707	[a]
It is boring to talk about my problems[b]	.649	[a]	[a]	[a]
Does no good to think about my problems[b]	.639	[a]	[a]	[a]
I would rather live with my faults than try to change[b]	.472	[a]	[a]	[a]
DATOS-A measure items				
How troubled are you with your drug problem	[a]	.439	[a]	[a]
How important is it to get treatment for your drug problem	[a]	[a]	[a]	.964
Your drug problem has caused problems in your life	[a]	.826	[a]	[a]
Your drug problem has caused problems for others	[a]	.817	[a]	[a]

[a] = loadings <.40
[b] = reverse scored.

A Latent Construct for Social Response to Substance Use Consequences. First, inspired by theoretical work of Massey et al. (2017), we selected items to define different components of a response to social consequence that involved 1) recognition of substance use causing a problem and 2) motivation to change their substance use (see items in Table 2). The items measuring this construct were collected at three out of the five timepoints (timepoints two through four). Response frequencies on the URICA revealed <5% endorsement on the lower end of all items; thus, we collapsed these items leaving three responses for each item. Then, these items were used to statistically define social response to substance use consequences.

Next, we randomly assigned a training a test set of participants (70% and 30% respectively) and conducted a factor analysis on the training set as well as a CFA on the test dataset to verify the response to social consequences of use construct. For the factor analysis we used a varimax rotation to examine the factor structure. We determined the number of factors using a scree plot and that factor had an eigenvalue for each factor were >1. These criteria revealed a 4-factor structure represented the construct. This factor structure adequately fit the data (x^2 (17) = 24.55, TLI = .977, RMSEA = .033) and accounted for 98% of the variance (see loadings in Table 2).

We then conducted an item level analysis to determine an optimal parceling scheme from this factor structure. We examined correlated residuals (θ matrix) and parceled items together that showed a tendency to correlate with each other after conditioning on the underlying construct being measured (Little, Rhemtulla, Gibson, & Schoemann, 2013). We parceled items that had the highest set of loadings >10 (Supplementary Table S1). This resulted in one item parcels for each individual factor.

Using the parceled indicators, we then conducted a CFA with the test sample to confirm the factor structure. The factor structure was confirmed using the item parcels (x^2 (2) = 2.12, CFI = .998, TLI = .990, RMSEA = .040) with an adequate reliability (α = .69). This same parceling scheme was used for all timepoints to examine mean growth trajectories of social response to substance use consequences. To ensure the same construct was being measured at each timepoint we established measurement invariance at the configural, loadings, and intercept level (Table 3).

Individual Models of Growth

We examined mean change for each variable of interest (i.e., substance use, social response, cognitive empathy, and affective empathy) using growth curve modeling in the structural equation modeling framework. Preliminary investigation of means for each timepoint suggested changes in social response to use was linear, whereas empathy and substance use variables were nonlinear. To test whether a linear trend adequately represents the data, we first test a linear model against a non-linear latent basis model. If non-linear, we then attempted to model the optimal functional form by adding a quadratic trend and compare the AIC to determine which model more closely models the data (See Table 4). The latent basis curve model estimates non-linear trajectories with level and shape latent growth factors. The level factor is constrained to one for each timepoint and the shape factor constrains the initial timepoint to 0 and either the second or last timepoint to 1 allowing the other timepoints to be estimated freely.

For models with continuous variables (i.e., cognitive empathy, affective empathy, consequence response) we used full information maximum likelihood estimation method (FIML). FIML produces unbiased estimates of parameters by using all available data to maximize the likelihood over each vector of observations to derive parameter estimates (Little & Rubin, 2019; Muthén, Tam, Muthén, Stolzenberg, & Hollis, 1993). Models with binary variables, specifically substance use, we used the weighted least squares mean and variance adjusted estimator (WSLMV) to model the categorical outcomes. WLSMV assumes a continuous latent construct underlying substance use at each timepoint, which allows us to measure the extent of variation over time (Asparouhov & Muthén, 2010). Concerning missing data, FIML and WLSMV can produce unbiased estimates and retain missing values without dropping cases (Asparouhov & Muthén, 2010). In comparison to traditional deletion of substitution methods which introduce significant bias into statistical analyses, these modern missing data approaches are far superior for reducing bias (Little & Rubin, 2019).

Table 3. Longitudinal Invariance for Social Response.

Model	AIC	X^2 (df)	CFI	RMSEA	ΔX^2 (df)	*p*	ΔCFI	ΔRMSEA	Decision
Configural invariance	7847.1	111.51 (33)	.970	.069	–	–	–	–	–
Metric invariance	7842.3	118.7 (39)	.968	.064	7.18 (6)	.31	.000	.005	Pass
Scalar invariance	7863.3	151.71 (45)	.959	.069	33.01 (6)	<.001	.009	.005	Pass

Table 4. Fitting Single Growth Curve Models.

	AIC	X^2 (df)	CFI	TLI	RMSEA	ΔX^2 (df)	ΔX^2 p	Best fit model
Affective empathy								
Linear	51,673	74.29 (10)	.961	.961	.044			
Latent basis	51,658	53.61 (7)	.972	.959	.045	20.67 (3)	<.001	Latent basis
Quadratic	51,624	17.26 (6)	.993	.989	.024	36.35 (1)	<.001	Quadratic
Cognitive empathy								
Linear	53,708	131.12 (10)	.927	.927	.060			
Latent basis	53,635	52.64 (7)	.972	.961	.044	78.48 (9)	<.001	Latent basis
Quadratic	53,612	27.98 (6)	.987	.978	.033	24.65 (1)	<.001	Quadratic
Social response								
Linear	22,058	134.50 (52)	.985	.974	.022			
Latent basis	22,062	142.11 (54)	.984	.973	.022	7.61 (2)	.022	Linear
Substance use								
Linear	NA	1747.5 (10)	.00	−29.7	.827			
Latent basis	NA	7.51 (7)	.991	.987	.017	2182.3 (3)	<.001	Latent basis
Quadratic	NA	144.49 (6)	.00	−3.08	.301	143.03 (1)	<.001	Latent basis

Cross-Lagged Effects of Empathy on Substance Use Trajectories Regressed on Social Response

We then examined social response growth terms on substance use latent growth terms as well as cross-lagged effects of cognitive and affective empathy as a time-varying predictor on social response (Wu & Lang, 2016; Wu, Selig, & Little, 2012). We included time constant controls for age, sex, and treatment modality for each regression path. For meaningful intercept interpretation, we coded social response such that the intercept was at the final timepoint (timepoint four) and for substance use at timepoint five. We examined how time-varying predictors influenced social response after controlling for covariates and how social response influenced the latent growth trajectory of substance use (See Supplementary Figure 1 for specification). And finally we tested indirect effects for each cross lagged connection on substance use outcomes using the product of coefficients (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002).

An important feature of our growth curves is placement of importance on the response to social consequences of use at the end of treatment. Changing the loci of importance in a trajectory does not impact the temporal ordering of a growth curve, it merely emphasizes the point at this is important for the current study. Given treatment is expected to impact how one responds to social consequences related to use – we place the importance of the intercept for at the end of treatment to account for this expected effect. The importance of the intercept at the end of treatment would be interpreted as the mean level of response to social consequences of use at the end of treatment.

Importantly, under no circumstance did we have any latent variables with less than three items representing that latent factor. For the final model, response to social consequences of substance use each have four items and the intercept and growth factors of response to social consequences of substance use has three items each. Substance use growth and intercept factors have five items. Finally, both cognitive and affective empathy are not estimated as latent factors but instead are modeled as observed cross-lagged effects to improve causal evidence.

Missing Data Sensitivity Analysis. The data collection had a substantial amount of missing data (see Table 1). To address this, we did a sensitivity analysis by running the analyses with all waves of

data and also dropping wave three and four (where missingness was at its highest). The results of the models were the same; thus, we only report results with all five waves of data.

Additionally, we conducted a set of t-tests to try and identify if any bias in the data accounted for patterns of missingness with demographic variables and variables of interest. These tests did not find any reason for missing and therefore assume data to be missing at random for which we can properly treat using FIML estimation.

Results

Sample. The sample consisted of 3382 adolescents in substance use treatment (2497 males [74%] 885 and females [26%]) between the ages of 12–18 (15.75 ± 1.36) that were predominantly White (White = 1758 [52%], Black = 807 [24%], Hispanic = 685 [20%], other = 132 [4%]. Most of the participants were assigned to residential treatment (residential 1627 [48%], inpatient = 929 [27%], outpatient = 826 [25%]). When recording baseline use of cannabis, alcohol, cocaine, or hallucinogens, 3% of participants reported using no substances, 15% reported using one substance, 48% reported using 2, 24% reported using three, and 10% reported using all four over the past 3 months. Marijuana was the most used with 92% of participants reported its use. Distributions of the IRI for both cognitive (overall average 13.71 ± 5.37) and affective empathy (overall average 17.43 ± 4.87) were in the moderate range. Mean IRI scores for each timepoint in the present study (Table 1) are within a SD of mean IRI scores of other large adolescent studies (e.g., Hawk et al., 2013; Overgaauw, Rieffe, Broekhof, Crone, & Güroğlu, 2017).

Direct Association Between Empathy and Use. Cognitive and affective empathy had moderate to low negative zero-order correlations with substance use (see Supplementary Table S2).

Individual Growth Trajectories. Individual growth curves suggest that the mean trajectories of social response (mean growth = .535, $p = .038$) increase over time whereas substance use decreases over time (mean growth = −.225, $p < .001$). Cognitive empathy and affective empathy have a mean increase over time with a quadratic decrease between timepoints 4 and 5 (Cognitive: mean growth = 1.04, $p < .001$, quadratic −.186, $p < .001$; Affective: mean growth = .311, $p < .001$, quadratic −.052, $p = .017$; see Figure 1).

Full Model. When testing the hypothesized model of social response regressed on cognitive and affective empathy simultaneously as well as mean trajectory of substance use regressed on social response, we found that a higher mean reported level of social response at the end of treatment (timepoint 4) associated with a steeper decrease in mean substance use growth ($\beta = -.065$, $p = .009$); and the model accounted for 69% of the variance in substance use growth trajectory ($R^2 = .690$). Additionally, cognitive empathy consistently positively predicted and accounted for over 75% of the variance of social response at each time point (T2: $\beta = .017$, $p < .001$ $R^2 = .786$; T3: $\beta = .008$, $p = .006$, $R^2 = .785$; T4: $\beta = .015$, $p < .001$, $R^2 = .798$) whereas affective empathy did not predict social response at any timepoint ($p > .05$). Assessment of indirect effects demonstrated that, although time three was insignificant, response to social consequences of use regressed on empathy at time one and time three indirectly decreased substance use trajectory ($\beta = -.001$, $p = .022$; $\beta = -.001$, $p = .065$; $\beta = -.001$, $p = .024$). Age and sex did not significantly predict the growth trajectory in substance use, but the outpatient sample had a less steep decrease in substance use in reference to residential treatment participants ($\beta = .085$, $p < .001$). The final model adequately fitted the data without any modifications (X^2 (266) = 668.79, CFI = .920, TLI = .903, RMSEA = .058; see Figure 2 for depiction of significant paths). Within the model, cognitive and

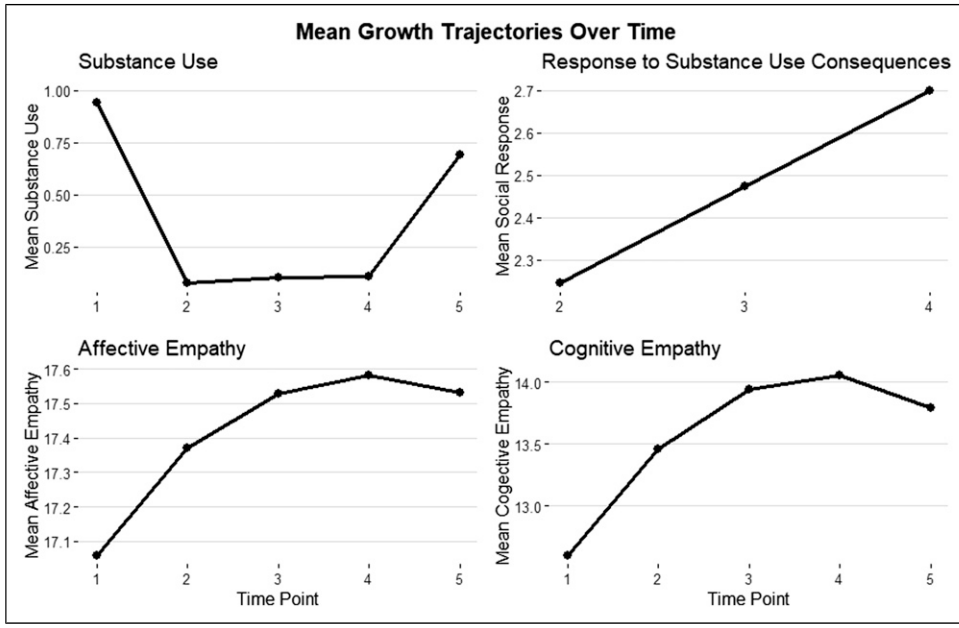

Figure 1. Depicts the functional form of mean trajectories over time for variables in full structural equation model.

Affective empathy had high to moderate zero-order correlations within construct but cognitive had moderate to low zero-order correlations with affective empathy (see Supplementary Table S3).

Discussion

The present study provides critical evidence regarding the temporal role empathy has with substance use trajectories via response to social consequences of substance use. Specifically, increases in cognitive empathy amongst adolescents in substance use treatment temporally predicts greater recognition of consequences and treatment motivation (i.e., response to social consequences of use), which in turn predicts a stronger negative mean trajectory of substance use over time. Present findings may indicate that recognizing social consequences of use is a motivating factor for reducing substance use amongst adolescents, and this is driven by higher levels of cognitive empathy.

Confirmatory Factor Analysis. The finding that the construct of interest adequately fit the data brings empirical evidence for a latent construct consisting of both recognition of consequences and motivation for treatment. Because this latent construct consists of items involving recognition of consequences to others and self-related to substance use and motivation for substance use treatment, we assert this latent construct describes a response to social consequences related to use. While it may be argued these two components are separate, the empirical evidence holds that these items together explain our latent construct of interest, which is a significant finding in and of itself. We hope this inspires future investigation into this latent construct and its association with substance use trajectories in youth and adults.

Individual Growth Trajectories. Functional forms of growth on variables of interest suggest, on average, cognitive and affective empathy as well as response to social consequences increased,

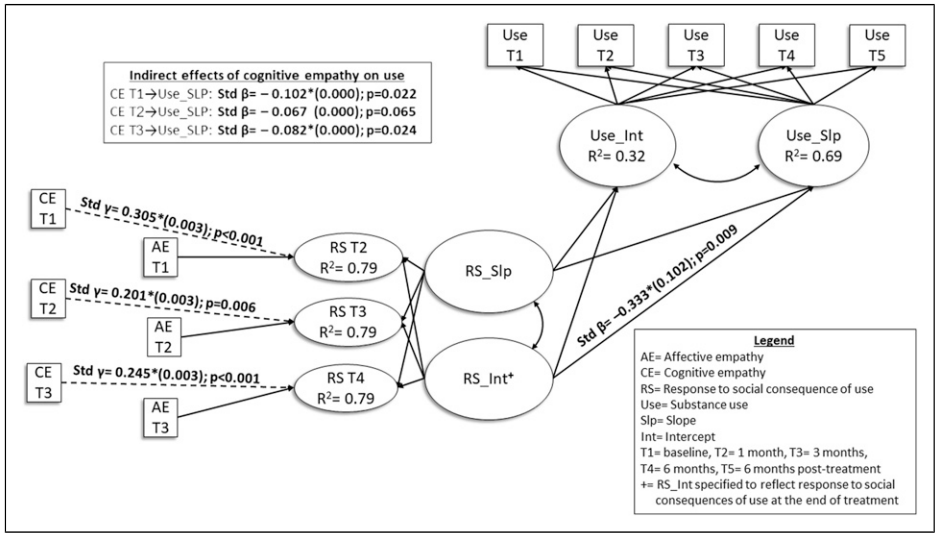

Figure 2. Depicts the full structural equation model with significant betas. All abbreviations are depicted in the legend and indirect effects are reported in the upper left hand table.

whereas substance use decreased (Figure 1). Cognitive and affective empathy had a steep increase at the start of treatment and a slight decrease at 6-months post-treatment whereas substance use had a sharp decrease at the start of treatment and an increase at 6-month follow up. While we do not have specific information on what occurred during treatment, it appears that treatment had a positive effect on all variables of interest with some drop off with follow up 6-months post-treatment.

Empathy is expected to increase during adolescence, and as expected affective empathy started higher than cognitive empathy. However, we are unable to determine why empathy dropped after treatment. Because adolescents can have heightened sensitivity to the social environment (Blakemore & Mills, 2014), this increase may be due to the support received during treatment that when removed post-treatment saw a slight average drop. The drop in empathy may also be due to an effect of substance use specifically as the average substance use also increased post treatment. Because empathy is still under development, and therefore more malleable, this finding may be specific to adolescents, and we may not see this same pattern in adults. This is an unexpected finding important to investigate in future studies.

Response to social consequences of substance use had a steady and significant linear increase during treatment. But, because this information was only available during treatment, we do not know how this may have changed post-treatment. Future studies could build on these results by capturing baseline and post-treatment response to social consequences related to use.

Full Model. Regression path results extend previous research by suggesting that cognitive empathy has an indirect effect on substance use amongst adolescents (Figure 2). Nguyen et al. (2011) and Laghi et al. (2019) demonstrate cross-sectionally that higher levels of cognitive empathy associate with higher levels of drug refusal efficacy and, subsequently, lower levels of substance use. The present methods extend these findings by demonstrating this relationship exists longitudinally and higher responses to use related social consequences as a motivational factor for decreased use. It is plausible that drug refusal may be the result of responding to social consequences related to substance use, which motivates increases in drug refusal behavior. Future studies could parse apart

the mechanism of action by examining both drug refusal and response to social consequences related to substance use amongst adolescents.

One potential concern by readers for interpretation is that participants learned responses for empathy measures that are more socially desirable over time. However, we find this to be unlikely because (1) respondents did not receive direct feedback on their responses as being "good" or "not good" that would have allowed learning to occur (2) the timespan of multiple months is an adequate time before retaking the measure and (3) empathy dropped, on average, after treatment and if learning effects existed, we would have expected this to continue to increase.

While there is a growing literature both theoretically and empirically demonstrating temporal precedence of empathy impairments prior to substance use (for review: Winters, Brandon-Friedman, et al., 2021), it is important there plausibly some bidirectionality between empathy and substance use and ceasing use in and of itself may have improved empathy. It is critical to explore this bidirectionality in future studies. Moreover, given the developmental trajectory of cognitive empathy during adolescence, the observed effects may have some relevance for natural development of cognitive empathy over the course of treatment. However, the average rapid decrease and slight decrease after treatment evidences some variance outside of development alone and that something about the substance use treatment received had an impact on both empathy and substance use.

Affective empathy did not predict how one responded to social consequences of substance use as hypothesized. Although it plausibly has an impact on response to social consequences, affective empathy consistently demonstrates a direct association with substance use in adolescents (Laghi, Bianchi, Pompili, Lonigro, & Baiocco, 2019; Luengo, Otero, Carrillo-de-la-Peña, & Mirón, 1994; Winters, Wu, & Fukui, 2020) whereas cognitive empathy associates with substance use indirectly (For review: Winters, Brandon-Friedman, et al., 2021). The present results support previous literature that cognitive empathy has an indirect effect on substance use where affective empathy does not. This suggests that cognitive understanding of others' perspective may impact a sense of connection to and response to consequences related to substance use – this may be necessary to stimulate the affective resonance with others in this response. Further investigation is needed to parse apart the direct and indirect effects of cognitive and affective empathy in relation to adolescent substance use.

Limitations. The present findings need to be interpreted under the following limitations. First, the sample was limited to adolescents in substance use treatment, which limits generalizability to the general population. Second, the measure for social response is conceptual and empirically verified but may not be generalizable to samples outside participants who are in substance use treatment. Further verification of this measure with different samples is needed. Third, the data used were collected for a different purpose and confounding variables relevant for the present analysis such as socioeconomic status and demographic information were not available. Fourth, severity of substance use was not captured in the outcome variable because severity ratings were not available in this dataset – only weather or not a substance was used. Although the presence of substance use is meaningful and substance use severity was partially accounted for by treatment groupings, future studies could explicitly examine substance use severity. Fifth, there were a large number of missing cases as the study continued. However, the missing data approaches we applied help to minimize any bias the may be introduced by missing participants and maintain the integrity of the analysis far better than leaving cases out (Little & Rubin, 2019). Moreover, we did a sensitivity analysis of excluding T3 and T4 and found it did not change the results that further support our analysis. Sixth, while the present study evidence empathy and response to social consequences to substance use generally, it is entirely plausible that substance use type may be particularly important for the relationships observed here; therefore, future studies could build on the present

results by including detailed analyses on severity of individual substances used. Seventh, the substance use variable used the top substances endorsed by the present sample that may not reflect current substance use trends in adolescents, thus future investigations could build on this result by using current samples and examining those most endorsed by the population. Eighth, we did not have specific information on use such as if substances were used individual or co-used. Although we do not believe this could impact the important findings of the present study it this information may be relevant for further nuance in future investigations. Ninth, comorbidity of symptoms such as ADHD, depression, or psychosis can impact empathy. However, the present study did not have adequate measures of symptom severity, therefore we did not include these symptoms as controls. Future studies should consider the importance of comorbid symptoms and their impact on empathy in relation to substance use. Also, the available data was over 30 years old. While understandably raising questions of relevance for contemporary youth, this large longitudinal dataset is appropriate for this question given the relevant variables available and population. Additionally, this is an initial investigation with measures that are still published in the literature with contemporary youth related to substance use; therefore, the present analysis evidences the relevance of investigating this phenomenon in future data collections. Finally, there was no direct manipulation on the variables of interest. Although we establish temporal precedence which may lead one to consider potential causal associations, a clinical trial that directly tests manipulation of these variables is necessary to confirm.

Conclusion

Despite these limitations, the present study partially substantiates that a latent construct inspired by Massey et al. (2017) that both recognition of social consequences and motivating factors related to treatment empirically form a latent construct the well call a response to social consequences related to use. We demonstrate higher levels of response to social consequences of substance use in adolescents at the end of their substance use treatment predicts steeper decreases in substance use. The present analysis extends theory by Massey et al. (2017) revealing that greater levels of cognitive empathy predicts a greater response to social consequences of substance use. Clinically this suggests that processes of perspective taking rather than emotional sharing may be relevant for understanding how one's substance use impacts others and perceptions of treatment being an important factor for them. Future studies could build on this finding by parsing apart drug refusal and response to social consequences in relation to cognitive empathy. Moreover, longitudinal clinical trials may be warranted for establishing causality.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: D. E. W. was supported by a training grant from National Institutes of Mental Health, T32MH015442. S. M. was supported by grants K23DA037913 (PI Massey) and R01DA050700 (PI Massey) from the National Institute on Drug Abuse.

ORCID iD

Drew E. Winters https://orcid.org/0000-0002-0701-9658

Supplemental Material

Supplemental material for this article is available online.

References

Anderson, C., & Keltner, D. (2002). The role of empathy in the formation and maintenance of social bonds. *Behavioral and Brain Sciences*, *25*(1), 21–22. https://doi.org/10.1017/s0140525x02230010

Asparouhov, T., & Muthén, B. (2010). *Weight least squared estimation with missing data*. statmodel. https://www.statmodel.com/download/GstrucMissingRevision.pdf

Baron-Cohen, S., & Wheelwright, S. (2004). The empathy quotient: An investigation of adults with Asperger syndrome or high functioning autism, and normal sex differences. *Journal of Autism and Developmental Disorders*, *34*(2), 163–175. https://doi.org/10.1023/b:jadd.0000022607.19833.00

Blakemore, S. J. (2012). Development of the social brain in adolescence. *Journal of the Royal Society of Medicine*, *105*(3), 111–116. https://doi.org/10.1258/jrsm.2011.110221

Blakemore, S. J., & Mills, K. L. (2014). Is adolescence a sensitive period for sociocultural processing? *Annual Review of Psychology*, *65*(1), 187–207. https://doi.org/10.1146/annurev-psych-010213-115202

Cliffordson, C. (2002). The hierarchical structure of empathy: Dimensional organization and relations to social functioning. *Scandinavian Journal of Psychology*, *43*(1), 49–59. https://doi.org/10.1111/1467-9450.00268

Cousijn, J., Luijten, M., & Feldstein Ewing, S. W. (2018). Adolescent resilience to addiction: A social plasticity hypothesis. *The Lancet Child & Adolescent Health*, *2*(1), 69–78. https://doi.org/10.1016/S2352-4642(17)30148-7

Davis, M. H. (1980). A multidimensional approach to individual differences in empathy. *Journal of Personality and Social Psychology*, *10*(85), 49.

Davis, M. H. (1983). Measuring individual differences in empathy: Evidence for a multidimensional approach. *Journal of Personality and Social Psychology*, *44*(1), 113–126. https://doi.org/10.1037/0022-3514.44.1.113

Decety, J. (2011). Dissecting the neural mechanisms mediating empathy. *Emotion Review*, *3*(1), 92–108. https://doi.org/10.1177/1754073910374662

Decety, J., Bartal, I. B.-A., Uzefovsky, F., & Knafo-Noam, A. (2016). Empathy as a driver of prosocial behaviour: Highly conserved neurobehavioural mechanisms across species. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, *371*(1686), 20150077. https://doi.org/10.1098/rstb.2015.0077

Decety, J., & Cowell, J. M. (2015). Empathy, justice, and moral behavior. *AJOB Neuroscience*, *6*(3), 3–14. https://doi.org/10.1080/21507740.2015.1047055

Decety, J., & Michalska, K. J. (2010). Neurodevelopmental changes in the circuits underlying empathy and sympathy from childhood to adulthood. *Developmental Science*, *13*(6), 886–899. https://doi.org/10.1111/j.1467-7687.2009.00940.x

Dennis, M., & Scott, C. K. (2007). Managing addiction as a chronic condition. *Addiction Science & Clinical Practice*, *4*(1), 45–55. https://doi.org/10.1151/ascp074145

Eisenberg, N. (2005). The development of empathy-related responding. *Nebraska Symposium on Motivation*, *51*, 73–117.

Eisenberg, N., Fabes, R. A., Murphy, B., Karbon, M., Smith, M., & Maszk, P. (1996). The relations of children's dispositional empathy-related responding to their emotionality, regulation, and social functioning. *Developmental Psychology*, *32*(2), 195–209. https://doi.org/10.1037/0012-1649.32.2.195

Hawk, S. T., Keijsers, L., Branje, S. J. T., Graaff, J. V. d., Wied, M. d., & Meeus, W. (2013). Examining the interpersonal reactivity index (IRI) among early and late adolescents and their mothers. *Journal of Personality Assessment*, *95*(1), 96–106. https://doi.org/10.1080/00223891.2012.696080

Hu, L. t., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*(1), 1–55. https://doi.org/10.1080/10705519909540118

Hubbard, R. L., Craddock, S. G., Flynn, P. M., Anderson, J., & Etheridge, R. M. (1997). Overview of 1-year follow-up outcomes in the drug Abuse treatment outcome study (DATOS). *Psychology of Addictive Behaviors*, *11*(4), 261–278. https://doi.org/10.1037/0893-164x.11.4.261

Konrath, S. H. (2013). *Critical synthesis package: Interpersonal reactivity index (IRI)*. Mededportal Publications. https://doi.org/10.15766/mep_2374-8265.9596

Kral, T. R. A., Solis, E., Mumford, J. A., Schuyler, B. S., Flook, L., Rifken, K., Patsenko, E. G., & Davidson, R. J. (2017). Neural correlates of empathic accuracy in adolescence. *Social Cognitive and Affective Neuroscience*, *12*(11), 1701–1710. https://doi.org/10.1093/scan/nsx099

Kristiansen, P. L., & Hubbard, R. L. (2001). Methodological overview and research design for adolescents in the drug abuse treatment outcome studies. *Journal of Adolescent Research*, *16*(6), 545–562. https://doi.org/10.1177/0743558401166002

Laghi, F., Bianchi, D., Pompili, S., Lonigro, A., & Baiocco, R. (2019). Cognitive and affective empathy in binge drinking adolescents: Does empathy moderate the effect of self-efficacy in resisting peer pressure to drink? *Addictive Behaviors*, *89*, 229–235. https://doi.org/10.1016/j.addbeh.2018.10.015

Little, R. J. A., & Rubin, D. B. (2019). *Statistical analysis with missing data*. New York, NY: Wiley. https://books.google.com/books?id=BemMDwAAQBAJ

Little, T. D., Rhemtulla, M., Gibson, K., & Schoemann, A. M. (2013). Why the items versus parcels controversy needn't be one. *Psychological Methods*, *18*(3), 285–300. https://doi.org/10.1037/a0033266

Luengo, M. A., Otero, J. M., Carrillo-de-la-Peña, M. T., & Mirón, L. (1994). Dimensions of antisocial behaviour in juvenile delinquency: A study of personality variables. *Psychology, Crime & Law*, *1*(1), 27–37. https://doi.org/10.1080/10683169408411934

MacKinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G., & Sheets, V. (2002). A comparison of methods to test mediation and other intervening variable effects. *Psychological Methods*, *7*(1), 83–104. https://doi.org/10.1037/1082-989x.7.1.83

Massey, S. H., Newmark, R. L., & Wakschlag, L. S. (2018). Explicating the role of empathic processes in substance use disorders: A conceptual framework and research agenda. *Drug and Alcohol Review*, *37*(3), 316–332. https://doi.org/10.1111/dar.12548

McConnaughy, E. A., Prochaska, J. O., & Velicer, W. F. (1983). Stages of change in psychotherapy: Measurement and sample profiles. *Psychotherapy: Theory, Research & Practice*, *20*(3), 368–375. https://doi.org/10.1037/h0090198

McHugh, R. K., Votaw, V. R., Sugarman, D. E., & Greenfield, S. F. (2018). Sex and gender differences in substance use disorders. *Clinical Psychology Review*, *66*, 12–23. https://doi.org/10.1016/j.cpr.2017.10.012

Mulaik, S. A., James, L. R., Van Alstine, J., Bennett, N., Lind, S., & Stilwell, C. D. (1989). Evaluation of goodness-of-fit indices for structural equation models. *Psychological Bulletin*, *105*(3), 430–445. https://doi.org/10.1037/0033-2909.105.3.430

Muthén, B., Tam, T., Muthén, L., Stolzenberg, R. M., & Hollis, M. (1993). Latent variable modeling in the LISCOMP framework: Measurement of attitudes toward career choice. In: *New directions in attitude measurement* (pp. 277–290). Festschrift for Karl Schuessler.

Nguyen, A. B., Clark, T. T., & Belgrave, F. Z. (2011). Empathy and drug use behaviors among African-American adolescents. *Journal of Drug Education*, *41*(3), 289–308. https://doi.org/10.2190/de.41.3.d

Overgaauw, S., Rieffe, C., Broekhof, E., Crone, E. A., & Güroğlu, B. (2017). Assessing empathy across childhood and adolescence: Validation of the empathy questionnaire for children and adolescents (EmQue-CA). *Frontiers in Psychology*, *8*, 870–870. https://doi.org/10.3389/fpsyg.2017.00870

R Core Team (2021). *R: A language and environment for statistical computing*. R Core Team. https://www.R-project.org/

Revelle, W. (2021). *psych: Procedures for psychological, psychometric, and personality research*. Evanston, IL: The Comprehensive R Archive Network, Northwestern University. R package version 2.1.9 https://CRAN.R-project.org/package=psych

Rosseel, Y. (2012). Lavaan: An R package for structural equation modeling. *Journal of Statistical Software*, *48*(2), 1–36. https://doi.org/10.18637/jss.v048.i02

Schumann, K., Zaki, J., & Dweck, C. S. (2014). Addressing the empathy deficit: Beliefs about the malleability of empathy predict effortful responses when empathy is challenging. *Journal of Personality and Social Psychology*, *107*(3), 475–493. https://doi.org/10.1037/a0036738

Shin, H. S., Park, H., & Lee, Y.-M. (2022). The relationship between medical students' empathy and burnout levels by gender and study years. *Patient Education and Counseling*, *105*(2), 432–439. https://doi.org/10.1016/j.pec.2021.05.036

Singer, T. (2006). The neuronal basis and ontogeny of empathy and mind reading: Review of literature and implications for future research. *Neuroscience and Biobehavioral Reviews*, *30*(6), 855–863. https://doi.org/10.1016/j.neubiorev.2006.06.011

Smith, A. (2006). Cognitive empathy and emotional empathy in human behavior and evolution. *The Psychological Record*, *56*(1), 3–21. https://doi.org/10.1007/bf03395534

Walter, H. (2012). Social cognitive neuroscience of empathy: Concepts, circuits, and genes. *Emotion Review*, *4*(1), 9–17. https://doi.org/10.1177/1754073911421379

Winters, D. E., Brandon-Friedman, R., Yepes, G., & Hinckley, J. D. (2021). Systematic review and meta-analysis of socio-cognitive and socio-affective processes association with adolescent substance use. *Drug and Alcohol Dependence*, *219*, 108479. https://doi.org/10.1016/j.drugalcdep.2020.108479

Winters, D. E., Pruitt, P. J., Fukui, S., Cyders, M. A., Pierce, B. J., Lay, K., & Damoiseaux, J. S. (2021). Network functional connectivity underlying dissociable cognitive and affective components of empathy in adolescence. *Neuropsychologia*, *156*, 107832. https://doi.org/10.1016/j.neuropsychologia.2021.107832

Winters, D. E., Wu, W., & Fukui, S. (2020). Longitudinal effects of cognitive and affective empathy on adolescent substance use. *Substance Use & Misuse*, *55*(6), 983–989. https://doi.org/10.1080/10826084.2020.1717537

Wu, W., & Lang, K. M. (2016). Proportionality assumption in latent basis curve models: A cautionary note. *Structural Equation Modeling: A Multidisciplinary Journal*, *23*(1), 140–154. https://doi.org/10.1080/10705511.2014.938578

Wu, W., Selig, J. P., & Little, T. (2012). Longitudinal data analysis. *Oxford Handbook of Quantitative Methods*, *2*, 387–410.

Zaki, J. (2018). Empathy is a moral force. In K. Gray, & J. Graham (Eds.), *Atlas of moral psychology* (pp. 49–58). Guildford WA: The Guilford Press.

Author Biographies

Drew E. Winters, PhD. holds a T32 funded postdoctoral fellowship in developmental psychobiology at the University of Colorado Anschutz Medical Campus in the department of Psychiatry. His research focuses on the interaction between social cognition and executive functioning in relation to adolescent mental health.

Joseph T. Sakai, M.D., is an associate professor of Psychiatry at the University of Colorado Anschutz Medical Campus.

Suena Massey, M.D., is a Faculty of Medicine at Harvard Medical School in the department of Psychiatry.