Attributions of Adolescents with Type 1 Diabetes Related to Performing Diabetes Care around Friends and Peers: The Moderating Role of Friend Support

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Objective To examine the relationships among negative attributions of friend and peer reactions to diabetes management in social situations, anticipated adherence difficulties, friend support, diabetes stress, and metabolic control. **Methods** A sample of 102 adolescents with Type 1 diabetes completed instruments measuring attribution of friend and peer reactions, anticipated adherence, friend support, and diabetes stress. Metabolic control was measured by the percentage of hemoglobin A1c. **Results** Structural equation modeling demonstrated an excellent fit of two models depicting the mediating role of anticipated adherence difficulties and diabetes stress on the relationship between negative attributions of friend (first model) and peer (second model) reactions and metabolic control. Friend support was found to moderate the path between diabetes stress and metabolic control in an unexpected manner. That is, as friend support increased, so did the relationship between stress and metabolic control. **Conclusions** Adolescents who make negative attributions about reactions of friends and/or non friend peers are likely to find adherence difficult in social situations and have increased stress, with the latter associated with metabolic control. Results are discussed in terms of a social information processing model of adjustment.

Key words adherence; adolescents; attributions; diabetes; friends.

Management of Type I insulin-dependent diabetes involves adherence to a series of complex daily behaviors such as monitoring blood glucose levels, injecting insulin, carefully maintaining diet plans, and exercising. The maintenance of these adherence behaviors is seen as the best way to maximize a long-term positive prognosis and decrease the likelihood of short-term complications (e.g., hypoglycemia, hyperglycemia, ketoacidosis) and long-term negative consequences (e.g., renal failure, retinopathy) [Diabetes Control and Complications Trial (DCCT), 1993].

Even though adolescents possess greater diabetes knowledge than children, they tend to have more problems with adherence (Anderson, Auslander, Jung, Miller, & Santiago, 1990; Johnson, Silverstein, Rosenbloom, Carter, & Cunningham, 1986; Thomas, Peterson, & Goldstein, 1997). Social situations, especially those involving friends, may negatively impact the adherence behavior of adolescents (Wysocki, Greco, & Buckloh, 2003), and adolescents report that adherence difficulties are more frequent in social and peer contexts (Berlin et al., 2006). Some adolescents may feel unable to maintain their regimen within these contexts because they anticipate peer pressure or are apprehensive about being singled out by others (Susman-Stillman, Hyson, Anderson, & Collins, 1997; Wysocki et al., 2003). These results suggest that cognitive appraisals of social situations may be related to adherence behavior.

A social information processing model of adjustment has been proposed as a framework for understanding the role of cognitive appraisals involved with diabetes care efforts around friends, and their relationship with diabetes stress and metabolic control (Hains, Berlin, Davies, Parton, & Alemzadeh, 2006). These appraisals

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include filtering only specific aspects of the situation, incorrectly appraising others' intentions, or assessing ambiguous situations as threatening in terms of potential consequences (Crick & Dodge, 1994). The model suggests that adolescents with Type 1 diabetes may perceive adherence behavior as difficult in social situations due to a fear of negative friend evaluations. Therefore, maladaptive interpretations of events could result in poor behavioral adherence choices and/or emotional distress, and potential problems with metabolic control.

Research has shown support for various paths of this model. Adolescents with Type 1 diabetes become increasingly influenced by expected disapproval from friends in social situations that require adherence behavior, and consequently report less regimen adherent solutions to these problem situations (Thomas et al., 1997). In addition, adolescents who make negative attributions about expected friend reactions to their diabetes care efforts are more likely to anticipate adherence difficulties. These anticipated difficulties are associated with increased diabetes-related stress, which in turn is related to poorer metabolic control (Hains et al., 2006). Thus, negative attributions of friend reactions and adherence efforts are not related to metabolic control directly, but rather through diabetes-related stress, which has been found to have a direct association with metabolic control (Aikens, Wallander, Bell, & Cole, 1992; Farrell, Hains, Davies, Smith, & Parton, 2004; Hains et al., 2006).

Decisions to avoid adherence behaviors around friends are problematic because adolescents are missing opportunities for support. Despite adolescents' apprehensions to the contrary, friends of teenagers with Type 1 diabetes have been found to provide both emotional and companionship support and support for some aspects of the treatment regimen (La Greca, Bearman, & Moore, 2002). A strong relationship between friend support and adherence, however, has not been found (Bearman & La Greca, 2002). One possible reason for this lack of relationship is the role of attributions and cognitive appraisals, which when positive may serve as a protective factor and when negative may impact the adjustment of adolescents with chronic illness (Wallander & Varni, 1992).

While the social information processing model provides a framework for examining the relationship among attribution of friend reactions, adherence behavior, stress, and metabolic control, the role of friend support in this model has not been addressed. Friend support may impact the nature of this relationship. In the context of high levels of friend support, the relationship between negative attributions, adherence difficulties, diabetes stress, and metabolic control might be lessened.

This study was designed to (a) clarify the relationships among negative attributions of friend reactions and peer reactions, anticipated adherence difficulties, friend support, diabetes stress, and metabolic control; and (b) develop questionnaires with sufficient psychometric properties to test this aforementioned model. The hypothesized model is presented in Fig. 1. Using structural equation modeling (SEM), the first objective was to replicate past research showing a relationship between negative attributions of friend reactions and metabolic control that is mediated by anticipated adherence difficulties and diabetes stress. Second, we examined whether a similar pattern of relationships held for attributions of general (nonfriend) peer reactions to adherence in school-based settings. Much of the research that has examined adherence in social situations has focused on friends, and not peers in larger social contexts. The larger peer group provides a different scope of social functioning, and the impact of attributions about peer reactions to diabetes care in social settings like school needs to be considered

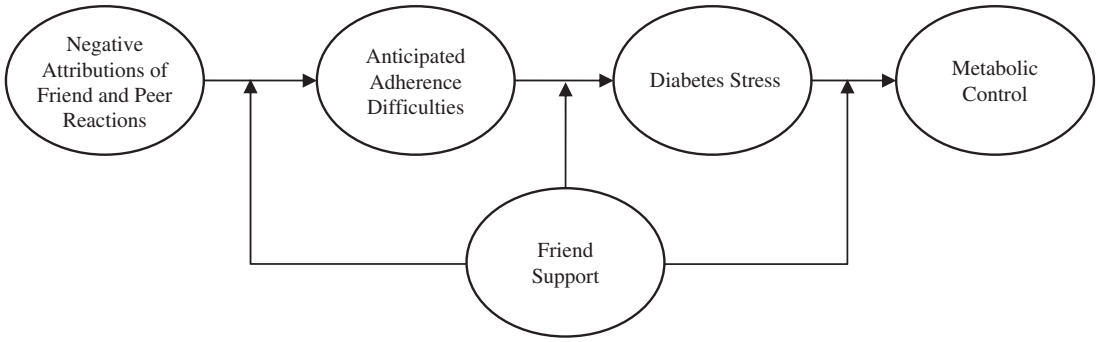

Figure 1. Hypothesized relationships between Negative Attributions, Anticipated Adherence Difficulties, Diabetes Stress, Metabolic Control, and Friend Support.

(La Greca et al., 2002). For this study, we looked at academic settings where large groups of adolescents who are not necessarily friends are present to observe diabetes management efforts. Third, we examined whether friend support moderated the relationships among attributions, adherence difficulties, stress, and metabolic control.

Methods

Participants

The study was reviewed and approved by the institutional review boards of the University of Wisconsin-Milwaukee and Children's Hospital of Wisconsin. Adolescents between the ages of 10 and 18 years, who were outpatients receiving treatment for Type 1 diabetes in the Diabetes Clinic at Children's Hospital of Wisconsin (CHW), were recruited for the study. The participants are seen for management and treatment of their diabetes in outpatient appointments at the clinic every 3–4 months. Written informed consent/assent was obtained from a parent/guardian and from the adolescents. Initially, 123 adolescents consented to participate and 102 (83%) returned the instruments. The mean age of the participants was 13.87 years ($SD = 2.01$, range 10–18 years), and 60% were female. The average time since diagnosis was 5.58 years ($SD = 4.1$ years) and ranged from 3 months to 16 years. The self-reported racial background of the final sample included 81 European Americans, 6 African Americans, 4 Latino/Hispanics, 2 Asian Americans, 2 American Indians, and 5 multiracial individuals.

Procedure

Participants were recruited by one of two methods. In one method, members of the diabetes treatment team introduced the research study to adolescents and their parents while they were at a clinic visit. If the families expressed interest, a graduate student in psychology described the project in more detail and obtained consent. In a separate method of recruitment, the study was introduced to the adolescents and their families at an evening educational group hosted by the diabetes clinic at CHW. Graduate students in psychology staffed an information booth during the evening's activities. A clinic team member hosting the evening session introduced the graduate students, and directed interested individuals to this information booth. The graduate students provided a description of the study to interested parties and obtained consent.

Participants were given a packet of instruments that included demographic information, attributions about reactions of others to self-care in social situations, friend support, and diabetes stress. Adolescents were given the option of completing the instruments at clinic or the evening session, or taking them home and returning them by paid business reply envelope. The majority of the adolescents who returned completed questionnaires did so within two weeks. All completing adolescents received a gift certificate to a local shopping mall for their participation.

Measures

Demographic Information

Demographic information related to gender, race, age, grade in school, and duration of diabetes was included on a cover sheet.

Attribution of Friend and Peer Reactions

The *Friend and Peer Attribution Questionnaires* were adapted from an earlier version of an attribution questionnaire which focused only on friend reactions (Hains et al., 2006). This previous measure has demonstrated good reliability (internal consistency) and concurrent criterion, and construct validities (Hains et al., 2006). These modifications included splitting items with dual content into separate questions (e.g., 'my friends would understand and be supportive' to 'my friends would understand' and 'my friends would be supportive') and adding questions to expand the scales' content validity. This questionnaire describes 11 social situations involving friends and other peers where the youth is faced with an adherence situation. Seven of the situations involve friends in social settings and four involve others peers in school-related settings. Specific situations were developed based on the literature on adherence in social contexts and the clinical experience of the researchers.

The following is an example of an adherence situation involving friends: ''Imagine that your friends ask you to go out somewhere and it's almost time for you to test your blood sugar. You don't have your test materials with you and your friends are impatient to leave.'' Each of the 11 friend and peer situations was followed by 13 questions asking the youth how they think their friends or peers would react if the youth did his or her self-care in the situation.

Several of these questions asked to what extent the adolescents expected to have certain thoughts about the friends' (or other peers') reactions, with the adolescents responding on a 5-point scale (1 = strongly disagree; 5 = strongly agree). Positively worded attributions (e.g., I'd think my friends would understand) were

reverse scored. Five of these questions for the vignettes involving friends were averaged to form the Negative Friend Attribution Scale. To form the Negative Peer Attribution Scale, five of the questions for the vignettes involving other peers were averaged. Five additional questions, which asked about the ease and likelihood of adherence in these situations were summed and averaged to form the Anticipated Adherence Difficulties Scale for both the friend vignettes and the other peer vignettes.

Diabetes Stress

The *Diabetes Stress Questionnaire* (DSQ) is a 65-item self-report instrument designed to assess daily stressors for adolescents related to diabetes. The measure yields a composite scaled score with higher scores indicating higher levels of stress. Internal consistency has been reported to be excellent (Cronbach's $\alpha = .97$), and the measure has also been shown to have good concurrent validity (Boardway, Delamater, Tomakowsky, & Gutai, 1993).

Friend Support

Friend support was examined by the *Diabetes Social Support Questionnaire* (DSSQ; Bearman & LaGreca, 2002). The DSSQ is a 28-item self-report measure of friends' support for diabetes care. Internal consistency for the total scores is high (Cronbach's $\alpha > .90$), and the measure has been found to have good correspondence with other support measures (Bearman & LaGreca, 2002).

Metabolic Control

Metabolic control of the sample was measured by the percentage of hemoglobin A1c ($HbgA_{1c}$), and was obtained from the clinic visit during which the adolescents were recruited or the most recent clinic visit in the case of youths recruited during the evening educational group. All samples were collected via DCA2000 (Bayer, Tarrytown, NY) with the nondiabetic reference range between 4.5% and 5.7%. $HbgA_{1c}$ levels reflect the average level of blood glucose over a 2–3 month period. The mean $HbgA_{1c}$ level for the participating youths was 8.314 ($SD = 1.38$), which is comparable to the mean for the clinic as a whole ($M = 8.6$).

Results

Analytic Plan

In order to test the proposed model, a series of steps was needed: (a) determine adequacy of the factor structure and psychometric properties of the Friend and Peer Attribution Questionnaires using confirmatory factor analysis (CFA); (b) test the hypothesized relationships among the study variables; (c) determine significance of the mediational/indirect effects; and (d) determine whether peer support moderates relationships within the models.

To assess the fit of the measurement and structural models, a variety of indices appropriate for smaller samples and nonnormal data were used including a Satorra–Bentler Scaled chi-square (SB χ^2) to degrees of freedom ratio of two or less (Ullman, 2001), a Comparative Fit Index (CFI) above 0.90, a Root Mean Square Error of Approximation (RMSEA) statistic below 0.10, and a Standardized Root Mean Square Residual (RMR) below 0.08 (Browne & Cudeck, 1993; Hu & Bentler, 1999; MacCallum, Browne, & Sugawara, 1996).

Factor Structure and Psychometric Properties of the Friend and Peer Attribution Questionnaires

CFA using a robust maximum-likelihood estimation method in LISREL 8.54 (Jöreskog & Sörbom, 2003) was employed to validate the factor structures of the Friend Attribution Questionnaire (FAQ) and the Peer Attribution Questionnaire (PAQ). This method allowed for the computation of an SB χ^2 and robust standard errors which adjust for multivariate kurtosis (Satorra & Bentler, 1994). These initial analyses indicated that the proposed models provided a poor fit to the data according to Bollen's (1989) and Hoyle's (1995) standards; however, the fit of these models became excellent by allowing the error terms between two questions that were formerly paired (e.g., frustrated or upset) to correlate. This technique allowed the shared variance of the questions that was unrelated to the latent constructs to correlate without affecting any of the estimated relationships between the latent variables within the model (Jaccard & Wan, 1996). Table I presents the initial and final fit statistics for the PAQ and FAQ. Table II shows the means, *SD*s, and internal consistencies (α) for the various scales and scale items across vignettes used in this study.

With regard to the validity of the measures, substantiation of criterion validity was obtained by examining the correlations among study variables (Table III). More specifically, Negative Attributions of Friend Reactions (NAFR) and Negative Attributions of Peer Reactions (NAPR) had significant positive relationships with diabetes-related stress, Anticipated Adherence

Table I. Fit Statistics for the Confirmatory Factor Analyses of the Friend and Peer Attribution Questionnaires and Structural Equation Models

Confirmatory factor analysis models	Sattora–Bentler χ^2/df	CFI	RMSEA	SRMR
FAQ	94.18/34 = 2.77	0.94	0.134	0.058
FAQ with one correlated error term	47.67/33 = 1.45	0.98	0.067	0.052
PAQ	52.86/26 = 2.03	0.89	0.104	0.081
PAQ with one correlated error term	23.08/25 = 0.92	0.97	0.000	0.052
Friend Structural Model	5.57/3 = 1.86	0.95	0.095	0.046
Peer Structural Model	5.59/3 = 1.86	0.93	0.095	0.053

FAQ, Friend Attribution Questionnaire; PAQ, Peer Attribution Questionnaire; CFI, Comparative Fit Index; RMSEA, Root Mean Square Error of Approximation; SRMR, Standardized Root Mean Square Residual.

Table II. Descriptive Statistics for the Friend and Peer Attribution Questionnaires

Scale/item	*M*	*SD*	α
Negative Attributions of Friend Reactions ($N = 102$)	7.62	2.25	.92
I think my friends would understand (r).	1.60	0.53	.88
I'd think my friends would be supportive (r).	1.63	0.54	.89
I'd think my friends would get upset.	1.57	0.54	.81
I'd think my friends would get frustrated.	1.56	0.54	.82
I'd think my friends might not like me as much anymore.	1.25	0.41	.75
Anticipated Adherence Difficulties-Friends ($N = 102$)	9.27	2.84	.85
I think it would be easy to do my self-care in this situation (r).	1.94	0.66	.86
I think I would be likely to do my diabetes care in this situation (r).	1.71	0.55	.82
Even though I know it is important, I would find it hard to do my self care in this situation.	2.01	0.87	.88
I would do my self-care regardless of what my friends thought (r).	1.73	0.74	.92
I would wait until I was out of this situation before I did my self-care.	1.86	0.75	.88
Negative Attributions of Peer Reactions ($N = 100$)	9.26	3.56	.95
I think the other kids would understand (r).	2.02	0.83	.88
I'd think the other kids would be supportive (r).	2.07	0.84	.88
I'd think the other kids would get upset.	1.81	0.79	.86
I'd think the other kids would get frustrated.	1.82	0.80	.83
I'd think the other kids might not like me as much anymore.	1.53	0.63	.78
Anticipated Adherence Difficulties-Peers ($N = 100$)	9.66	3.80	.88
I think it would be easy to do my self-care in this situation (r).	2.02	0.99	.91
I think I would be likely to do my diabetes care in this situation (r).	1.80	0.76	.92
Even though I know it is important, I would find it hard to do my self-care in this situation.	2.15	1.10	.91
I would do my self-care regardless of what the other kids thought (r).	1.71	0.82	.95
I would wait until I was out of this situation before I did my self-care.	1.78	0.85	.92
Diabetes Stress ($N = 102$)	2.12	0.54	.96
Metabolic Control as measured by $HbgA_{1c}$ ($N = 99$)	8.31	1.38	.90
Frequency of Friend Support ($N = 101$)	1.97	1.18	.95

'r' denotes items that were reversed scored.

Difficulties-Friends (AADF), and Anticipated Adherence Difficulties-Peers (AADP) and no direct relationship with metabolic control. Similarly, AADF and AADP were positively correlated with diabetes-related stress and not related directly to metabolic control. These results provide evidence of criterion validity, since these relationships are in the magnitude and direction that are theoretically expected (Cohen & Swerdlik, 1999). Furthermore, the corrected item-total correlations for the subscales of FAQ (NAFR: $M = 0.69$, $SD = 0.12$; AADF: $M = 0.55$, $SD = 0.10$) and PAQ (NAPR: $M = 0.80$, $SD = 0.08$; AADP: $M = 0.61$, $SD = 0.10$) provided strong evidence for both content and construct validity (Cohen & Swerdlik, 1999).

Table III. Bivariate Relationships between Negative Attributions of Friend Reactions and Peer Reactions, Anticipated Adherence Difficulties, Friend Support, Diabetes Stress, Metabolic Control, and Age

	1	2	3	4	5	6	7	8
1. Age		.139	.192	.229*	.202*	−.106	.021	.083
2. NAFR			.542**	.521**	.486**	.050	.249*	−.023
3. NAPR				.424**	.597**	−.039	.340**	.064
4. AADF					.789**	.015	.236*	.173
5. AADP						.031	.290**	.153
6. Peer Support total: frequency							.218*	.003
7. Diabetes-related stress								.234*
8. Hemoglobin A1c								

NAFR, Negative Attributions of Friend Reactions; NAPR, Negative Attributions of Peer Reactions; AADF, Anticipated Adherence Difficulties-Friends; AADP, Anticipated Adherence Difficulties-Peers.
*$p < 0.05$, **$p < 0.01$.

Hypothesis Testing

Mediation Analyses

In light of the preliminary evidence for the factor structure and reliability of the FAQ and PAQ, the hypothesized model was evaluated using SEM. Although similar to multiple regression (MR), there are several benefits to testing models via SEM. These benefits include the ability to: (a) simultaneously estimate the significance of both direct and indirect relationships; (b) obtain estimates corrected for variables with non-normal distributions and less-than-perfect reliability; and (c) determine the adequacy of the model using goodness of fit statistics. To decrease the number of estimated parameters, latent variables were defined by fixing the sole indicator's factor loading to 1.0 and its error term to 1 minus the reliability (alpha coefficient) multiplied by the indicator's variance (Hayduk, 1987). This technique produces path estimates identical to those obtained using multiple indicators or item parcels (Sass & Smith, 2006). This technique allowed for this study's cases to measure ratio (approximately 14:1) to exceed standard recommendations for SEM of 5–10 cases per measure (Bentler, 1990; Kline, 2004). For $HbgA_{1c}$, the error term was set to 10% given that the correlations of ∼.95 between the DCA2000 and high-performance liquid chromatography suggest reliable variance of around 90% (Guerci et al., 1997).

The two hypothesized mediational models for both peers and friends were tested using robust maximum-likelihood estimation method in LISREL 8.54. All goodness of fit indices suggested an excellent fit between the models and the data (Table I, models five and six). As predicted, Negative Attributions had a direct effect on Anticipated Adherence Difficulties, which directly affected Diabetes Stress, which in turn had a direct effect on Metabolic Control. Across both models, Negative Attributions of others' reactions and Anticipated Adherence Difficulties had significant indirect effects on metabolic control through the variable Diabetes Stress. As hypothesized, a significant indirect relationship between Negative Attributions of others' reactions and Diabetes Stress was found through the mediating variable of Anticipated Adherence Difficulties. These two models accounted for the following percentages of variance of dependent latent variables: 61% AADF, 51% AADP, 9% Diabetes Stress, and 9% Metabolic Control. These final models with standardized estimates are presented in Fig. 2 with the indirect relationships indicated with a dashed line. Additional details regarding the model, the covariance/correlation matrixes of items and variables, and unstandardized estimates can be obtained from the corresponding author.

Moderation Analyses

When MRs are used to test moderations, it can produce biased and inconsistent coefficient estimates along with a loss of statistical power as the reliability of the measures decline (Aiken & West, 1991; Busemeyer & Jones, 1983). To correct for reliability, several smaller structural equation models were tested to determine whether Friend Support moderated the paths between (a) NAFR and Anticipated Adherence Difficulties among friends; (b) Anticipated Adherence Difficulties among friends and Diabetes Stress; (c) NAPR and Anticipated Adherence Difficulties among peers; (d) Anticipated Adherence Difficulties among peers and Diabetes Stress; and (e) Diabetes Stress and Metabolic Control. Similar to MR techniques, each of these models included two mean centered simple effects and one product variable. The latent simple effect and product variables were defined in the manner previously described; however,

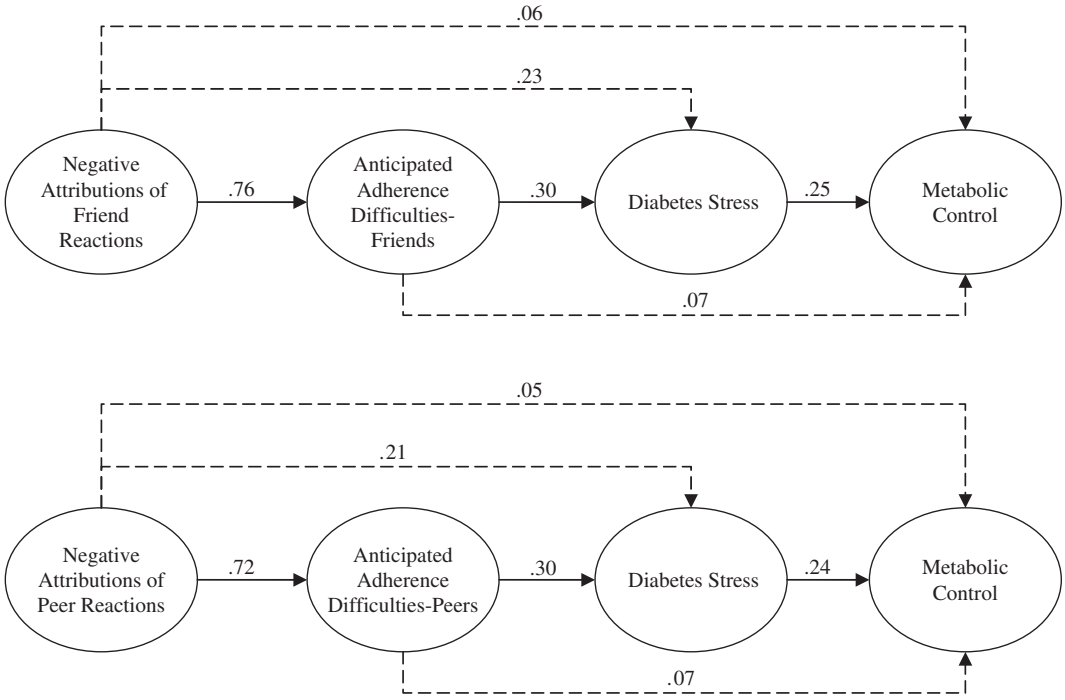

Figure 2. Final path models with standardized estimates. Indirect effects are indicated with a dashed line (all paths are significant at $p < .05$).

the reliability for the interaction variable was estimated using Busemeyer and Jones' (1983) formula for the reliability of a product.

These five models were tested using robust maximum-likelihood estimation method in LISREL 8.54. Because the models were saturated (e.g., degrees of freedom equaled zero), no goodness of fit indices were available. Of these analyses, only the path between Diabetes Stress and Metabolic Control was found to be moderated by Friend Support (Table IV). Post hoc probing revealed that as friend support increased, so did the relationship between stress and metabolic control. More specifically there was essentially no relationship between these variables at low levels of friend support (-1 *SD*; simple slope $= 0.09$, $t = 0.25$, $p = .81$); however, at the mean (simple slope $= 0.65$, $t = 2.63$, $p = 0.06$) and high levels of support ($+1$ *SD*), this relationship was significant (simple slope $= 1.22$, $t = 3.40$, $p = .001$).

Discussion

This study was designed to clarify the relationships among negative attributions of friend reactions and general peer reactions, anticipated adherence difficulties, friend support, diabetes stress, and metabolic control. In keeping with past research (Hains et al., 2006), negative attributions of friend reactions had a direct effect on anticipated adherence difficulties, which had a direct effect on diabetes stress, which in turn had a direct effect on metabolic control. This same pattern was also found when adolescents considered self-care behavior around peers other than friends in school settings. Across both friend and other peer models, negative attributions of others' reactions and anticipated adherence difficulties had significant indirect effects on metabolic control through associations with diabetes-related stress. As hypothesized, a significant indirect relationship between negative attributions of others' reactions and diabetes-related stress was found through the mediating variable of anticipated adherence difficulties. The importance of cognitive appraisals in the adjustment of children with chronic physical conditions has been proposed in other theoretical models (e.g., Wallander & Varni, 1992), and the findings of this study are consistent with that work.

The role of friend support was only found to moderate the path between diabetes-stress and metabolic control. Thus, it appears that friend support may not have a large impact on the nature of the relationship between attributions of others' reactions and anticipated adherence difficulties, or the relationship between adherence difficulties around others and diabetes stress.

Table IV. Summary of Structural Equation Models to determine the Moderating Effect of Friend Support

Model/dependent variable	Independent variables	Standardized path coefficient	*t*
1. AADF	NAFR	.77	7.48*
	Friend Support	.03	0.35n.s.
	NAFR × Friend Support	−.11	−1.35n.s.
2. Diabetes Stress	AADF	.27	2.24*
	Friend Support	.23	2.65*
	AADF × Friend Support	−.07	−.69n.s.
3. AADP	NAPR	.70	8.56*
	Friend Support	.08	0.92n.s.
	NAPR × Friend Support	−.13	−1.74n.s.
4. Diabetes Stress	AADP	.27	2.51*
	Friend Support	.23	2.23*
	AADP × Friend Support	−.05	−0.47n.s.
5. Metabolic Control	Diabetes-Related Stress	.27	2.89*
	Friend Support	−.07	−0.72n.s.
	Diabetes-Related Stress × Friend Support	.22	2.95*

NAFR, Negative Attributions of Friend Reactions; NAPR, Negative Attributions of Peer Reactions; AADF, Anticipated Adherence Difficulties-Friends; AADP, Anticipated Adherence Difficulties-Peers.

*$p < .05$, n.s., Nonsignificant.

In a seemingly paradoxical fashion, as friend support increased, so did the relationship between stress and metabolic control. A few interpretations of this finding are possible. First, for adolescents experiencing greater stress or poorer metabolic control, their friends become more supportive, but these friends may not be effective in helping them manage their diabetes-related difficulties. Alternatively, adolescents with higher diabetes stress may not make good use of coping support from friends, or they may actually find increased friend support as aversive. Finally, the support efforts by friends may actually be maladaptive, encouraging the adolescents to make poor behavioral choices. These alternative explanations regarding the impact of friends should be examined in future research.

There are a number of limitations for this study. First, adolescent responses to vignettes may not provide an accurate account of actual behavior in real social situations with friends. Multiple informer reports of behavior and cognitions in actual situations or qualitative interviews may shed further light on the factors of interest. Some adolescents who have very negative expectations of friend and peer reactions may have experienced social sanctions doing diabetes care in public. In terms of the sample, the majority of adolescents completed the questionnaires at home, and we have no information on whether they completed the forms independently. We also did not code the data to assess differences between the two recruitment methods. Likewise, we are missing the data on metabolic control for those adolescents who did not return completed forms and therefore cannot compare them with those of adolescents who completed the study. Also, the sample was predominately European American (81%), which limits the generalizability of the findings. In addition, causal relationships cannot be specified due to the cross-sectional design of the study. Rather, a longitudinal design with multiple measurements of metabolic control may better address the research questions. Finally, the current study may not have had enough statistical power to detect small to medium moderating effects of friend support (e.g., the path between negative attributions and anticipated adherence difficulties among peers) or any three-way interactions involving gender (Aiken & West, 1991).

Results of the study point to the role of negative appraisals of others' reactions to self-care efforts in social situations. Adolescents who expect sanctions from friends or peers for public self-care behavior anticipate more adherence difficulties in those situations. Friend support does not seem to have a large impact on this relationship. Even with support of friends readily available (Helgeson, Reynolds, Shestak, & Wei, 2006; La Greca et al., 2002), adolescents with diabetes may still worry about friend reactions. Thus, the social information processing model of adjustment suggests that adolescents' problems with adherence may be related in part to their own inaccurate thoughts and beliefs. Adolescents who avoid or carelessly engage in self-care behaviors because of (possibly) incorrect expectations of negative reactions from friends may miss opportunities to experience positive support and, ultimately, may increase their risk of diabetes complications.

Interventions geared toward identifying, monitoring, and restructuring potentially distorted attributions related to self-care may be important steps in improving adherence behavior. Cognitive behavioral interventions to address misattributions of friend and peer reactions are indicated by the results of this study. Adherence in social situations represents only one context for this behavior, however. Future research should address the role of attributions related to engaging in self-management while in other settings or around other individuals (e.g., family, teachers). In addition, cognitive behavioral interventions should not be limited to changing cognitions about others' reactions. Behavioral strategies to improve access to friend support (e.g., social or assertiveness skills to explain self-care to friends or enlist their help, rehearsal of plans to minimize intrusion of self-care in some settings) may all be beneficial components of a treatment package.

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References

Aikens, J. E., Wallander, J. L., Bell, D. S. H., & Cole, J. A. (1992). Daily stress variability, learned resourcefulness, regimen adherence, and metabolic control in Type 1 diabetes mellitus: Evaluation of a path model. *Journal of Consulting and Clinical Psychology, 60*, 113–118.

Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. Newbury Park, CA: Sage Publications.

Anderson, B. J., Auslander, W. F, Jung, K. C., Miller, J. P., & Santiago, J. V. (1990). Assessing family sharing of diabetes responsibilities. *Journal of Pediatric Psychology, 15*, 477–492.

Bearman, K. J., & LaGreca, A. M. (2002). Assessing friend support of adolescents' diabetes care: The Diabetes Social Support Questionnaire-Friends version. *Journal of Pediatric Psychology, 27*, 417–428.

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin, 107*, 238–246.

Berlin, K. S., Davies, W. H., Jastrowski, K. E., Hains, A. A., Parton, E. A., & Alemzadeh, R. (2006). Contextual assessment of problematic situations identified by adolescents using insulin pumps and their parents. *Families, Systems, & Health, 24*, 33–44.

Boardway, R. H., Delamater, A. M., Tomakowsky, J., & Gutai, J. P. (1993). Stress management training for adolescents with diabetes. *Journal of Pediatric Psychology, 18*, 29–45.

Bollen, K. A. (1989). *Structural equations with latent variables*. Oxford, England: John Wiley and Sons.

Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen, & J. S. Long (Eds.), *Testing Structural Equation Models* (pp. 136–361). Newbury Park, CA, Sage Publications.

Busemeyer, J. R., & Jones, L. E. (1983). Analysis of multiplicative combination rules when the causal variables are measured with error. *Psychological Bulletin, 93*, 549–562.

Cohen, R. J., & Swerdlik, M. E. (1999). *Psychological testing and assessment: An introduction to tests and measurement* (4th ed.). Mountain View, CA: Mayfield Publishing Company.

Crick, N. R., & Dodge, K. A. (1994). A review and reformulation of social information-processing mechanisms in children's social adjustment. *Psychological Bulletin, 115*, 74–101.

Diabetes Control and Complications Trial Research Group (1993). The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes-mellitus. *New England Journal of Medicine, 329*, 977–986.

Farrell, S. P., Hains, A. A., Davies, W. H., Smith, P., & Parton, E. (2004). The impact of cognitive errors, stress and adherence on metabolic control in youths with Type 1 diabetes. *Journal of Adolescent Health, 34*, 461–467.

Guerci, B., Durain, D., LeBlanc, H., Rouland, J. C., Passa, P., Godeau, T., et al. (1997). Multicentre evaluation of the DCA 2000 system for measuring glycated haemoglobin. *Diabetes & Metabolism, 23*, 195–201.

Hains, A. A., Berlin, K. S., Davies, W. H., Parton, E. A., & Alemzadeh, R. (2006). Attributions of adolescents with type 1 diabetes in social situations: Relationship with expected adherence, diabetes stress, and metabolic control. *Diabetes Care, 29*, 818–822.

Hayduk, L. A. (1987). *Structural equation modeling with LISREL*. Baltimore, MD: Johns Hopkins University Press.

Helgeson, V. S., Reynolds, K. A., Shestak, A., & Wei, S. (2006). Friendships of adolescents with and without diabetes. *Journal of Pediatric Psychology, 31*, 194–199.

Hoyle, R. H. (1995). *Structural equation modeling: Concepts, issues, and applications*. Thousand Oaks, CA: Sage Publications, Inc.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*, 1–55.

Jaccard, J., & Wan, C. K. (1996). *LISREL approaches to interaction effects in multiple regression*. Thousand Oaks, CA: Sage Publications, Inc Sage University papers series on Quantitative Applications in the Social Sciences, 07-114.

Johnson, S. B., Silverstein, J., Rosenbloom, A., Carter, R., & Cunningham, W. (1986). Assessing daily management in childhood diabetes. *Health Psychology, 5*, 545–564.

Jöreskog, K. G., & Sörbom, D. (2003). *LISREL 8: User's reference guide*. Lincolnwood, IL: Scientific Software International, Inc; 2000.

Kline, R. B. (2004). *Principles and practice of Structural Equation Modeling* (2nd ed.). New York: Guilford.

La Greca, A. M., Bearman, K. J., & Moore, H. (2002). Peer relations of youths with pediatric conditions and health risks: Promoting social support and healthy lifestyles. *Developmental and Behavioral Pediatrics, 23*, 271–280.

MacCallum, R. C., Browne, M. W., & Sugawara, H. M. (1996). Power analysis and determination of sample size for covariance structure modeling. *Psychological Methods, 1*, 130–149.

Sass, D. A., & Smith, P. L. (2006). The effects of parceling unidimensional scales on structural parameter estimates in Structural Equation Modeling. *Structural Equation Modeling, 13*, 566–586.

Satorra, A., & Bentler, P. M. (1994). Corrections to test statistics and standard errors in covariance structure analysis. In A. Von Eye, & C. C. Clogg (Eds.), *Latent variables analysis: Applications for developmental research* (pp. 399–419). Newbury Park, CA, Sage Publications.

Susman-Stillman, A., Hyson, D. M., Anderson, F. S., & Collins, W. A. (1997). Adolescent psychosocial development and adherence to treatment for insulin-dependent diabetes mellitus. In J. A. McNamara, & C. A. Trotman (Eds.), *Creating the compliant patient* (pp. 73–101). Ann Arbor, MI: Center for Human Growth and Development.

Thomas, A. M., Peterson, L., & Goldstein, D. (1997). Problem solving and diabetes regimen adherence by children and adolescents with IDDM in social pressure situations: A reflection of normal development. *Journal of Pediatric Psychology, 22*, 541–561.

Ullman, J. B. (2001). Structural equation modeling. In B. G. Tabachnick, & L. S. Fidell (Eds.), *Understanding multivariate statistics* (4th ed., pp. 653–771). Needham Heights, MA: Allyn & Bacon.

Wallander, J. L., & Varni, J. W. (1992). Adjustment in children with chronic physical disorders: Programmatic research on disability-stress-coping model. In A. M. La Greca, L. Diegel, J. L. Wallander, & C. E. Walker (Eds.), *Stress and coping in child health* (pp. 279–298). New York: Guilford Press.

Wysocki, T., Greco, P., & Buckloh, L. M. (2003). Childhood diabetes in psychological context. In M. C. Roberts (Ed.), *Handbook of pediatric psychology* (3rd ed., pp. 304–320). New York: Guilford Press.