Idiosyncratic Personal Explanations for Blood Glucose Events Are Associated With Poorer Self-Management and Glycemic Control in Adult Patients With Long-Standing Type 1 Diabetes

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OBJECTIVE — To examine whether spontaneous causal attributions for blood glucose events were associated with blood glucose control (HbA_{1c} [A1C]), self-management, and adjustment to diabetes.

RESEARCH DESIGN AND METHODS — A total of 62 adults (31 female) with type 1 diabetes, recruited from a diabetes specialist clinic, with a mean age of 42.3 years and a mean illness duration of 19.6 years, were interviewed about the onset, history, course, and management of their diabetes. Spontaneous causal attributions for fluctuations in blood glucose level were extracted from the interviews and coded in accordance with the Leeds Attributional Coding System. Participants completed questionnaire measures of anxiety, depression, and appraisal of diabetes. Glycemic control (A1C) at the time of interview and 1 year later was extracted from notes.

RESULTS — Participants who made proportionally more personal, or idiosyncratic, explanations for blood glucose fluctuations or events (such as hypoglycemic episodes) had higher A1C levels at time 1 and 1 year later and were judged to manage their diabetes less well. Furthermore, the association between personal attributions and A1C was partly accounted for by self-management behavior. Participants who made personal and stable attributions appraised their diabetes more negatively.

CONCLUSIONS — Clinicians should be sensitive to patients' causal explanations for blood glucose events. Helping patients consider alternative explanations may produce benefits in terms of better management and control of diabetes.

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How do patients' beliefs about diabetes impact their glycemic control? According to Leventhal's Self-Regulatory Model (1,2), when faced with a threat to health (in the case of diabetes, this might be the initial diagnosis, difficulties controlling blood glucose, or the onset of complications), people form cognitive representations of that threat. These representations then drive illness-related behaviors aimed at regulating the threat and achieving good illness outcomes. While evidence is accumulating that cognitive representations of illness are indeed associated with illness outcomes (3,4), to date there are few longitudinal studies that test the proposed mediating role of illness-related behaviors (3).

The present study focuses on one specific type of cognitive representation of illness, i.e., representation of cause. People engage in causal search in an attempt to explain and understand unexpected negative events, of which illness is a good example, and to help them plan how they should respond (5). For example, when people explain illness events in terms of factors that they believe they can control, they tend to both experience better psychological adjustment and to cope more actively (3,5,6).

There are a number of methodological issues to consider when studying causal attributions (5,6). First, how are the causal attributions elicited? If causal attributions are elicited using researcher-provided closed questions (7), potentially important explanations may be missed. Open questions (8) avoid this problem but still prompt causal search that might not otherwise have taken place. An alternative approach is to study causal attributions arising spontaneously while patients talk about their illness (9,10).

A second methodological issue concerns the classification of attributions. Causal attributions about illness are usually classified either by content, for example, attributions to stress or to chance or, alternatively, according to their position along a number of underlying dimensions (6). The dimensions most commonly used are locus (is the purported cause located within the patient or outside the patient?), controllability (could the patient reasonably control the cause?), and stability (is the cause of the event likely to remain the cause?) (6). Recent work has suggested a further dimension, labeled "personal-universal" (is the cause of the event idiosyncratic to the patient?) (9). The dimensional method allows comparisons across different types of events and

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Abbreviations: HAD, Hospital Anxiety and Depression scale.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

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has been widely adopted in health psychology (3,6,11,12).

The third methodological issue is the choice of event, where a distinction is made between attributions for illness onset ("why did I develop diabetes?") and ongoing diabetes events ("why were my blood sugars so high today?"). For example, the onset of diabetes may be attributed to heredity but current poor blood glucose control to dietary factors. Causal attributions for the onset of diabetes may be of limited relevance as drivers of day-to-day management behavior in patients with long-standing diabetes (13).

The few existing studies of diabetic patients' causal attributions have examined elicited attributions for diabetes onset rather than events occurring within the context of established diabetes (8,13,14). Children who attributed the onset of their diabetes to factors internal to and controllable by themselves ("self-responsibility attributions") had better blood glucose control and better psychological adjustment than those who made external attributions (8). In contrast, making "self-blaming" attributions is associated with poorer self-management behavior (14) and poorer personal functioning (15) in adults with diabetes. While both self-responsibility and self-blaming attributions involve factors internal to and potentially controllable by the actor, the critical distinction might be that the former are behavioral and the latter characterological attributions (16). That is, self-blaming patients may believe that they could have controlled the factor(s) implicated in their diabetes but are unlikely to do so in the future because of some dispositional or other factor idiosyncratic to them (e.g., "I have a large appetite"). Such patients may be less likely to attempt to change and more likely to experience negative affect (16).

In the present study, we investigated the causal attributions of people who had had diabetes for some time by examining spontaneously occurring attributions for events occurring within the context of established illness, which we called "blood glucose events." These events included episodes of hypoglycemia and hyperglycemia and periods when the patient had difficulty keeping blood glucose within desired levels. We coded the attributions in accordance with the Leeds Attributional Coding system (9), which includes the coding of attributions along a dimension labeled personal-universal and thereby allows an examination of idiosyncratic factors.

The research questions addressed in the present study were as follows. First, are patients' spontaneous causal attributions for blood glucose events related to blood glucose control, both concurrently and 1 year later? Second, are causal attributions related to self-management behaviors? Third, do self-management behaviors mediate any association between causal attributions and glucose control? Fourth, are causal attributions related to psychological adjustment to diabetes?

We hypothesized that internal and controllable attributions would be associated with better self-management and adjustment to diabetes and with better glucose control but that personal attributions would be associated with poorer self-management and adjustment and poorer glucose control. We expected self-blaming attributions (internal, controllable, and personal) to be associated with poorer self-management and poorer glucose control. Because the direction of causality of any associations between attributions, diabetes self-management, and glucose control cannot be determined from a cross-sectional analysis, we included the measure of glucose control 1 year later.

RESEARCH DESIGN AND METHODS

— This investigation was part of a larger study of expressed emotion in the spouses and partners of adult patients with type 1 diabetes (17,18) and was approved by the Central Manchester Research Ethics Committee.

The sample consisted of participants included in the study reported previously (17) plus two additional patients who had taken part in pilot interviews. Participants were 62 adult type 1 diabetic patients, 31 female, mean age (mean ± SD) 42.3 ± 10.7 years (range 25–64), and mean illness duration 19.6 ± 9.9 years (3–50). Patients taking steroid medication were excluded, as were those with current major physical comorbidity (e.g., amputations, chronic renal failure) or a diagnosis of serious mental illness. Participants were recruited by approaching eligible patients as they attended a specialist diabetes centre in Manchester.

Causal attributions

Patients were interviewed (by A.W.) using an adapted version of the Psychosocial Aspects of Diabetes Schedule (19). This included sections asking patients about the onset, history, and current state of their diabetes and about their self-management practices. Patients were asked whether they had had any major hypoglycemic episodes, defined as requiring the assistance of another person in the past 3 months, and if so, how many. Spontaneously occurring causal explanations for episodes of hyper- and hypoglycemia were extracted from this section of the interview, as described below.

Management of diabetes

A rating of the patients' management of diabetes was derived from the interviews and coded by three independent raters, two of whom (J.C. and Z.R.) were blind to all other study measures, the other rater being A.W. Four areas of self-management (insulin administration, diet, blood glucose testing, and precautions against hypoglycemia) were rated as either "good," "some problems," or "inadequate" in accordance with preagreed criteria. The scores were then combined into a five-point scale from zero (inadequate in more than one area) to four (good in all areas) (19).

Adjustment to diabetes

On the same day as they were interviewed, patients completed the Hospital Anxiety and Depression (HAD) scales (20), designed to detect depression and anxiety in medically ill populations, and the Appraisal of Diabetes Scale (21), on which higher scores indicate a more negative appraisal of diabetes.

Glycemic control

Illness duration and HbA_{1c} (A1C) level at the time of recruitment to the study (time 1) and again 12–14 months later (time 2) were extracted from the patients' notes. A1C is a measure of the percentage of hemoglobin in the blood that is bound to glucose and reflects average blood glucose levels over the preceding 2–3 months.

Extracting and coding causal attributions

Attributional statements were defined as "spontaneous utterances made by the speaker that gave or clearly implied a causal relationship between an event (in this study, blood glucose events) and its cause(s)" (11) and in which the speaker was expressing his or her own causal beliefs.

A protocol for coding attributions in accordance with the Leeds Attributional

Table 1— ***Pearson's correlations between proportional attribution scores, blood glucose and management variables, and adjustment to diabetes variables***

	Internal/ external	Controllable/ uncontrollable by patient	Stable/ unstable	Personal/ universal	Global/ specific	Illness duration	Self-management	A1C time 1	A1C time 2	HAD depression score	HAD anxiety score
Controllable/uncontrollable by patient	0.612†										
Stable/unstable	0.216	0.507†									
Personal/universal	0.083	−0.060	0.055								
Global/specific	0.010	−0.233	0.130	0.001							
Illness duration	0.060	0.008	−0.032	−0.034	0.114						
Self-management	−0.049	−0.039	−0.289*	−0.339*	−0.046	0.218					
A1C time 1	−0.036	0.063	0.176	0.330†	0.065	−0.330*	−0.518†				
A1C time 2	−0.126	−0.066	0.025	0.293*	0.208	−0.009	−0.548†	0.707†			
HAD depression score	−0.036	−0.104	−0.031	0.160	0.126	0.058	−0.178	0.005	0.074		
HAD anxiety score	0.259	0.025	0.035	0.169	0.140	−0.047	−0.328*	0.038	0.119	0.510†	
Appraisal of diabetes score	0.193	0.140	0.285*	0.278*	0.085	−0.093	−0.331*	0.150	0.148	0.479†	0.341*

*$P < 0.05$; †$P < 0.01$.

Coding System (11) was developed. The causal explanation contained in each attributional statement was then coded along each of the following dimensions. *1*) Internal/external: Is the cause of the event located within the patient? For example, "I checked my blood and it was high, and I realized I'd forgotten to take my insulin" (internal); "When it's hot and sunny, that makes it [blood glucose level] much worse, and you have to take more insulin" (external). *2*) Controllable/uncontrollable by the patient: Could the patient reasonably exert control over the event or alter the outcome? For example, "My control wasn't good when I was a student, you know, I was a typical student, socializing, drinking, not really taking any notice" (controllable by patient); "When I had my bypass operation, it was terrible, they [blood glucose levels] went really high" (uncontrollable by patient). *3*) Stable/unstable: Is the cause likely to continue to be the cause? For example, "It's because of my job, it makes my blood sugars low, I'm working all the time, getting my blood sugars down" (stable); "When I change my routine, like when I'm on holiday, my blood sugars go haywire" (unstable). *4*) Personal/universal: Is the cause idiosyncratic to the patient? For example, "I've never really been well controlled, simply because I don't take any notice of it all. I really don't like thinking about it" (personal to the patient); "In the evening, when you have a big meal, you need more insulin, otherwise they go high" (universal). *5*) Global/specific: Does the cause of the event also affect other areas of the patient's life? For example, "Stress affects it [blood glucose levels]. When I've been under more stress than usual, my insulin's gone up (meaning patient has needed more insulin to control blood glucose) (global); "If I am doing things like gardening, that puts them [blood glucose levels] very low" (specific).

A score of 1 was assigned where causes were judged internal, controllable, stable, personal, and global, and a score of 2 was assigned for external, uncontrollable, unstable, universal, and specific causes. Unrateable causes were scored 0. Proportional attribution scores were calculated for each of the dimensions by dividing the number of attributions coded 1 by the number of attributions coded 1 and 2, so scores varied between 0 and 1; the higher the proportional attribution, the greater the proportion of attributional statements that were rated 1. Finally, attributional statements that were both internal and controllable and personal (self-blaming attributions) were counted.

Inter-rater reliability. To establish interrater reliability of extraction of attributional statements, K.H. and H.S. each listened to the relevant portion of 10 interviews. Thirty-eight attributional statements were extracted, of which 33 (86%) were in common. The remaining five attributions were discussed with an experienced rater and coder of attributional statements (A.W.) and a decision made as to their acceptability. K.H. and H.S. then extracted attributions from a further 26 tapes each. To establish interrater agreement of attributional codings, K.H. and H.S. each independently coded 26 agreed attributional statements. Levels of agreement were internal/external 23/26 (88% agreement), Cohen's $\kappa = 0.783$; controllable/uncontrollable 25/26 (96%), $\kappa = 0.923$; stable/unstable 24/26 (92%), $\kappa = 0.857$; personal/universal 24/26 (92%), $\kappa = 0.785$; and global/specific 22/26 (85%), $\kappa = 0.667$. Codings that caused disagreement were discussed and resolved before each rater coded half of the remaining attributions.

RESULTS — A total of 183 relevant attributions were extracted from the interviews. Eight interviews had no relevant spontaneous attributional statements, so all further analysis was conducted using the sample of 183 attributions drawn from 54 interviews. To compare the 8 patients who made no relevant attributions with the remaining 54 patients' *t* tests comparing A1C, illness duration, anxiety and depression scores, self-management scores, number of major hypoglycemic episodes, and appraisal of diabetes scores were performed. These revealed no significant differences between the two groups. The eight patients who made no attributional statements were, however, older (age 51.5 ± 10.9 vs. 40.9 ± 10.4 years [mean ± SD], $t[60] = 2.754$, $P = 0.008$). The modal number of attributions made was three and the mean number 3.24 ± 1.8.

The mean A1C score at time 1 was 8.78 ± 1.6 and 1 year later 8.97 ± 1.4. A1C at recruitment and 1 year later were highly correlated and also moderately correlated with the measure of diabetes self-management (Table 1). At time 1, 41 patients (76%) had experienced no major

Table 2—*Regression analyses predicting A1C at times 1 and 2 on the basis of personal proportional attribution scores and self-management*

	A1C time 1*					A1C time 2†				
	B	SE *B*	β	*t*	Significance	*B*	SE *B*	β	*t*	Significance
Personal proportional attribution	1.157	0.831	0.174	1.393	$P = 0.170$	0.688	0.711	0.121	0.968	$P = 0.338$
Self-management	−0.576	0.157	−0.450	−3.672	$P = 0.001$	−0.545	0.134	−0.507	−4.069	$P < 0.001$
Constant	9.786	0.395		24.779	$P < 0.001$	9.966	0.339		24.745	$P < 0.001$

*Final adjusted $R^2 = 0.267$; F[2,51] for regression = 10.671; $P < 0.001$. †Final adjusted $R^2 = 0.286$; F[2,50] for regression = 11.393; $P < 0.001$.

hypoglycemic episodes requiring assistance in the past 3 months, 5 (9%) had experienced one, 4 (7%) had experienced two, and 4 (7%) had experienced three or more. The mean HAD depression score was 3.73 ± 2.9, and the mean HAD anxiety score was 6.27 ± 3.6. Depression, anxiety, and a negative appraisal of diabetes were all intercorrelated (Table 1) but were not correlated with A1C. Anxiety was negatively correlated with diabetes self-management.

Research questions 1 and 2: attributions, glucose control, and self-management

Making more personal attributions was associated with higher A1C scores at time 1. The association between A1C and personal attributions persisted at time 2 (Table 1). There was no correlation between any of the other attribution variables and A1C or between attribution variables and the number of major hypoglycemic episodes experienced in the 3 months preceding time 1.

Making more personal and stable attributions was associated with managing diabetes less well (Table 1). Only nine self-blaming attributions were made, by eight patients. These 8 patients had poorer self-management ratings than the remaining 46 patients (median scores of 1 and 2, respectively, Mann-Whitney $U = 102.5$, $P = 0.041$). Self-blaming attributions were not significantly associated with any other variable.

Research question 3: the mediational model

To test whether, in accordance with the self-regulatory model (1), the associations between personal attributions and poorer glucose control at both time points were mediated by poorer self-management behavior, two series of regression analyses were carried out, as recommended by Baron and Kenny (22). First, we determined that personal attributions predicted self-management ($\beta = -0.339$, $P = 0.012$). Second, we determined that proportional attribution scores for the personal/universal dimension predicted A1C at time 1 ($\beta = 0.330$, $P = 0.015$). Third, both personal attributions and self-management scores were entered into a regression equation to predict A1C at time 1. Inclusion of the self-management variable significantly reduced the β weight for the personal attributions, from 0.330 to 0.174 (Sobel $z = 2.121$, $P = 0.033$), showing partial mediation.

A similar set of analyses were carried out with respect to A1C at time 2. First, as above, personal attributions predicted self-management ($\beta = -0.339$, $P = 0.012$). Second, proportional attribution scores for the personal/universal dimension predicted A1C at time 2 ($\beta = 0.293$, $P = 0.034$). Third, with self-management scores in the equation, the β weight for the personal attributions significantly reduced from 0.293 to 0.121 (Sobel $z = 2.190$, $P = 0.029$), showing partial mediation. The parameters for the final equations are shown in Table 2.

Research question 4: attributions and psychological adjustment

Patients who made more personal attributions and those who made more stable attributions for blood glucose events appraised their diabetes more negatively. No other correlations between attributions and psychological adjustment variables were significant.

CONCLUSIONS

— The primary aim of our study was to determine whether patients' spontaneous causal attributions for blood glucose events are related to blood glucose control. Our key finding was that there is an association between personal attributions for blood glucose events and poorer glycemic control. This result is of particular importance given that the association between personal attributions and higher blood glucose levels persisted over 1 year. Furthermore, and importantly, our analysis suggests that the association between personal attributions and higher blood glucose levels was mediated by poorer self-management behavior. This finding supports Leventhal's self-regulatory model (1,2) and provides a plausible potential causal link between attributions and blood glucose control.

An earlier qualitative study of type 2 diabetic patients' causal stories reported that patients often cited habitual, recurring maladaptive behaviors (for example, a "love of sweets") as factors that provoked the onset of their diabetes (26). However, ours is the first study to demonstrate a quantitative relationship between personal attributions for blood glucose events and poorer glycemic control, and we do this in the relatively neglected context of patients with established diabetes. Our mediational analysis suggests the explanation for the correlation between personal attributions and poorer glycemic control is that these beliefs drive self-management behavior. Patients in our study who attributed blood glucose events to factors personal to them, even if the factors were potentially controllable, were less likely to attempt to change because they saw the causes as part of their make-up or habitual behavior. For example, one patient attributed her poor glucose control to her personality ("I know I'm described as moody") and another believed that her metabolism had changed after a traumatic event. Neither of these attributional beliefs suggests factors that are amenable to control.

The implications of these findings for clinical practice are that clinicians should be sensitive to patients' explanations for blood glucose events and should encourage patients to consider alternative and more adaptive explanations where appropriate. For example, if a patient expresses the belief that his or her poor control is due to being "just like my grandfather" who also had poor diabetes control, the clinician might use careful questioning to elicit alternative explanations, such as dietary or lifestyle factors, and then encourage the patient to consider the relative merits of each of these. In doing so, the

clinician attempts to use belief change to modify self-management behavior. This approach is in keeping with cognitive-behavioral and "patient empowerment" models of behavior change, which help patients to develop their own more adaptive ways of understanding diabetes, encourage problem solving, and provide patients with the knowledge, skills, and attitudes necessary to make informed choices about their own behavior (27,28).

The lack of a significant relationship between the proportion of attributions to causes controllable by the patient and either self-management or psychological adjustment was unexpected given the literature suggesting that attributions to factors controllable by the self are associated with more active coping and better psychological adjustment (6). However, the association between perceived control and illness outcomes in diabetes may be complex. For example, one study with adolescents with type 1 diabetes suggested that two factors moderate the association between perceived control and psychological adjustment, these being the extent to which perceptions of control are based on accurate knowledge of diabetes and the severity of the threat posed by diabetes (25). In our study, where patients had long illness duration, it is possible that they had good diabetes knowledge and the threat value of blood glucose events may have been reduced by experience in dealing with such events.

The finding that stable attributions were associated with poorer self-management and more negative appraisal of diabetes, although not specifically hypothesized, is intuitively reasonable and consistent with the previous literature (5). It suggests that patients are more likely to actively manage their diabetes when they believe that the factor causing their current suboptimal glucose control is not inevitably going to persist.

Most patients made relatively few spontaneous causal attributions for blood glucose events, with eight (13%) of the sample making none at all. The relative paucity of attributional statements is similar to that seen in a study of spontaneous causal attributions made by patients following a myocardial infarction (23). People usually engage in causal search when they encounter unexpected, negative events (10). Patients in the present study had had diabetes for at least 3 years and had experienced blood glucose events many times. Over time, they may have developed and settled on a personal understanding of their illness and its fluctuations and may have become less motivated to search for cause and to report their causal attributions (24).

The conclusions drawn from this study are limited by the rather small number of spontaneous attributional statements made. However, our study has a number of strengths. By studying spontaneously occurring attributions, we avoided some of the methodological problems encountered when patients are given a list of possible causes to endorse. The causal beliefs of long-standing diabetic patients have been relatively neglected. Most previous work has concentrated on the causal attributions that patients make for the onset of diabetes, which may be of limited relevance in patients who have had the condition for some time. Our study examined attributions for ongoing blood glucose events and may therefore be of more relevance to the management of patients with long-standing type 1 diabetes.

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