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Drug Awareness in Adolescents Attending a Mental Health Service: Analysis of Longitudinal Data

Jaume Arnau[1], Roser Bono[1], Rosa Díaz[2], and Javier Goti[2]

[1]Universidad de Barcelona (Spain)
[2]Hospital Clínico Universitario de Barcelona (Spain)

One of the procedures used most recently with longitudinal data is linear mixed models. In the context of health research the increasing number of studies that now use these models bears witness to the growing interest in this type of analysis. This paper describes the application of linear mixed models to a longitudinal study of a sample of Spanish adolescents attending a mental health service, the aim being to investigate their knowledge about the consumption of alcohol and other drugs. More specifically, the main objective was to compare the efficacy of a motivational interviewing programme with a standard approach to drug awareness. The models used to analyse the overall indicator of drug awareness were as follows: (a) unconditional linear growth curve model; (b) growth model with subject-associated variables; and (c) individual curve model with predictive variables. The results showed that awareness increased over time and that the variable 'schooling years' explained part of the between-subjects variation. The effect of motivational interviewing was also significant.
Keywords: linear mixed models, drug awareness, adolescence, longitudinal study, mental health.

Uno de los procedimientos más recientemente utilizados con datos de carácter longitudinal son los modelos lineales mixtos. Su creciente interés en investigación sanitaria se constata por un aumento de los estudios que utilizan este tipo de análisis. Este trabajo se centra en los modelos lineales mixtos aplicados a un estudio longitudinal sobre el conocimiento acerca del consumo de alcohol y otras drogas en una muestra de adolescentes españoles que inician tratamiento en un centro de salud mental. Concretamente, el objetivo principal fue comparar la eficacia de un programa de entrevista motivacional con otro estándar sobre el conocimiento de las drogas. Los modelos utilizados a fin de analizar el indicador global de conocimiento sobre drogas fueron los siguientes: (a) modelo incondicional lineal de curva de crecimiento, (b) modelo de crecimiento con variables asociadas a las personas y (c) modelo de curvas individuales con variables predictoras. Los resultados mostraron que el conocimiento incrementa con el paso del tiempo y que la escolarización explica parte de la variación entre-sujetos. En cuanto al efecto de la entrevista motivacional resultó ser significativo.
Palabras clave: modelos lineales mixtos, conocimientos sobre drogas, adolescencia, estudio longitudinal, salud mental.

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Correspondence concerning this article should be addressed to Roser Bono. Departament de Metodologia de les Ciències del Comportament, Facultat de Psicologia, Universitat de Barcelona, Passeig de la Vall d'Hebron 171, 08035-Barcelona. Phone: +34-933125080; Fax: +34-934021359. E-mail: rbono@ub.edu

Studies conducted in several countries indicate that it is during adolescence that people are most likely to begin consuming psychoactive substances, with drug use frequently beginning around the age of 13 or 14 (Plan Nacional sobre drogas [Spanish Government's National Plan on Drugs, NPD], 2007; Vega et al., 2002). For example, in a study carried out in schools in Barcelona, 37.5% of pupils reported having tried cannabis (Morales, Ariza, Nebot, Pérez, & Sánchez, 2008). The factors associated with the initiation of cannabis use among adolescents are smoking, alcohol abuse and the intention to consume cannabis (Pérez, Ariza, Sánchez-Martínez, & Nebot, 2010). In this context, a Spanish nationwide survey on drug use among secondary-school pupils found that in 2006 the main substances consumed by pupils aged 14-18 years were alcohol, tobacco and cannabis (NPD, 2007). Overall, 79.6% of those surveyed had drunk alcohol at least once in their life, 46.1% had smoked and 36.2% had consumed cannabis. Comparison of these results with those of previous surveys shows a fall in the prevalence of consumption over lifetime, which was more marked in the case of tobacco and cannabis.

This nationwide survey also noted that the large majority of pupils (85.6%) considered themselves to be sufficiently informed about drugs, their effects and the problems associated with their use. The main channels through which young people received information were their parents and siblings (73.2%), the media (69.3%) and teachers (63.8%). Comparison of these figures with those of previous years reveals a notable increase in the proportion of pupils who obtain information via their families and teachers. In this regard, one of the objectives of NPD is to ensure that by the time they leave secondary school the majority of children have received sufficient objective information and adequate education about the consequences of drug use and abuse (Ministerio del Interior [Spanish Interior Ministry], 2000). Thus, whereas in 2003, 60% of school pupils received information on drug use in the context of health education classes, this figure had reached 100% by 2008. It therefore seems relevant to study the effect of the number of years of schooling on young people's awareness of drugs and their effects, it being assumed that this variable would be an indicator of the education they have received in this regard while at school.

Most of the studies conducted in Spain regarding the consumption of psychoactive substances by adolescents are based on samples of school pupils (for example, Al-halabi-Díaz et al., 2006; Duarte & Molina, 2004; Morales et al., 2008; Oliva, Parra, & Sánchez-Queija, 2008). This is due, mainly, to the fact that sample selection is made easier by young people being grouped into schools and educational levels. Moreover, most educational and prevention programmes are targeted at this population, which comprises 70-80% of young people aged between 14 and 18 years (Sánchez-Hervás, 2000), thereby justifying the focus on it. An example of such a programme is the smoking prevention framework (Ariza et al., 2008). However, it is also interesting to identify habits and beliefs about substance use, as well as the factors related with these habits, in those populations who are most susceptible to developing drug problems, such as the children of alcoholics or adolescents with a psychiatric disorder (Castro-Fornieles et al., 2010; Díaz et al., 2001; Díaz, Castro-Fornieles et al., 2008a; Díaz, Gual et al., 2008b; Goti et al., 2010). Indeed, a more in-depth understanding of the factors that determine or modulate the development of drug awareness in young people with a psychiatric history would enable us to improve early detection techniques for the most vulnerable youth, as well as to develop more selective prevention programmes, i.e. ones which are specifically targeted at risk populations (Díaz, 2009). In this context, the present study of drug awareness and beliefs may be useful in terms of detecting those individuals with erroneous beliefs in this regard, individuals who should be the target of specific interventions designed to alter these ideas.

Longitudinal studies have been conducted into substance use trajectories and the factors related with drug use among adolescents (Henry, 2008; Swift, Coffey, Carlin, Degenhardt, & Patton, 2008; Pérez et al., 2010). From this methodological perspective, longitudinal designs are useful instruments for examining the processes of change that are directly associated with time, as well as for analysing longitudinal data in the context of substance use prevention (Mackinnon & Lockwood, 2003). In this regard, the field of health sciences has recently witnessed a growing interest in the application of multilevel or linear mixed models. For example, during the period 2000-2005 there was a notable increase in the number of articles indexed in the *Medline* and *PsycInfo* databases that used linear mixed models with longitudinal data (Bono, Arnau, & Vallejo, 2008).

In light of the above the main aim of the present study was to determine, by means of linear mixed models, the evolving awareness of the effects and risks of drug and alcohol consumption among adolescent users who were starting treatment at a mental health centre for a disorder that, in theory, was not related to drug use. In addition to standard treatment a subgroup of these patients also received a motivational intervention that aimed to modify their attitudes towards substance use. A number of previous studies have related drug awareness to substance use (Moral-Jiménez, Rodríguez-Díaz, & Sirvent-Ruiz, 2006; Schwartz, 2002). Here, the use of linear mixed models enabled us to analyse individual profiles and the trajectories followed by subgroups of patients according to the intervention they received (standard *vs*. motivational), as well as the variable 'schooling years', for its possible relationship with drug awareness.

Method

Participants

Subjects were 113 adolescents aged between 12 and 17 years (26 boys and 87 girls), all of whom were users

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of psychoactive substances. They were assessed at four time points after attending for the first time either, as out-patients, a child and adolescent mental centre (CAMC) or, as in-patients, the child psychiatry unit (CPU) of the Hospital Clinic in Barcelona, the total study period lasting approximately fourteen months and beginning in January 2004. The CAMC is responsible for providing child and adolescent mental health services to one of the districts in the metropolitan area of Barcelona, while the CPU is a reference in-patient unit for several such districts.

Instruments and predictive variables

Subjects were assessed by means of a drug awareness survey developed ad hoc for the present study. The questionnaire comprised 31 items referring to opinions and beliefs about the consumption of alcohol and other drugs (tobacco, marijuana, cannabis, heroin, cocaine, ecstasy and designer drugs), the response options being: *I think that is true* (T), *I think that is false* (F) and *I don't know, or I'm really unsure* (DK). These items were based on those included in the Spanish version of the Assessment Instrument Bank of the European Monitoring Centre for Drugs and Drug Addiction (Agencia Antidroga de la comunidad de Madrid [Anti-drug Agency of Madrid], 2003). The dependent variable chosen was the total score on the drug awareness questionnaire, which ranged from 0 to 31 points (from limited to considerable knowledge about drug use). In the present study this is a continuous quantitative dependent variable with a normal distribution.

As regards the variables which may influence the adolescents' knowledge about the use of psychoactive substances, the most important is time. Table 1 shows the descriptive demographic variables (gender and age). Socio-economic status was not included as a variable because 91.2% of the adolescents in the sample belonged to the same social class (middle). The following variables were included as possible independent variables or predictors of overall drug awareness:

Time: assessments carried out after the initial consultation, at one month, at six months and at one year.

Schooling years: based on the last academic year completed, or that in which more than half the academic year was completed.

Addiction severity index for adolescents in school status (ASI-school), measured on a five-point Likert scale: none (no real problem), a little (slight problem), average (moderate problem), a lot (considerable problem) and extreme (severe problem). This measure was derived from the Spanish adaptation of the Teen Addiction Severity Index (T-ASI), originally developed by Kaminer, Bukstein, and Tarter (1991) and adapted for Spanish populations by Díaz, Castro-Fornieles et al. (2008a)

Table 1
Descriptive statistics for the sample of adolescents (N = 113)

Variable		*N*	%	Mean	*SD*
Gender					
	Male	26	23		
	Female	87	77		
Age				15.31	1.20
	12	2	1.8		
	13	3	2.7		
	14	26	23.0		
	15	31	27.4		
	16	29	25.7		
	17	22	19.5		
Time					
	Baseline	113	27.1		
	1 month	106	25.7		
	6 months	98	23.7		
	1 year	97	23.5		
Schooling years					
	Primary (6 years)	2	1.8		
	Secondary year 1	12	10.6		
	Secondary year 2	17	15.0		
	Secondary year 3	20	17.7		
	Secondary year 4	37	32.7		
	Higher secondary year 1	19	16.8		
	Higher secondary year 2	6	5.3		
ASI-school					
	None / no real problem	44	38.9		
	A little / slight problem	21	18.6		
	Average / moderate problem	23	20.4		
	A lot / considerable problem	18	15.9		
	Extreme / severe problem	6	5.3		
	Missing	1	.9		

Design

The study used a longitudinal design with control group. One group received the target intervention and the other standard treatment. To this end, subjects were randomly assigned to one of two experimental conditions: 60 adolescent drug users received a motivational intervention (MI) designed ad hoc for this study and which aimed to reduce or eliminate their consumption; the other 53 adolescents received a standard treatment (ST). Five adolescents in the latter group were originally assigned to the MI group but refused this intervention. Pre- and post-intervention measures of drug awareness were taken in both groups.

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Procedure

Subjects in the control group received only ST, while those in the experimental group were offered, in addition to standard psychiatric care, a brief MI aimed at reducing or eliminating their substance use. This intervention was designed on the basis of previous research that has used motivational interviewing with young people (McCambridge & Strang, 2003; Migneault, Pallonen, & Velicer, 1997; Miller & Rollnick, 2002) and consisted of: a) an individual motivational interview with the adolescent; and b) an information/educational session for parents, which was offered either in groups or individually, depending on their availability. The MI was conducted by a specialist team to whom the cases in the experimental group were referred.

The pre-intervention assessment was carried out after the first psychiatric visit, while the post-intervention assessments were performed one month, six months and one year later. As usually occurs in longitudinal studies of this kind, sample attrition was observed across these assessments (see sample sizes according to time in Table 1). In order to avoid possible bias the assessments at each time point were conducted by professionals who did not form part of the therapeutic team. In all cases the adolescents and their parents signed an informed consent form, in which the conditions for taking part in the study were set out and the confidentiality of the data was guaranteed.

The Student's t test was used to obtain the descriptive statistics and determine any differences between the groups at each assessment point. The fixed effects and covariance components of the linear mixed models were also calculated.

Results

The variable 'drug awareness' was examined in order to study the effect of the type of intervention (standard *vs*. motivational), as well as the possible influence of other relevant variables (time, schooling years and ASI-school). Below, the analysis of the overall indicator of drug awareness is presented according to the unconditional linear growth curve model, the growth model with subject-associated variables, and the individual curve model with predictive variables.

Unconditional linear growth curve model

On a first level of analysis it is interesting to study the individual profiles as a function of time, in other words, the individual growth rate. This objective can be achieved by formulating an individual growth model that describes the variance of the repeated measures data for each subject. On a second level it is necessary to study the between-subjects differences in growth rates. On both these levels of analysis it is possible to define a series of predictors that are associated either with time or with subjects.

On the first level it was hypothesized that the drug AWARENESS which adolescent *j* has at point *i* is a linear function of TIME:

$$\text{AWARENESS}_{ij} = \pi_{0j} + \pi_{1j}\text{TIME}_{ij} + e_{ij} \qquad (1)$$

The fixed part of the individual growth model of equation (1) represents the trajectory of each subject over time and is composed of two parameters: the intercept or level of awareness of the subject at the first time point (π_{0j}) and the slope or individual growth rate of awareness as a function of time (π_{1j}). The random part e_{ij} is the residual of the model or the within-subject random error term.

On the second level, we are interested in describing the variability between subjects with respect to initial values (intercepts) and growth rates (slopes). This information is described by two equations where the parameters π_{0j} and π_{1j} from level 1 are explained by a population value or common mean (β_{00}), by a population slope or growth value that is common to all subjects (β_{10}) and by the random residuals of the second-level equations (u_{0j} and u_{1j}):

$$\begin{aligned} \pi_{0j} &= \beta_{00} + u_{0j} \\ \pi_{1j} &= \beta_{10} + u_{1j} \end{aligned} \qquad (2)$$

By introducing the corresponding values π_{0j} and π_{1j} of the second-level equations (2) into the first-level equation (1) we can derive the combined model with the fixed part ($\beta_{00} + \beta_{10}\text{TIME}_{ij}$) and the random part ($u_{0j} + u_{1j}\text{TIME}_{ij} + e_{ij}$):

$$\begin{aligned} \text{AWARENESS}_{ij} = [\beta_{00} + \beta_{10}\text{TIME}_{ij}] + \\ [u_{0j} + u_{1j}\text{TIME}_{ij} + e_{ij}] \end{aligned} \qquad (3)$$

Note that this growth model is unconditional, as it does not include covariables or predictors from the first level, in other words, covariables associated with time.

Table 2 shows the fixed effects and estimated covariance components based on the results of this first analysis of the growth curve for drug awareness, derived from the assessment of subjects at four time points.

This growth model includes two fixed effects: $\beta_{00} = 17.14$, which represents the population value when TIME = 0, and $\beta_{10} = 1.08$, which is the mean slope. This means that when the initial mean level of drug awareness corresponds to a score of 17.14, the individual increases his or her knowledge by 1.08 points at each assessment point. Both effects are significant ($p < .001$), thereby demonstrating that the parameters are not zero in this population. As regards the estimates of the covariance components, the estimated value of the within-subjects residual variance ($\sigma^2 = 8.43$) is also significant ($p < .001$), which indicates that the variance among repeated measures is not zero in this population. With respect to the other components, significant values were obtained for the error variance between individual

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Table 2
Estimated fixed effects and covariance components of the first model

Fixed effects				
Parameter	β	β *SD*	*t*	*p*
Intercept	17.14	.42	40.81	<.001
Time	1.08	.15	7.2	<.001
Covariance components				
Parameter	β	β *SD*	*Wald Z*	*p*
Residual	8.43	.84	10.03	<.001
UN (0,0)	14.30	2.77	5.16	<.001
UN (0,1)	–1.04	.82	–1.27	.200
UN (1,1)	.72	.37	1.95	.049

Note. UN: unstructured variance-covariance matrix.

intercepts ($p < .001$) and the error variance between individual slopes ($p = .049$). By contrast, the covariance between intercept and slope was not significant ($p = .200$).

On the basis of these results, and given the significance of the variation of the intercepts and slopes, it is possible that this variation is due, in part, to the action or presence of a second-level variable, in other words, to a subject-associated variable.

This first approach or model is the most simple and constitutes an exploratory examination of the data. On this first (or within-subjects) level the individual growth curves have been fitted as a function of time. These individual parameters may be considered as a group and, therefore, become dependent variables for a between-individuals or person-by-person analysis. Thus, the individual intercept and slope estimates become second-level dependent variables and are regressed over variables associated with individual characteristics. This first exploratory analysis may be completed or improved by introducing variables that explain these inter-individual differences. Such an explanation can be achieved by specifying models that take into account the most relevant characteristics of the individuals in the study sample.

Growth model with subject-associated variables

Based on the results in Table 2, which refer to the random effects of the first model, it is possible to introduce subject-associated variables (level 2) with the aim of minimizing the variance of u_{0j} and u_{1j}. Thus, on a second or between-subjects level we can test whether the initial degree of drug awareness is the same for all the adolescents, and also whether the growth rate over time varies according to certain individual characteristics. For example, variables such as gender, schooling years, drug use or age at first drug use may determine the initial variation and the variation between individual growth rates. From this analytic point of view the second point of interest is focused on the variation between individuals and how variables associated with them may be able to explain this variation. To this end, let us modify the expressions in equation (2) by introducing a variable that may be significant in the variation observed between subjects. Thus, if SCHOOLING YEARS is taken as the subject-associated variable, the analytic model on the between-subjects level is expressed as follows:

$$\begin{aligned} \pi_{0j} &= \beta_{00} + \beta_{01}\ \text{SCHOOLING YEARS}_j + u_{0j} \\ \pi_{1j} &= \beta_{10} + \beta_{11}\ \text{SCHOOLING YEARS}_j + u_{1j} \end{aligned} \tag{4}$$

where the parameters β_{01} and β_{11} explain the difference between initial levels of awareness and the difference between growth rates that is attributable to schooling years. By entering these two equations (4) into equation (1) we obtain the following mixed effects model:

$$\begin{aligned} \text{AWARENESS}_{ij} = {} & [\beta_{00} + \beta_{10}\ \text{TIME}_{ij} + \\ & \beta_{01}\ \text{SCHOOLING YEARS}_j + \\ & \beta_{11}(\text{TIME}_{ij} \times \text{SCHOOLING YEARS}_j)] + \\ & [u_{0j} + u_{1j}\ \text{TIME}_{ij} + e_{ij}] \end{aligned} \tag{5}$$

In the first part of equation (5), which corresponds to the fixed part of the model, the variable SCHOOLING YEARS has been included in order to reduce the variation produced by the between-subjects differences, in other words, to explain part of the between-subjects variation observed in the previous model. As regards the random part of equation (5), u_{0j} represents the random effect associated with each subject, $u_{1j}\ \text{TIME}_{ij}$ is the random variation of the interaction between subjects and time, and e_{ij} is the random variation of the data between subjects.

Table 3 shows the estimated fixed effects of the second model, as well as the estimate of the covariance components. It can be seen that the intercept has a statistically significant value of 7.77 ($p = .005$), which indicates the mean level of drug awareness among subjects when controlling for their schooling. The value of the parameter associated with schooling, or the relationship between the subject's awareness and the level of schooling, is also significant ($p = .001$).

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Table 3
Estimated fixed effects and covariance components of the second model

Fixed effects				
Parameter	β	β *SD*	*t*	*p*
Intercept	7.77	2.68	2.90	.005
Time	3.02	1.02	2.96	.004
Schooling years	.99	.28	3.53	.001
Schooling years × Time	–.20	.11	–1.82	.057
Covariance components				
Parameter	β	β *SD*	*Wald Z*	*p*
Residual	8.42	.84	10.02	<.001
UN (0,0)	12.28	2.51	4.89	<.001
UN (0,1)	–.63	.76	–.83	.411
UN (1,1)	.63	.37	1.70	.084

Note. UN: unstructured variance-covariance matrix.

Therefore, it explains in part the subjects' level of drug awareness. The time variable also influences overall awareness (p = .004). However, as the interaction between time and schooling years does not reach statistical significance (p = .057) it can be inferred that the effect of schooling does not vary over time.

Note that in Table 3 the estimated value of the residual variance ($\sigma^2 = 8.42$) is equivalent to that of the first model. As regards the remaining estimates of the covariance components, it can be seen that the inclusion of schooling years helps to reduce the size of the intercept variance. Thus, (14.30-12.28) / 14.30 = .14 means that there is a reduction of 14%. In other words, the covariable explains 14% of the variation of the intercepts. Similarly, and as regards the slope variance, comparison of the two models gives (.72-.63) / .72 = .125, in other words, a reduction of 12.5%.

Individual curve model with predictive variables

A key aspect of individual growth curve models is the possibility they offer of examining the graph of each person's growth profiles, which are assumed to be linear in nature. The adolescents studied here differ in their drug awareness across the different assessments. In Figure 1 it can be seen that the individual growth profiles show, in their regression slopes, a growing awareness from one time point to another, with this growth being more marked in the case of the MI group. Additionally, the between-subjects variability decreases in the last session for the MI group.

Comparison of the mean level of awareness of the ST and MI groups, by means of the t test for independent samples (Table 4), reveals that at baseline there are no significant differences between the two kinds of intervention (p = .310). However, the group which received the MI intervention then shows a higher mean level of drug awareness at one month (p = .026), at six months (p < .001) and at one year (p = .028). As indicated by these results, Figure 2 shows that initially the two groups have the same mean level of drug awareness. Subsequently, however, the growth in the mean score obtained on the drug awareness questionnaires is greater among those adolescents who received the MI intervention.

In light of the changes observed, both within and between subjects, one must then ask which predictive variables are capable of explaining the differences in profiles between individuals. Thus, we extend the general growth curve model in which the variation of the individual intercepts and slopes is related to contextual variables, characteristics or situations associated with individuals, for example, the variable SCHOOLING YEARS, which was significant in the previous model. Let us then

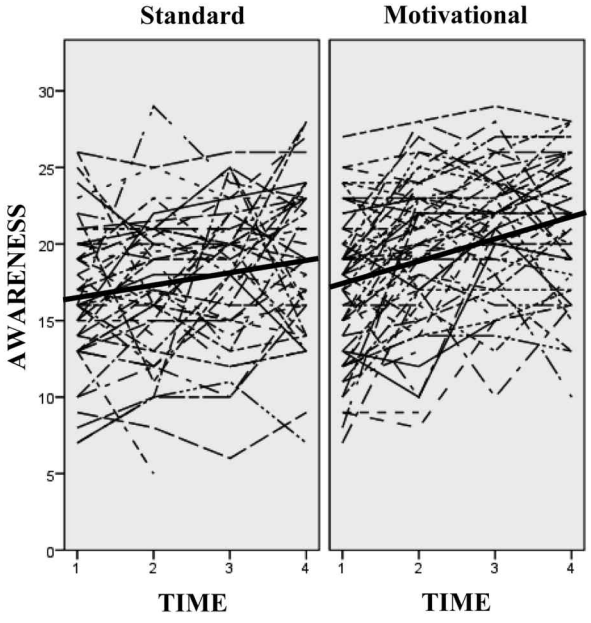

Figure 1. Plot of individual growth curves according to the intervention (Standard *vs*. Motivational).

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Table 4
Comparison of the experimental and control groups at each assessment point

Time	ST group	MI group	*t*	*p*
Baseline	16.38 (4.31)	17.29 (4.90)	–1.02	.310
1 month	17.21 (4.55)	19.37 (4.99)	–2.26	.026
6 months	17.81 (4.52)	20.98 (3.99)	–3.68	<.001
1 year	19.12 (4.99)	21.25 (4.42)	–2.23	.028

ST = standard treatment; MI = motivational intervention

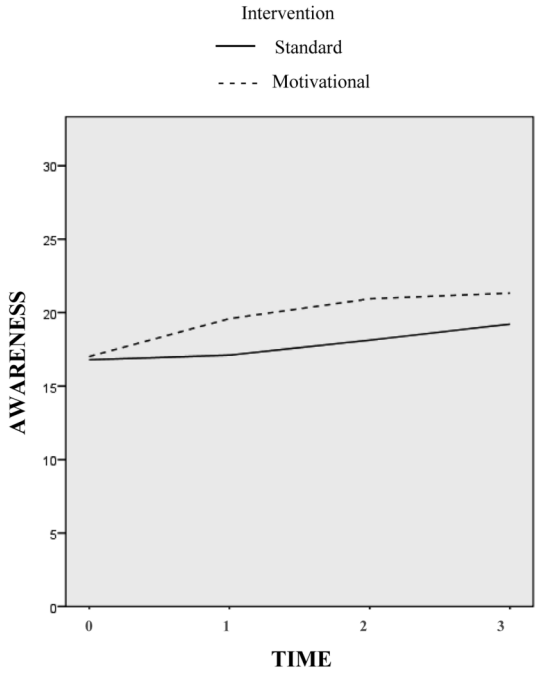

Figure 2. Mean growth profiles according to the intervention (Standard *vs*. Motivational).

reformulate the drug awareness model by incorporating the variable INTERVENTION and the variable ASI-SCHOOL, which correlates negatively with awareness. Thus, model (5) is reformulated in the following terms:

$$\begin{aligned} AWARENESS_{ij} = [&\beta_{00} + \beta_{10}\ TIME_{ij} + \\ &\beta_{01}\ INTERVENTION_j + \beta_{02}\ ASI\text{-}SCHOOL_j + \\ &\beta_{03}\ SCHOOLING\ YEARS_j] + [u_{0j} + u_{1j}\ TIME_{ij} + e_{ij}] \end{aligned} \quad (6)$$

This third model is based on a first-order autoregressive (AR(1)) covariance structure of the residuals, as it was this structure that offered the best fit according to the Akaike information criterion (AIC) (Akaike, 1974). This structure is consistent with longitudinal processes.

Table 5 shows the estimated values of the fixed effects and the covariance parameters for the most complete model studied here, having set the AR(1) structure as the error covariance matrix and, at the same time, maintained the specification of the intercepts and slopes as random variables. In this case the mean level of drug awareness among the subjects, after controlling for their years of schooling, the intervention and the variable ASI-school, is 8.26, which only differs slightly from the previous model in which the within-subjects structure was not introduced into the overall

Table 5
Estimated fixed effects and covariance components of the third model

		Fixed effects			
Parameter		β	β *SD*	*t*	*p*
Intercept		8.26	2.65	3.12	.002
Time		1.09	.16	6.81	<.001
Intervention		1.72	.69	2.49	.014
ASI-school		–.27	.27	–1.00	.307
Schooling years		.69	.24	2.87	.005
		Covariance components			
Parameter		β	β *SD*	*Wald Z*	*p*
Residual	AR(1)	11.91	1.70	7.00	<.001
Correlation	AR(1)	.30	.11	2.73	.005
UN (0,0)		8.14	2.76	2.95	.003
UN (0,1)		.04	.59	.07	.940
UN (1,1)		.00[a]	.00	.	.

Note. UN: unstructured variance-covariance matrix; AR(1): first-order autoregressive variance-covariance matrix.
[a] Redundant covariance parameter.

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variance-covariance matrix. The value of the parameter associated with time is significant ($p < .001$), as are the effects due to the intervention ($p = .014$) and schooling years ($p = .005$). However, the effect attributable to the ASI-school factor is not significant ($p = .307$).

The covariance parameters are the residual variance ($\sigma^2 = 11.91$) and the correlation between each observation point and the next ($\rho = .30$), both of which are significant ($p < .001$ and $p = .005$). Among the random effects parameters only the first is significant ($p = .003$), which indicates that there is considerable variation between the individuals' initial levels of drug awareness.

Discussion

In general terms this study demonstrates that MI is effective. Furthermore, the number of years of schooling and time both have a positive influence on how much adolescents know about the use of psychoactive substances. In what follows, we will describe in more detail the different models applied in this study.

The analysis of each of the three models shows that under the simple growth model the individual levels of drug awareness grow significantly over time. However, as the between-subjects variance components were significant, in relation to both the mean level of drug awareness and the slopes for growth in this awareness, it was necessary to propose a second model that reflected these differences.

In this second model a series of covariables were examined in order to take account of the between-subjects variations observed in the first model. From among these covariables or subject-associated variables, the variable 'schooling years' was selected, since it was the only factor that reached an acceptable level of significance. Thus, schooling years explained, in part, the variation in drug awareness which subjects show in relation to a mean level in the population, and to the growth slopes over time. Given these results it can be concluded that schooling years plays a decisive role with respect to the phenomenon studied.

Finally, the model of drug awareness was then reformulated by considering the variables 'intervention' and 'ASI-school', in addition to schooling years. Application of this third model demonstrated that the effect due to the intervention and the effect of schooling years were both significant, whereas the effect related to the ASI-school variable was not.

The efficacy of brief motivational interventions targeting substance use behaviour among young people from the general population has been previously reported (Tait, Hulse, & Robertson, 2004). This has not been the case, however, in psychiatric populations, where such interventions have been shown to be less effective (Baker et al., 2002). In line with a previous report (Goti et al., 2010) the present study found that subjects who received the brief intervention showed an increased drug awareness immediately afterwards. The application of linear mixed models enabled us to examine not only the evolution of this awareness at three post-intervention time points, but also the possible influence of other variables as regards this increased knowledge. Given the results obtained it can be concluded that one factor which has a notable influence on drug awareness and its evolution is the drug education that adolescents receive at school. This highlights the importance of ensuring that schools can properly educate young people about the consequences of drug use. In fact, one of the aims of the NPD is to ensure that the majority of schoolchildren receive adequate information and education about the potential effects of drugs. As a result, many schools have recently introduced teaching about drug dependency and have strengthened prevention programmes at all levels. In this context it is worth noting that several studies have found that the use of psychoactive substances among adolescents is associated with school dropout (Chassin et al., 2004; Johnson et al., 2000).

In terms of possible limitations of the present study, it needs to be asked whether the sample is sufficiently representative of the population. Our view is that the inclusion of subjects from more than just one geographical area within the city of Barcelona lends the sample a considerable degree of representativeness. That aside, one aspect that could limit the generalizability of the results is the notable preponderance of participants who were female and of intermediate socio-economic status. The fact that girls made up 77% of the sample is due to the fact that the child psychiatry service in which subjects were recruited is also the reference unit for the treatment of eating disorders, which predominantly affect females. A further limitation could be that the instrument used to measure drug awareness was designed specifically for the present study. This highlights the need to validate these kinds of instruments, since drug awareness and attitudes are susceptible to change through school education and brief motivational interventions, both of which appear to be determining factors as regards substance use (Moral-Jiménez et al., 2006). The availability of such instruments would be useful not only for the early detection of subjects at risk, in relation to possible erroneous beliefs or attitudes, but also for evaluating the effectiveness of prevention programmes in risk populations.

Finally, from the analytic point of view, mention should be made of a number of aspects that are taken into account by linear mixed models applied to longitudinal data. These aspects include the within-subjects and between-subjects variation, an unbalanced design, missing data and sample attrition (Fernández, Livacic-Rojas, & Vallejo, 2007; Gill, 2000). It should also be noted that specifying the correct covariance structure in linear mixed models produces more powerful estimates of the fixed parameters (Fernández et al., 2007; Wolfinger, 1996). Taken together, these aspects lead to greater efficacy in the analysis and description of longitudinal studies.

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