# WHAT DOES 'POSITIVE' ATTITUDE REALLY MEAN?

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*In this communication we analyze a dichotomy that pervades research on attitude in mathematics education: the classification of attitude as positive / negative. After highlighting the ambiguity of the term 'positive', and some problems related to it, we suggest that the positive / negative dichotomy is too simplistic to take into account the deep interaction between affect and cognition that characterises mathematics learning.*

## INTRODUCTION

In the field of mathematics education, research on attitude has always been motivated by the 'belief', common to mathematicians and mathematics educators, that *'something called "attitude" plays a crucial role in learning mathematics'* (Neale, 1969, p.631). More recently *attitude* is being considered together with *beliefs* and *emotion* to be one of the constructs that constitute the affective domain (Mc Leod, 1992). De Bellis & Goldin (1999) also include *values* in this domain, and view affect as the most fundamental, and most unrecognized in importance, of the internal representational systems. Even if the meaning of the various terms is not always agreed upon, or even made explicit (Hart, 1989; Pajares, 1992) there is consensus on the fact that emotions and beliefs deeply interact: on one hand, most emotions have a cognitive component (Mandler, 1984; Ortony et al., 1988), on the other, beliefs can have an emotional counterpart (this is the case for example of beliefs about self, such as self-efficacy beliefs, as underlined by Bandura, 1986). As regards attitude, an emotional component is generally explicitly recognised in this construct, often together with a cognitive component, mainly identified with beliefs.

Most researchers have underlined the need of some theory for research on affect, in order to make clearer the connections among the various components, and their interaction with cognitive factors in mathematics education (Mc Leod, 1992). Research on attitude has been judged to be particularly contradictory and confusing[1], due to the fact that it has given more emphasis to the creation of measurement instruments rather than to the elaboration of a theoretical framework (Kulm, 1980; Ruffell, Mason & Allen, 1998). In a previous work (Di Martino & Zan, 2001) we suggested that one of the reasons for this confusion is that a large portion of studies show a lack of a clear definition of attitude. Attitude tends rather to be defined implicitly and a posteriori through the instruments used to measure it (Leder, 1985; Daskalogianni & Simpson, 2000).

The problem of a lack of a clear and agreed upon definition is in the same way common to social psychology. The most recent theories agree on the multidimensionality of the construct, and make reference to a *tripartite model*, according to which attitude has a

[1] The work providing coherent information focused on the description of the differences between groups of people, usually males and females (Fennema, 1989).

cognitive, an affective, and a behavioural component (Eagly & Chaiken, 1998). Within the field of mathematics education many explicit definitions of attitude towards mathematics refer to this tripartite model (Leder, 1992; Ruffell et al., 1998), even if it is possible to find some explicit definitions according to which attitude is simply a general emotional disposition (Haladyna et al., 1983). The idea of attitude that emerges from this latter definition, which we called 'simple' (Di Martino & Zan, 2001) is not considered very significant by many mathematics education researchers, who underline the importance of linking a positive emotional disposition with an epistemologically correct view of the discipline (Ernest, 1988). Kulm (1980) suggests that '*It is probably not possible to offer a definition of attitude toward mathematics that would be suitable for all situations, and even if one were agreed on, it would probably be too general to be useful*' (p. 358). In this way, the definition of attitude assumes the role of a '*working definition*' (Daskalogianni & Simpson, 2000). This position sees the construct of attitude functional to the problems the researcher poses himself: we consider it to be useful in these terms in the context of mathematics education as long as it is not simply borrowed by the context in which it appears, i.e. the social psychology, but is characterised as an instrument capable of taking into account problems typical of mathematics education. This is in line with the position of Ruffell et al. (1998), who see attitude as an observer's construct.

Regardless of the presence of an explicit definition and its nature, the instruments used to assess attitude often make implicit reference to the tripartite model, in that they take into consideration beliefs and behavior as well as emotions. The assessment of each component opens significant problems: for instance the limitations of questionnaires (the most common assessment instruments) have been underlined. As regards beliefs, the mismatch between beliefs expoused and beliefs in action is well known (Schoenfeld, 1989). Many researchers have also underlined the necessity of taking into account not only single beliefs, but also how an individual's beliefs are structured and held, i.e. his/her belief systems (Pajares, 1992; Di Martino & Zan, 2001). Regarding emotions however, researchers have underlined the limits of instruments such as questionnaires and interviews in capturing emotional reactions that are not conscious (Schlöglmann, 2002).

But as well as these, the assessment of the interaction between the various components poses other problems, above all when this assessment takes the form of measurement, as happens in most studies both in mathematics education and in social psychology. Even if the instruments used appear increasingly sophisticated, the measurement generally results in a reduction to the favorable / unfavorable bipolarity, possibly obtained by summing points relating to the three dimensions: cognitive, affective and behavioral. While some scholars play down this operation, observing that 'the correlation among measures of the three components, although leaving room for some unique variance, are typically of considerable magnitude' (Ajzen, 1988, p.22), others consider this reduction as contradicting the recognised complexity of the tripartite model (s. Eagly & Chaiken, 1998).

## THE POSITIVE / NEGATIVE DICHOTOMY

Synthesizing the evaluation of attitude in the favorable / unfavorable dichotomy recalls the dichotomy of positive/ negative attitude that pervades both implicitly and explicitly mathematics education research. For example, classic studies performed on the

relationship between attitude and achievement (see for example the meta-analysis of Ma & Kishor, 1997) in fact investigate the correlation between *positive* attitude and success. In this way, studies aiming to change attitude end up in reality setting the objective of transforming a 'negative' attitude in a 'positive' one.

But is the notion of 'positive' attitude in mathematics education capable of taking into account the deep interaction among beliefs / emotions / behaviour that is the basis of the tripartite model?

In mathematics education just like in social psychology, the characterisation of attitude as positive is for the most part linked to a measurement and therefore score: in general (for example when instruments such as the Thurstone or Likert attitude-scaling techniques or the semantic differential technique are used) the score is obtained by summing points relating to the single items. The choice of scores to be assigned to the items naturally leads to a positive/negative type evaluation of each one. This characterisation is not so frequent in qualitative type studies, and when it is present, it is generally accompanied by a description of the factors (behavior, beliefs, emotions) from which it is obtained. In any case, the evaluation of a positive attitude brings us back to a positive evaluation of at least one of the components: emotions, beliefs, behaviour.

But even a partial analysis of literature highlights that the adjective 'positive' is used with different meanings, not just in different studies, but even within the same study. More precisely, this meaning varies depending whether 'positive' refers to emotions, beliefs, or behavior:

1) When it refers to an emotion, 'positive' normally means 'perceived as pleasurable'. So anxiety when confronting a problem is seen as 'negative', while the pleasure in doing mathematics is evaluated as 'positive'.

2) When it refers to beliefs, 'positive' is generally used with the meaning 'shared by the experts'.

3) When it refers to a behavior, 'positive' generally means 'successful'. In the school context, a successful behaviour is generally identified with high achievement: this naturally poses the problem of how to assess achievement (Middleton & Spanias, 1999).

But in reality the three meanings overlap. For example, in the case of beliefs, sometimes 'positive' means that it is supposed to elicit a 'positive' emotion. A typical case is represented by the belief 'Mathematics is useful', which is also used in questionnaires aimed at measuring just the emotional dimension of attitude (i.e. the 'simple' definition of attitude: s, Haladyna et al., 1983). But often 'positive' referred to a belief means that it is supposed to be related to a 'positive' behavior, i.e. to a successful behavior. Sometimes the latter meaning is also used for emotions, implicitly admitting that a 'positive' emotion toward mathematics, being pleasurable, is necessarily associated with a 'positive' behavior in mathematics. In reality various studies (Evans, 2000) suggest the possibility that for certain subjects, an optimal level of anxiety exists, above which, but also below which, performance is reduced. The problem is that generally the difference between the various meanings is rarely made explicit: in this way, an a priori assumption is often made as to what should in effect be the result of the research, for example, that a belief which is 'positive' because it is shared by the experts is associated with a 'positive' behaviour in that it is successful.

Depending on the criteria used to evaluate an attitude, it is therefore possible that there are different results: for example, an attitude can be evaluated 'positive' as regards the emotional dimension, but 'negative' regarding the cognitive dimension, or viceversa. This is what Hannula (2002) observes, describing the evolution of the attitude of Rita, a lower secondary school student: he underlines that, using the term 'attitude' in a traditional manner, *'in the beginning Rita had an 'attitude' that was negative and positive at the same time'* (p.42). The problem is only apparently overcome when the algebraic sum of the two components results in a single evaluation. Furthermore, as we have observed, beliefs are often used to assess the significance of the emotional dimension, or evaluated according to their 'behavioural' consequence, and this increases ambiguity.

## SOME PROBLEMS RELATED TO THE POSITIVE / NEGATIVE DICHOTOMY

If the researcher does not make explicit his/her choices, it becomes problematic to interpret results obtained within a study, and to perform comparisons with different studies: we are not surprised therefore at the difficulty encountered when coordinating and interpreting widely different results collected in order to study the correlation between 'positive' attitude and achievement.

But even if this ambiguity is overcome by making explicit the choices made, in our opinion other problems remain.

The first is that the separate observation of beliefs and emotions does not allow researchers to pick up the interaction between the two constructs, in particular, the emotional dimension of beliefs and the cognitive dimension of emotions.

But trying to consider this interaction (as apparently is the case when a belief is evaluated according to the emotion that it elicits or to the associated behaviour) poses another problem: in evaluating a belief as 'positive' or 'negative' according to its emotional or behavioral component, we assume not only that a certain belief has an emotional component, but also the significance of that emotional component; not just that it is linked to behaviour, but also the type of behavior. In the end, we accept a cause/effect model according to which the same belief 'causes' the same emotion or the same behavior in all individuals.

The inadequacy of this model has emerged from a recent study (Di Martino & Zan, 2002) in which we set the problem of investigating the interaction between beliefs / emotions.

In this study, we considered some beliefs typically used to assess attitude toward mathematics, and considered 'positive' in that they are beliefs shared by experts.

Here we refer only to one of the two different questionnaires that we prepared, and to the first belief, i.e.: 'In mathematics there is always a reason for every thing'.

In questionnaire 1 we proposed the following formulation:

Choose the option you most agree with:
☐ In mathematics there is always a reason for every thing
☐ It is not true that in mathematics there is always a reason for every thing
And:
☐ I like ☐ I don't like ☐ I find indifferent
…this characteristic of mathematics.

If we call B the agreement with the belief 'In mathematics there is always a reason for every thing', and non B the agreement with the belief 'It is not true that in mathematics there is always a reason for every thing', we may combine these two possibilities[2] with the three options:

☐ I like ☐ I don't like ☐ I find indifferent

By labelling these three cases respectively with +, — , and 0, we have the following theoretical possibilities:

(B, +); (B, -); (B, 0); (nonB, +); (nonB, -); (nonB, 0).

Our study highlights that these possibilities are not only theoretical. Questionnaire 1 was administered to 211 high school students (aged between 14-18), and we found the following data:

| (B, +) | (B, -) | (nonB, +) | (nonB, -) | (nonB, 0) | (B, 0) | TOT |
|---|---|---|---|---|---|---|
| 95 | 27 | 17 | 14 | 20 | 38 | 211 |

Therefore only 109 students (i.e. 51.7% of the sample) associated belief B with a positive emotion, and belief nonB with a negative one.

The two combinations (B, -) and (nonB, +) appear particularly interesting in this context, since there is a discrepancy between the emotional and the cognitive component of the belief B in these pairs, i.e. the emotional and the cognitive components are 'opposite'. This discrepancy highlights the limits of observing these components *separately*, without taking into account *the interaction* between beliefs and emotions. In particular, as regards the (B, -) pair, traditional assessment of attitudes would interpret the agreement with a belief that is shared by experts as *positive*, even if it would interpret an emotion such as 'I dislike it' as *negative*. Vice versa the case (nonB, +) would be considered 'positive' according to the emotional component, but negative according to the cognitive one[3].

But above all, the real presence of all the possible pairs underlines that a certain belief can elicit different emotions in different individuals: this renders it impractical to evaluate a priori the emotional component of a belief as positive or negative.

## CONCLUSIONS

The reduction to a positive / negative dichotomy in the characterization of attitude toward mathematics brings up many types of problems both on a theoretical and didactical level.

We have highlighted three problems at a theoretical level, linked on one hand to the fact

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[2] There is also the possibility that the subject has neither belief B nor belief nonB. Of course, this possibility is not easily detectable using questionnaires.

[3] These considerations refer only to the process of assessment; regarding interpretation, we suggested several possibilities for such a discrepancy, for example that the emotional component + or – may be directly linked to belief B, but also indirectly, through interaction with other beliefs, such as beliefs about self (for example 'I am not able to understand these reasons'). From a didactical point of view this difference is important, since it suggests different kinds of intervention.

that the adjective 'positive' is used with different meanings, and on the other to the subjective nature of the interaction between emotions / beliefs:

- The fact that there can be different meanings to the word 'positive' relating to attitude poses a problem of ambiguity. This underlines the necessity that the researcher makes explicit his/her choices (Zan & Di Martino, 2003) to permit communication, particularly in the interpretation of results and confrontation with other research.

- The fact that the criteria used to evaluate the emotional component and the cognitive component are different, and can even result in contradictory evaluations (see the study cited above in the cases (B, -) and (nonB, +)), highlights the problem of managing to consider both of the components in a single evaluation. It also highlights the limits of a positive/ negative evaluation which makes reference to a single component. This type of evaluation can only be viable in our opinion in the case of particularly simple problems such as those encountered when predicting the choice of mathematics courses, for which it can be sufficient to refer simply to the emotional dimension.

- But above all, the subjective and complex nature of the cognition / emotion interaction highlights the limits of a *normative* model for attitude, which searches for universal laws and rules of behaviour, subject to a cause and effect explanation (s. Cohen & Manion, 1994).

This brings us to the other problem: the inadequacy of the positive / negative dichotomy from a didactical point of view. This dichotomy hides extremely different situations and needs under the same label, when they in fact require different interventions. For example, the negative emotional disposition of a pupil who sees mathematics as made of nonsensical rules requires a completely different intervention compared to the negative emotional disposition of a pupil who has an 'epistemologically correct' view of the discipline, but a low sense of self-efficacy.

In conclusion, the positive / negative dichotomy appears inadequate to confront the complexity that characterises the interaction between emotions/beliefs, and therefore also the more significant problems that the context of mathematics education presents. In order to account for this complexity, we consider that it is necessary to overcome this reduction, using a multiple approach to assess attitude, privileging the description in context, as performed by some researchers (Leder, 1992; Ruffell et al., 1998; Daskalogianni & Simpson, 2000; Evans, 2000; Karsenty & Vinner, 2000; Hannula, 2002).

According to this interpretive approach, attitude becomes 'a construct of an observer's desire to formulate a story to account for observations', rather than 'a quality of an individual' (Ruffell et al., 1998, p. 1): a construct useful to understand motives of intentional actions, rather than to explain the causes of behaviour.

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