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High school girls motivation toward mathematics: Effects of perceived instrumentality and attitude toward the future

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High School Girls Motivation Toward Mathematics: Effects of Perceived Instrumentality and Attitude Toward the Future

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Abstract

Research in the area of future time perspective has suggested that academic motivation is associated with the perceived instrumentality of academic pursuits, and affective attitude toward personal future (Van Calster, Lens & Nuttin, 1987). Motivation tends to be higher when perceived instrumentality is high, but only when one has a positive attitude toward personal future. The present study tested these findings in regard to motivation toward mathematics in a sample of 119 13-year-old high school girls. Main effects for affective attitude and perceived instrumentality on motivation were found. Students who had a positive affective attitude were more motivated than students who had a neutral or negative affective attitude. Students who had high perceived instrumentality were more motivated than students with low perceived instrumentality. The hypothesised interaction between the two independent variables on motivation was not supported. At the same time an experiment was conducted to test the effect of an increase in perceive instrumentality on motivation. The participants in an experimental group read a mock newspaper article and viewed a video, both of which emphasised the importance of mathematics for future career success. Using planned comparisons it was predicted that students with a positive affective attitude would be more motivated after the manipulation, while the students with a negative or

neutral affective attitude would report no change in motivation. It was also predicted that students in a control group would not experience a change in motivation. The hypothesised increase in motivation for the students in the experimental group with a positive affective attitude was not supported. Manipulation checks indicated that the experimental manipulation had not been successful in increasing perceived instrumentality. The main implication for educators from this study, is that students' affective attitude toward personal future is an important factor to consider when trying to increase high school girls' motivation toward mathematics. Directions for future research and other practical implications are discussed.

Declaration

I certify that this thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any institution of higher education; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

Signature

Date..1/2/95.....

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CHAPTER 1

The Role of The Future in Human Behaviour

The way people perceive their future may influence their present behaviour. If the future is perceived as bright and positive, this could be expected to motivate people to strive to achieve the future. In contrast, if the future is perceived as bleak and gloomy, this could be de-motivating, particularly if a present activity is perceived as taking one to a negative future. For example, if mathematics is perceived as a stepping stone to the future and the future is perceived as negative, then this may have a de-motivating effect on willingness to study mathematics.

According to "future time perspective", the way people perceive, organise and feel about their future, should have an impact on their present behaviour. The role of people's psychological future was introduced by Lewin (1948) as a motivational force which influences mood and behaviour. Since then, various different terms have been used to describe what appears to be the same phenomenon.

These apparently conceptually similar terms include "future time perspective", "future orientation" and "future time orientation". The first term, "future time perspective" (FTP) was introduced by Lewin (1948) as having an influence on human actions, emotions, morale and persistence.

FTP was defined by Lomranz, Shmotkin and Katznelson (1983, p. 407) as "the way in which people

conceive of, organise and feel about their future". People's FTP consists of two components: a motivational/affective component and a cognitive component (De Volder & Lens, 1982; Lens, 1987; Nuttin, 1964, 1985; Thomae, 1981; Verstraeten, 1980). The motivational/affective component consists of needs and valences. Peoples' needs direct them to look to the future to find possible ways of satisfying these needs. When people look to the future, plans and events are given valence depending on whether or not they satisfy the underlying needs. Valence refers to the attractiveness or aversiveness of future objects (goals and events) (Feather, 1988).

The cognitive component of FTP can be conceptualised as a cognitive schema. According to Nuttin (1985), this component refers to how far a person's psychological future extends from the present (extension), the perceived linkage between present and future activities (structure), how many objects exist in the future (density), and how realistic each of these objects is (level of realism). Individual differences on each of these dimensions are a source of individual differences in behaviour.

In his theoretical work on FTP, Nuttin (1985) firstly proposed that people with greater extension and density in their psychological future should be more able to find incentives to perform a present activity than people with less extension and density. This is because, longer and more dense FTPs should contain more

goals and events. Secondly, Nuttin proposed that people with a greater degree of structure in their FTP should be more able to perceive links between a present activity and its future consequences than people whose FTP is less structured. Thus for people who perceive greater structure in the future, their behaviour should not only be influenced by the immediate outcome of an activity, but also influenced by future outcomes of the activity. Thirdly, according to Nuttin, the more realistic a future goal or event is perceived to be, the more accurate is the perceived probability and value of goal attainment. Furthermore, greater realism is associated with greater understanding of what is required to attain the future goal. Thus greater future realism should be associated with greater motivation.

"Future orientation" is another term that has been used in this context. It was used by Raynor and his colleagues to refer to the future consequences of a present activity, and the motivational effect of anticipating those future consequences (Raynor, 1970, 1978, 1981; Raynor & Entin, 1982). Raynor also used the term "perceived instrumentality" to refer to the same concept. The term future orientation used by Raynor and his colleagues appears similar to the degree of structure in a person's FTP identified by Nuttin (1985). However, future orientation appears to refer to the structure of one activity (that is, the link between one present activity and its future outcomes),

while the degree of structure in a person's FTP refers to the global structure in FTP (that is, the link between various activities and outcomes).

Other researchers have used future orientation as a broader term. Both Tismer (1985; 1987) and Trommsdorf (1983) considered future orientation as a component of FTP, but they wrote about future orientation as though it had the same components and dimensions as Nuttin's (1985) conceptualisation of FTP.

Tismer (1985; 1987) conceptualised future orientation as near or distant future aspirations, expectations, hopes and fears. Trommsdorf (1983) mentioned that future orientation consists of two components - a cognitive aspect and a motivational/affective aspect. The cognitive dimensions of future orientation were identified as degree of realism, extension, density of anticipations, structure of events, and judgement of internal versus external causality. With the exception of the last dimension, these dimensions of future orientation proposed by Trommsdorf (1983) are the same as the FTP dimensions proposed by Nuttin (1985).

Regarding the second component of future orientation, the motivational/affective component, Trommsdorf (1983) referred to the motivational part of this aspect as the goals, hopes, fears and wishes which direct and energise behaviour, that is, the valence of future objects. This is similar to the FTP motivational/affective component which refers to the

valence of future objects which direct people to approach attractive goals and events, and avoid aversive objects (Nuttin, 1985).

According to Trommsdorf (1983) the affective component of future orientation refers to the effect of a person's general affective attitude toward the future. That is, the more or less, optimistic versus pessimistic, positive versus threatening anticipation of the future. This affective component was referred to by Nuttin (1985) as the affective attitude toward personal future. Affective attitude toward personal future refers to a person's global attitude toward the future; whether that person perceives the future as bleak and gloomy, or as positive and attractive. Lens (1987) considered a person's affective attitude to be a function of the valences of all the future objects in a person's FTP.

Seginer (1992) considered future orientation to consist of similar structural properties to those proposed by Nuttin (1985) and Trommsdorf (1983), that is extension, density, and degree of structure. Seginer (1992) also conceived of the psychological future as containing thematic domains. Within each of these thematic clusters exist plans and goals. For example, for a student these themes might include school, work and career, family, self, others, and higher education domains, which may vary in terms of salience, density of goals and plans, and amount of detail and concreteness.

FTP as conceptualised by Lewin (1948), Lens (1987), Verstraeten (1980), Nuttin (1964, 1985), and Thomae (1981), appears synonymous with the conceptualisation of future orientation by Seginer (1992), Tismer (1985; 1987) and Trommsdorf (1983). Raynor and his colleagues, however, used the term future orientation to refer to a concept which is a dimension of FTP. That is, to refer to perceptions of one present activity having future consequences. To minimise confusion, it would seem sensible to use the term future time perspective for the overarching concept, and the term perceived instrumentality to refer to a person's perception that a present activity will have future implications.

The third term that has been used to refer to a person's psychological future is "future time orientation". Future time orientation has been defined as a person's capacity to anticipate, clarify, and structure the future. It is generated by a person's motives, which influence behaviour by directing a person to select certain future events and to avoid others (Gjesme, 1975, 1983; Halvari, 1991). This is similar to Nuttin's (1985) conceptualisation of needs motivating people to look to the future to find ways of satisfying their needs. Future time orientation, however, has been operationally defined differently to FTP. Gjesme (1975, 1983) defined future time orientation as a person's degree of involvement in the future, the extent to which a person thinks about the

future, and how distant a person perceives the future to be from the present. Thus while FTP refers to the conceptualisation, organisation and feelings about the future, future time orientation refers to the amount of involvement with the future. The two concepts are related, but not synonymous.

To summarise, FTP has been defined as how a person conceptualises, organises, and feels about the future. FTP is aroused by a person's needs, and it motivates and directs behaviour. Cognitive dimensions of FTP include extension, degree of structure (including the perceived instrumentality of specific activities), level of realism, density of objects, and perception of internal versus external control in future events. The combined valences of future events and goals makes up people's affective attitude toward personal future, which refers to how bleak or how bright they perceive their future to be. In addition, FTP can be conceptualised as being divided up into thematic domains, which are organised schematically.

The Development of Future Time Perspective

People are not born with a FTP; it is something which develops with maturity (Gjesme, 1983; Lewin, 1948; Nuttin, 1985; Raynor & Entin, 1982). Both Nuttin (1964; 1985) and Gjesme (1983) proposed that FTP originates from a person's needs and motives. An arising need gives a person a vague sense that something is missing. The person then starts to look to the future to find a way to satisfy the need.

As people mature, so does their ability to cognitise the future. People become able to use symbols to conceptualise the future and more able to structure the future to perceive and devise plans to achieve goals to satisfy needs (Nuttin, 1985). They become capable of identifying which activities are important for future success (Raynor & Entin, 1982). Also, according to Lewin (1948) and Nuttin (1985), as people develop through adolescence, their FTP extends further into the future, and future objects are perceived more realistically. In addition, as people mature they become more able to delay gratification and thus more able to look to the future for behaviour incentives (Gjesme, 1983).

Previous research has provided support for the view that as people mature, their FTP extends further into the future and becomes more realistic. For example, Verstraeten (1980) found 16-year-old participants had a longer FTP with more realism than 15-year-old participants.

Furthermore, research has considered the effects of socio-economic status and gender on FTP. Trommsdorf (1983) found that people from a socially and economically deprived background tended to have a less extended and less structured FTP than people from a non-deprived background. He argued that this may be adaptive for people from a deprived background, as their distant future may be bleak and pessimistic, and

an extended and structured FTP consisting of bleak events may be maladaptive and de-motivating.

Trommsdorf (1983) reviewed previous research which compared the FTP of males and females. Males were found to have more hopes and fears in the occupational domain than females, while females had more hopes and fears in the family domain. However, more recent research by Lennings (1992), has compared the extension and structure of FTP between males and females. Both sexes were found to have equal extension and structure of FTP for both careers and relationships. Lennings (1993) suggested that this finding of little sex difference on extension of FTP may reflect changing effects of socialisation over the previous decade. That is, there was less difference in the socialisation of males and females in the Lennings (1992) study, than there was ten years ago (Trommsdorf, 1983).

The Effects of Future Time Perspective on Human Behaviour

Previous theory and research have investigated the effects of different dimensions of FTP on human behaviour and motivation. Raynor (1970) considered the influence of FTP within the context of expectancy-value theory (Atkinson & Feather, 1966). Raynor (1970) proposed that the effects of achievement motives on achievement behaviour would be mediated by a cognitive dimension of FTP. This cognitive dimension was whether or not behaviour in an achievement situation was perceived as important for future career success

(Perceived Instrumentality). He predicted that university students whose motive to achieve success was greater than their motive to avoid failure (success-oriented subjects) would be more motivated to achieve good grades when getting good grades was perceived as instrumental for future career success, than when getting good grades was not perceived as instrumental for future career success. In contrast, students whose motive to avoid failure was greater than their motive to achieve success (failure-oriented subjects) would be less motivated when grades were perceived as instrumental for future career success than when they were not perceived as instrumental.

In Raynor's (1970) first study, he found support for the predicted interaction between achievement motives and perceived instrumentality on university students' grades. This study involved 221 male and female university students enrolled in an introductory psychology course. Success-oriented participants were students who had high need for achievement and low test anxiety. Failure-oriented participants were students who had low need for achievement and high test anxiety. Perceived instrumentality was measured by two questions which required the students to indicate how important they thought getting a good grade in introductory psychology was for future career success. The dependent variable was the students' grades in introductory psychology.

In the second study conducted by Raynor (1970), the predicted interaction between achievement motives and perceived instrumentality was not supported. This study involved 168 male university students. Success-oriented students and failure-oriented students were identified by the same procedure as in Raynor's first study. Perceived instrumentality, however, was measured differently. Instead of the students indicating how important they thought getting a good grade in introductory psychology was for future career success, the students listed the courses (units) they were enrolled in and indicated how important they thought each course was for future career success. An ANOVA was conducted with achievement motives and perceived instrumentality of introductory psychology as the independent variables, and introductory psychology grade as the dependent variable. An ANOVA was also conducted with achievement motives and students average perceived instrumentality for the courses they were enrolled in as the independent variables, and grade point average as the dependent variable. In both ANOVAs main effects were found for achievement motives and perceived instrumentality on the students' grades, but no interaction was found. Students with high perceived instrumentality achieved higher grades than students with low perceived instrumentality, regardless of their achievement motives. Success-oriented students achieved higher grades than failure-oriented subjects regardless of perceived instrumentality.

According to Raynor (1970), failure to find the predicted interactions in the second study may have been due to the effects of extrinsic motivation. That is the effect of extrinsic reward (e.g., praise by parents) may have outweighed the effects of achievement motives. However, this does not explain why the predicted interaction was found in the first study and not in the second.

Gjesme (1975) considered the relationship between achievement motives and achievement performance as a goal becomes closer in time. This study involved 379 12-year-old boys and girls. These students were randomly assigned to one of four conditions. In each condition the students were given a series of anagram and numerical tasks. Students in condition one were informed that the tasks were a test. The other three groups were informed that the task would be folowed by a test in one week, one month or one year.

Gjesme (1975) found that when the goal was closer in time, the relationship between achievement motives and achievement performance was greater. For success-oriented participants, the students in the conditions with the test closer in time performed better on the tasks than the students with the test more distant in time. In contrast, failure-oriented subjects performed worse when a future goal was closer.

Pearlson (1982) provided further support for Gjesme's (1975) hypothesis that as a future goal becomes more distant in time, the association between

achievement motives and performance decreases. Also, Seginer (1992) found that people tend to be more concerned with future events which are relatively closer in time.

De Volder and Lens (1982) studied the effects of perceived instrumentality on 18-year-old high school boys' academic achievement and academic persistence. They found that students who had high grade point average and high study persistence, perceived studying hard as more instrumental for future goals, than students with lower grade point average and less study persistence. They also found that students with high grade point average and high study persistence attributed greater positive valence to distant future goals than the other students. Thus De Volder and Lens proposed that greater positive valence attributed to distant future goals and higher perceived instrumentality results in greater study persistence and higher grade point average. However, their research involved a correlational design, and one cannot be certain about the direction of causality.

Van Calster, Lens and Nuttin (1987) extended the proposition provided by De Volder and Lens (1982). Van Calster et al. (1987) replaced the variable valence of future goals with the variable affective attitude toward personal future, as it was proposed by Lens (1987) that affective attitudes can be considered equivalent to the sum of valences of future objects. For example, people whose psychological future consists

of more positively valenced goals and events than negatively valenced ones, would be expected to have a positive affective attitude. In contrast, people whose FTP consists of more negative than positive future goals and events, then they would be expected to have a negative affective attitude. Van Calster et al. (1987) measured affective attitude by the global affective evaluation subscale of the revised Time Attitude Scale developed by Nuttin (1985). This subscale requires respondents to indicate on five bipolar adjectives (e.g., Attractive-Threatening) how they spontaneously perceive their future.

Van Calster et al. (1987) predicted that the relationship between perceived instrumentality and achievement behaviour would be mediated by affective attitude. They found main effects for both affective attitude and perceived instrumentality of studying hard for future career success on 18-year-old high school boys' study motivation and academic achievement. More importantly, they found a disordinal interaction between the two independent variables (affective attitude and perceived instrumentality) on the two dependent variables. Among the students who had high perceived instrumentality, those who had a positive affective attitude were more motivated to study hard and achieved higher grades than students who had a negative affective attitude. Among the students with low perceived instrumentality, those who had a negative affective attitude were more motivated and achieved

higher grades than those who had a positive affective attitude. For students with a positive affective attitude, those who had high perceived instrumentality were more motivated and achieved higher grades than those who had low perceived instrumentality. For students who perceived the future as negative (negative affective attitude), students with low perceived instrumentality were more motivated and achieved higher grades than students with low perceived instrumentality.

Van Calster et al.'s (1987) explanation for this interaction was as follows. If the future is perceived as bright and positive (positive affective attitude), then students would be more motivated to engage in a task which is going to enable this positive future to occur (high perceived instrumentality), than to engage in a task which is not instrumental for the future. In contrast, if the future is perceived as bleak and gloomy (negative affective attitude), then students would be less motivated to engage in a task which is going to enable this negative future to occur (high perceived instrumentality), than to engage in a task which is not instrumental for the future.

Lens and Decruyenaere (1991) found main effects for both perceived instrumentality and affective attitude on study motivation, similar to those found by Van Calster et al. (1987). However, they did not examine the interaction between the two independent variables. The purpose of their study was to ascertain

if motivation could be predicted by various motivation variables, including expectancy-value variables, attribution variables, achievement motives, perceived instrumentality and affective attitude.

In contrast, Rosseel (1989) found affective attitude was not related to study motivation, with a sample of high school boys and university males. According to Rosseel, a possible reason why the predicted relationship was not supported may have been because the sample consisted of people with a more positive affect attitude than anticipated. That is, there may not have been enough variation in affective attitude for there to have been a main effect on motivation.

Mathematics Motivation in Girls

To date, perceived instrumentality and affective attitude have largely been examined in regard to boys' academic motivation and achievement, However, a particularly important area where the theory may be relevant is that of high school girls' motivation toward mathematics.

Recent research has found that in the last two years of high school, girls tend to participate less than boys in mathematics (Feather, 1988; Willis, 1989). The difference in participation rates does not appear to have been due to academic achievement. Instead, participation appears more likely to have been influenced by motivation. This is because previous research has found motivational variables (e.g.,

expectancy-value variables) to be greater predictors of participation in mathematics than academic achievement (Eccles, Adler & Meece, 1984).

Previous research examining females motivation toward mathematics has investigated the effects of self-efficacy and expectancy-value (Eccles et al., 1984; Meece, Wigfield & Eccles, 1990), test anxiety (Meece et al., 1990), attribution style and learned helplessness (Eccles et al., 1984), spatial visualisation (Reyes & Padilla, 1985), segregation of mathematics classes (Sangster & Crawford, 1986), and perceived instrumentality of mathematics (Eccles et al., 1984; Fear & Kapostasy, 1992; Meece et al., 1990). However, to date previous research has not assessed the relationship between affective attitude toward personal future and females motivation toward mathematics, nor the interaction between affective attitude and perceived instrumentality on females motivation.

The present study examined the ability of FTP theory to predict high school girls' motivation toward mathematics. Based on Van Calster et al.'s (1987) findings, it was predicted that the relationship between perceived instrumentality and high school girls' continuing motivation toward mathematics would be mediated by their affective attitude. Continuing motivation refers to student's motivation in the future (Eccles et al., 1984; Uguroglu & Walberg, 1986). In the present study, continuing motivation was operationally defined in terms of consequences of

motivation (Atkinson & Feather, 1966; Beck, 1990; Boekaerts, 1987; Vroom, 1964), including persistence on mathematical tasks, time taken to complete mathematical tasks, energy and amount of effort exerted on math tasks and homework, choice and preference for studying and doing mathematics, and willingness and intentions to continue studying mathematics .

The present research consisted of two studies. The first study was a correlational design for which an interaction between perceived instrumentality and affective attitude on motivation was hypothesised so that:- a) Among the students with high perceived instrumentality, students with a positive affective attitude were expected to have higher motivation than students with a negative affective attitude; b) Among the students with low perceived instrumentality, no significant difference in motivation was expected between students with a positive affective attitude and students with a negative affective attitude; c) Among the students with a positive affective attitude, students with high perceived instrumentality were expected to have higher motivation than students with low perceived instrumentality; d) Among students with a negative affective attitude, students with high perceived instrumentality were expected to have less motivation than students with low perceived instrumentality.

Because most studies in this area to date have been correlational, the second study was an

experimental design to test the effects of manipulating perceived instrumentality. It was hypothesised that among the students with low perceived instrumentality, an increase in perceived instrumentality would result in an increase in motivation for students with a positive affective attitude, but not for students with a negative affective attitude.

CHAPTER 2

Continuing Motivation Toward Mathematics: Scale Construction

An inventory was developed to assess students' continuing motivation toward mathematics. The questionnaire was designed to measure high school students' willingness and intentions to study mathematics in the future.

Continuing motivation toward mathematics was operationally defined in terms of consequences of motivation, including behavioural intentions, affects and attitudes (Atkinson & Feather, 1966; Beck, 1990; Boekharts, 1987; Vroom, 1964). Highly motivated students, in contrast to students with low motivation, would be expected to persist for a relatively longer period of time on difficult mathematical problems; exert more energy when in math class and when working on math homework; spend more time working on math homework and math assignments; consider math homework to be as important as homework from other subject areas; be more willing and have greater intentions to study mathematics in the future; and be more likely to intend to have a positive attitude toward mathematics.

Based on this operational definition of a motivated student, twenty items were constructed (Appendix A). Two pilot studies were then conducted to refine the questionnaire and assess its concurrent validity. As previous research has found a significant

positive correlation between study motivation and academic achievement, concurrent validity would be supported if the refined questionnaire correlated with students' achievement in mathematics (Gottfried, 1985; Uguroglu & Walberg, 1979, 1986). Also, the refined questionnaire should correlate with teachers' ratings of students' motivation.

In pilot study one, the questionnaire was refined. It was hypothesised that students' scores on the questionnaire would correlate with their previous mathematics grade. In the second study, it was hypothesised that students' scores on the questionnaire would correlate with a mathematics teacher's rating of students' motivation and with students' scores on a mathematics achievement test.

Pilot Study 1

Method

Participants. The initial sample consisted of 96 year 8 and year 9 high school girls from a public high school in a northern suburb of Perth (M = 13.24, SD = 0.82).

Materials. The initial questionnaire consisted of 20 items and was designed to assess high school students' continuing motivation toward mathematics. The first four items measured intentions to study mathematics in the future (e.g., "I don't intend to take any more mathematics than I have to") and

motivation to work hard (e.g., "I am not motivated to work very hard on mathematics during lessons"). These items were based on four items from Aiken's (1979) Scale of Attitudes Toward Mathematics. The four items were reworded to assess students' continuing motivation.

The next four items measured students' intentions to persist for a long time on difficult problems (e.g., "When a math problem arises that I can't immediatley solve, I intend to stick with it until I have the solution") and the appeal of solving mathematical problems (e.g., "Figuring out mathematical problems does not appeal to me"). The items were based on four items from the Effectance Motivation in Mathematics Scale (Fennema & Sherman, 1976). They were reworded to focus on continuing motivation.

The next two items measured students' intentions to exert energy and try hard (e.g., "in the next Math test I intend to try hard to do my best"). The items were based on Reynolds and Walberg's (1992) academic motivation items. These items were reworded to relate specifically to mathematics and to assess continuing motivation.

The remaining items were written so that they related to the consequences of continuing motivation. Nine assessed behavioural manifestations of motivation including persistence ("If I had a difficult math problem, I wouldn't spend much time on it"), speed (e.g., "When I have a set of math questions, I would

work through them as quickly as possible"), intention (e.g., "I intend to do as little math homework as possible over the next month"), and willingness to exert effort (e.g., "I don't intend to put much effort into my next assignment"), for math class, assignments and homework. The final item referred to having a positive attitude toward mathematics ("I intend to have a positive attitude toward mathematics").

Each item on the initial questionnaire required participants to indicate a response on a 5-point Likert scale with descriptors: "Strongly Disagree", "Disagree", Undecided", "Agree", and "Strongly Agree". Half of the items were positively worded and the other half were negatively worded to counteract the effects of acquiescence and response set. The positively worded items were scored so that Strongly Agree items were given a score of five and Strongly Disagree items were given a score of one. Reverse coding was used for the negatively worded items.

Students were also asked to write their age and name, and to indicate their previous mathematics grade (received three months prior to the date of testing) and their present year of study. Sixteen students did not report their previous mathematics grade.

Students' names were requested so their responses could be compared with teacher ratings of their motivation toward mathematics. However, teachers were unable to rate their students' motivation toward mathematics, due to limited time.

Design and procedure. Questionnaires were administered to the students during form period by their form teachers. There were approximately 25 students in each class. Each teacher informed the students that the purpose of the questionnaire was to assess students attitudes toward mathematics. Confidentiality was assured, and they were told them that participation was not compulsory. They were asked to answer as honestly as possible, and instructed to place completed questionnaires in a yellow envelope at the front of the class to ensure confidentiality.

Results

Inter-item correlations, item-total correlations and item distributions were examined for the 20 items. All of the inter-item correlations were less than .8, thus none of the items were considered redundant. Four items had low item-total correlations (i.e., < .30) and were deleted from further analyses. Also, four items had high negative skewness with more than 70% of subjects responding with a score of four or five, reflecting a possible ceiling effect. These four items were also deleted from further analyses.

Principal components extraction was conducted with the twelve remaining items. Assumptions of normality, linearity and factorability of R were all met. Three factors were extracted which accounted for 59% of the total variance. After varimax rotation, a relatively complex structure was identified, as half the items had factor loadings greater than .30 on two factors.

Factor loadings, communalities (h^2) and interpretative labels are shown in Table 1. Loadings below .30 have been suppressed and loadings above .45 are in bold to aid interpretation. Furthermore, brief item labels are shown in Table 1 to facilitate comprehension of the items. For example, "When I get math homework, I intend to work hard on it" was labelled "Homework - work hard" (refer to Appendix A for motivation items and their corresponding labels).

Factor one was tentatively labelled "intrinsic motivation", because the items with the highest factor loadings (> .45) measured time and effort willing to expend, want and appeal of math problems and intentions to have a positive attitude toward mathematics. As items with the highest factor loadings (> .45) on factor two measured intentions to continue mathematics, and motivation and want to work hard, this factor was tentatively labelled "continuing mathematics". Factor three was tentatively labelled "extrinsic motivation", because the items with the highest factor loadings (> .45) measured motivation contingent on external reward (math grade) and intentions to exert effort.

Table 1

Factor Loadings of Motivation Items : Scale Construction

Item	F_1[a]	F_2	F_3	h^2
Homework - work hard	**.70**			.55
Positive attitude	**.69**			.50
Problems - persistence	**.67**	.35		.57
Problems - appeal	**.61**			.42
Test - study time	**.58**		.32	.53
Problems - want to work on	**.50**	**.54**		.61
Homework - effort	**.48**		**.61**	.62
Further knowledge	.35	**.74**		.69
Future maths		**.81**	.38	.70
Math plans		**.71**		.68
Class - work hard		**.56**		.44
Bad grade - try harder			**.83**	.77
Percent of Variance	22.44%	22.41%	14.18%	59%

[a]Factor labels:

*F*1 Intrinsic motivation

*F*2 Intention to continue mathematics

*F*3 Extrinsic motivation

The twelve items in the refined scale had good internal consistency (Cronbach's alpha = .86). Item scores were summed to give a composite score with a possible range of 12 to 60. Students' grades were converted to a numeric score from 1 to 5, with 5 for an A and 1 for an F. A moderate significant positive correlation was found between motivation and grade, $r\ (77) = .44$, $p < .05$, thus the hypothesised relationship between motivation toward mathematics and previous grade was supported, indicating concurrent validity for the scale.

Discussion

From the original 20 Continuing Motivation Toward Mathematics items, 12 items were considered suitable in the final questionnaire. In female students, this questionnaire was found to measure three dimensions of motivation toward mathematics - intrinsic motivation, intentions to continue mathematics, and extrinsic motivation. Also, the third factor largely consisted of one variable and would require more variables to load highly on that factor to be considered an adequate measure of extrinsic motivation.

The sum of the twelve items from the final questionnaire was found to be positively related to subjects' previous math grade, which provides some support for its concurrent validity. As the questionnaire was designed to measure students' future motivation, it was labelled the Continuing Motivation Toward Mathematics questionnaire (CMTM).

Pilot Study 2

Method

Participants. Twenty eight year eight high school students participated in the second part of the pilot study (age M = 12.93 and SD = .60). This sample consisted of 10 girls and 18 boys from a public high school in the eastern suburbs of Perth.

Materials. Two questionnaires were used in the second pilot study. The first was the CMTM developed in the first pilot study.

The second questionnaire used in the present pilot study was the Progressive Achievement Test (Math) or PATMATHS (ACER, 1984). The PATMATHS measures students' ability and knowledge in mathematics. The shortened version of Form 3a was used which consists of 50 mathematical questions. The questions in the PATMATH require a multiple choice response and each correct response receives a score of one. Thus the participants could achieve a score between 0 and 50.

Although the PATMATHS has adequate reliability (K-R 20 = .89), limited support has been provided for its validity. The finding that achievement on the test improves from one year to the next provides some support for its construct validity. However, according to ACER (1984), the issue of the content validity of the PATMATHS is highly subjective and requires teachers to assess the content of the test to see if it is appropriate to the curriculum. As well as the PATMATHS booklets, each student required a computer answer sheet, three blank pages for working paper, a pencil and an eraser.

In addition to the two questionnaires, a teacher rating sheet was used. The teacher was required to rate each student on a scale from 1 to 10 regarding how motivated each student was considered to be. A score of one indicated "Not at all motivated" and a score of

ten indicated "Very motivated". A motivated student was defined as someone who puts in a lot of effort to solve mathematical problems, persists on difficult mathematical problems, and is keen to do mathematical problems.

Design and procedure. This pilot study was conducted by the researcher during a mathematics class. Students were informed that the study was a part of the researcher's assessment at university. They were told that they had a questionnaire and an achievement test to complete. They were assured of confidentiality and informed that their responses would not influence their marks in mathematics. The CMTM was given to each student and they were asked to answer as honestly as possible by circling the appropriate response.

After the CMTM was completed, the PATMATHS was administered by the standardised procedure (ACER, 1984). Briefly, the students were told how to complete the answer sheet and were taken through two practice questions. They were allowed 45 minutes to work on the test, however, the time ran five minutes into their lunch time. The students were given the option to utilise the last five minutes if they wanted to, or they could go to lunch. All the students chose the latter option.

During the PATMATHS testing period, the teacher was asked to rate each student regarding how motivated toward mathematics on the teacher rating scale.

After the questionnaires were completed, the students and teacher were thanked for their participation, and informed that they would receive a report at a later date.

Results

Means and standard Deviations for motivation, teacher's ratings, and PATMATHS scores are displayed in Table 2 for males, females and the combined sample. All tests of significance were calculated with an alpha level of .05. Kruskal-Wallis tests found no significant difference between males and females on the three variables, thus correlations were calculated on the combined sample.

Table 2

Means and Standard Deviations for Motivation, Math Achievement Scores and Teacher's Ratings

Gender/ Combined	Motivation		Teacher's Ratings		Math Achievement	
	M	SD	M	SD	M	SD
Males	43.78	7.74	6.33	1.94	19.94	5.48
Females	43.90	7.72	7.70	1.16	21.50	10.16
Combined	43.82	8.09	6.82	1.81	20.50	7.34

A positive correlation was found between the CMTM, and teacher's ratings and PATMATHS. The positive correlation between teacher's ratings and motivation

was significant, r (26) = .35, p =.03, thus providing support for the hypothesised relationship between motivation toward mathematics and the teacher's ratings of motivation. However, the positive correlation between motivation and PATMATHS scores was not significant, r (26) = .21, p = .15. Thus the hypothesised relationship between motivation toward mathematics and mathematic achievement was not supported.

Discussion

The results provided support for the hypothesised relationship between the CMTM and the teacher's rating of students' motivation, and the concurrent validity of the CMTM. The hypothesised correlation between the CMTM and PATMATHS scores was in the expected direction, but not significant. This result questions the concurrent validity of the CMTM.

General Discussion

In the pilot studies, a questionnaire was constructed to measure high school students' continuing motivation toward mathematics. Of the original 20 items, 12 were retained in the final questionnaire. Items were retained which were not made redundant by other items, which measured the same concept as the other items and were not highly negatively skewed (which suggested a ceiling effect). Principle components extraction resulted in three factors which

accounted for 59% of the total variance. After varimax rotation, these factors were labelled intrinsic motivation, intention to continue mathematics and extrinsic motivation. The refined questionnaire was labelled the Continuing Motivation Toward Mathematics (CMTM) questionnaire.

The results of the pilot study indicated that the CMTM had adequate internal consistency (Chronbach's alpha = .86). The correlations between the CMTM and teacher's ratings, and previous mathematics grade provided support for its concurrent validity. However, the nonsignificant correlation between the CMTM and math achievement test scores, raises doubt about its concurrent validity.

CHAPTER 3

Study 1: Correlational Design

Method

Participants. A convenience sample of 133 year eight high school girls participated in the study. Ninety six students were from an all-girl private school and 37 were from a co-ed private school. The students from the all-girl school were reputed to have been from an upper socio-economic class. The co-ed school students were reputed to have been from a middle socio-economic class. Both schools were located in the central suburbs of Perth.

Thirteen students did not complete the questionnaires and were excluded from the analyses. The remaining 119 students had an age mean of 12.72 (SD = 0.49).

Materials. Three questionnaires were used in the present study. The first questionnaire was the CMTM which measures willingness and intentions to study mathematics. This has been described in chapter 2.

The second questionnaire measured perceived instrumentality of mathematics for distant future goals. This questionnaire consisted of six positively worded items requiring a response on a five point scale ranging from Strongly Disagree to Strongly Agree. These questions were similar to the items used in Raynor (1970) and Van Calster et al. (1987) to measure the perceived instrumentality of attaining high grades

for future career success (e.g., "Getting a good grade in mathematics will enable my future career plans to work out"). However, the items in the present questionnaire were not limited to career success, but included other distant goals listed in De Volder and Lens (1982). These include making a lot of money ("Performing well in mathematics will enable me to make a lot of money"), having high social status ("Getting a poor grade in mathematics will limit me from having high social status") and owning a lot of things ("Performing well in mathematics will enable me to own a lot of things"). The full instrument is shown in Appendix B.

Each item was scored as one for strongly disagree and five for strongly agree, with a possible composite score ranging from 6 to 30. Higher scores indicated higher perceived instrumentality.

The third questionnaire was the subscale global affective evaluation from the revised Time Attitude Scale (Nuttin, 1985). The revised Time Attitude Scale (TAS) measures how people perceive and feel about their future in six domains. The first subscale, structuration, measures how precise and structured people perceive their future to be. The second subscale assesses whether people perceive their future as determined by themselves or others (internal control). Degree of difficulty, the third domain, measures the extent to which people perceive their future as conflicted and difficult, or conflict free

and easy. The fourth subscale, value, refers to how boring or exciting people perceive their future to be. The fifth subscale, temporal distance, assesses how far the future is perceived as being from the present.

The final domain, global affective evaluation, can be considered a summary of people's affective attitude toward the future. That is, whether the future is perceived as attractive and positive, or bleak and gloomy. As the global affective evaluation subscale has been found to account for 66% of the total variance of the TAS (Nuttin, 1985), only this subscale was used in the present study.

Previous research has found satisfactory internal consistency for the global affective evaluation subscale, with a Kuder-Richardson coefficient of.85 (Nuttin, 1985) and a Chronbach's alpha of.88 (Roossel, 1989). Tests of the validity of the revised TAS is limited to one study. Van Calster (1979) provided support for the factorial validity of the six subscales of the revised TAS (cited in Nuttin, 1985). These factors were extracted with two independent samples; a sample of university students and a sample of high school students. In addition, support for the concurrent validity of the original TAS may be considered as evidence of the validity of the revised version, as the two consist of similar items. The original version of the TAS has been found to correlate with a scale of optimism, and was able to distinguish

neurotic and psychiatric soldiers from university students and physically sick soldiers (Nuttin, 1985).

The global affective evaluation subscale of the TAS requires respondents to report how they spontaneously perceive their future on five pairs of bipolar adjectives: pleasant-unpleasant, beautiful-horrible, threatening-attractive, warm-cold and light-dark. Items were scored on a 7-point scale, with seven corresponding to the positive pole (e.g., pleasant) and one corresponding to the negative pole (e.g., unpleasant). Summing the items yielded a composite affective attitude score with a possible range of 7 to 35. Higher scores indicated more positive attitude.

In addition to the above three questionnaires, participants were also asked to indicate their age, first-name and surname.

Design and procedure. Questionnaires were administered to each student by their mathematics teachers during math class. Each class consisted of approximately 25 students. The students were informed that the purpose of the study was to assess high school girls' attitudes toward mathematics. They were instructed to complete the questionnaires by circling the appropriate response. They were asked to answer as honestly as possible, and informed that the questionnaire was not compulsory and that their responses would be kept confidential. Students were also told their names were required so their responses could be matched with another questionnaire to be

completed by some students at a later date. In addition, before questionnaires were given out, students were instructed to place their questionnaire in a yellow envelope when they had finished. This was sealed to ensure anonymity.

After the questionnaires were completed, students were thanked for their participation and informed that the researcher would return at a later date to discuss the research with them.

Results

Internal consistency for each of the variables was adequate:- perceived instrumentality (Chronbach's alpha = .81), affective attitude (Chronbach's alpha = .78) and motivation (Chronbach's alpha = .86). Also, analysis of the relationship between the two independent variables indicated that they were unrelated, r (117) = .11, $p > .05$.

Principal components extraction with varimax rotation was conducted on motivation scores. Assumptions of normality, linearity and factorability of R were all met. Three factors were extracted which accounted for 60% of the total variance. After varimax rotation the structure was rather complicated, with five variables having factor loadings above .30 on two factors. Factor loadings, communalities (h^2) and interpretive labels are presented in Table 3. Factor loadings below .30 have been suppressed and loadings above .45 are in bold to aid interpretation.

As the items with the highest loadings (> .45) on factor one measured intentions to continue mathematics, want and appeal of math problems, and persistence, it was tentatively labelled "continuing mathematics". Factor two was tentatively labelled "intrinsic motivation", because the items with the highest factor loadings (> .45) measured intentions to work hard and have a positive attitude toward mathematics. Factor three was tentatively labelled "extrinsic motivation", because the items with the highest factor loadings (> .45) measured motivation stimulated by external sources; that is, a bad grade and a math test.

Table 3

Factor Loadings on Motivation Items: Correlational Study

Item	F_1[a]	F_2	F_3	h^2
Future maths	**.77**			.61
Problems - want to work on	**.76**			.70
Problems - appeal	**.73**			.62
Maths plans	**.69**	.30		.60
Further knowledge	**.68**	.32		.58
Problems - persistence	**.55**	.32		.49
Class - work hard	.41	**.58**		.51
Positive attitude	.33	**.70**		.61
Homework - work hard		**.71**		.57
Homework - effort		**.71**		.57
Test - study time		**.63**	**.48**	.62
Try harder - bad grade			**.82**	.70
Percent of Variance	29%	21%	9%	60%

[a]Factor labels:

*F*1 Continuing mathematics

*F*2 Intrinsic motivation

*F*3 Extrinsic motivation

This factor solution appeared similar to the factor solution in pilot study one. Consistent with the recommendations of Tabachnick & Fidell (1989, p. 644) the pattern and magnitude of loadings of the present study were compared with the pattern and magnitude of loadings obtained in the pilot study. Each factor extracted in the present study was compared with its apparently similar factor extracted in the pilot study. Correlations were conducted between factor loadings of factor 1 with pilot study factor 2, factor 2 with pilot study factor 1, and factor 3 with pilot study factor 3. Significant positive correlations were found in each instance, r (10) = .60, p = .02; r (10) = .64, p = .01; r (10) = .51, p = .04. These indicated that the factor solution obtained in the present study was significantly similar to the factor solution obtained in the pilot study. However, it was possible that the correlation between factor 3 of the present study and factor 3 of the pilot study was increased by the numerous variables with small loadings. Thus, Cattell's Salient Similarity Index (Tabachnick & Fiddell, 1989) was calculated between factor 3 and pilot factor 3. The two factors were found to be significantly similar, s = .4, p < .05.

Kruskal-wallis tests (alpha = .05) were calculated to identify any significant relationships between age and school on motivation, affective attitude and perceived instrumentality. Nonparametric tests were used because the ratios of smallest to largest cells

were to large; 1:40 for age and 1:3 for school. No significant result was found for age on any of the three variables. However, a significant difference was found between the two schools on affective attitude, H (1, N = 121) = 1.72, p = .003. The all girl school had a more positive attitude (M = 67) than the co-ed school (M = 46).

A median split on perceived instrumentality (Mdn = 20) formed two subgroups. Students with a score of 20 or less were deemed to have low perceived instrumentality and students with a score greater than 20 were deemed to have high perceived instrumentality. Within these two subgroups, students were divided into three affective attitude subgroups. Using the method adopted by Van Calster et al. (1987), students with a score ranging from 5 to 24 were considered to have a negative attitude, students with a score ranging from 25 to 29 were considered to have a neutral attitude and students with a score between 30 to 35 were considered to have a positive attitude. Thus the six subgroups were as follows:-

1. Low instrumentality, negative attitude
2. Low instrumentality, neutral attitude
3. Low instrumentality, positive attitude
4. High instrumentality, negative attitude
5. High instrumentality, neutral attitude
6. High instrumentality, positive attitude

Motivation Means and standard deviations for affective attitude and perceived instrumentality groups are presented in Table 4. A 2 x 3 ANOVA (alpha = .05) was conducted with motivation as the dependent variable, and affective attitude and perceived instrumentality as the independent variables. Before running the ANOVA, four univariate outliers were identified. According to the recommendations in Tabachnick and Fidell (1989), the score for each outlier was adjusted to within + or - 1 of the next nearest score, after which there were no outliers, and assumptions of normality and homogeneity of variance were met.

Table 4

Means and Standard Deviations on Motivation

Affective Attitude		Perceived Instrumentality		
		Low	High	Total
Negative	M	42.21	42.52	42.36
	SD	4.69	7.95	6.73
	n	28	25	53
Neutral	M	40.03	46.05	43.04
	SD	9.21	7.07	8.65
	n	19	19	38
Positive	M	46.13	49.07	47.60
	SD	8.01	5.04	6.74
	n	15	15	30
Total	M	42.49	45.32	43.87
	SD	7.39	7.41	7.51
	n	62	59	121

Main effects were found for the two independent variables. Perceived instrumentality, F (1, 115) = 5.43, p = .022, accounted for 4.5% of the variance in motivation. Students with high perceived instrumentality had higher motivation (M = 45.32) than students with low perceived instrumentality

(M = 42.49). Affective attitude, F (2, 115) = 5.59, p = .005, accounted for 8.9% of variance. A post hoc comparison of pairwise differences among the three attitude groups was conducted using Tukey's HSD test. The positive attitude group was significantly more motivated (M = 47.60) than the other two groups; negative attitude (M = 42.36) and neutral attitude (M = 43.04). No significant interaction between the two independent variables on motivation was found, F (2, 115) = 1.80, p = .17 (refer to Appendix C for SPSS output).

As a significant difference was found between the two schools on attitude, a separate analysis was conducted on the all-girl school using an alpha level of .05. The sample size from the co-ed school was considered too small to conduct a separate analysis. A 2 x 3 ANOVA was conducted on motivation for the all-girl school with perceived instrumentality and affective attitude as the independent variables. The findings were the same as for the main ANOVA. Main effects were found for perceived instrumentality and affective attitude on motivation. There was no significant interaction between the two independent variables on motivation.

Discussion

The hypothesised interaction between perceived instrumentality and affective attitude was not supported. Thus the relationship between perceived instrumentality and motivation was not mediated by

affective attitude. Nor was the relationship between affective attitude and motivation mediated by perceived instrumentality.

Main effects were found for perceived instrumentality and affective attitude. Students with high perceived instrumentality had greater motivation than students with low perceived instrumentality. Students with a positive affective attitude toward personal future had greater motivation than students with a neutral or negative affective attitude.

CHAPTER 4

Study 2: Experimental Design

Study two was designed to assess the causal relationship between perceived instrumentality and motivation. This study was arranged with the schools and completed prior to the analyses of study one.

Method

Participants. Sixty two year 8 high school girls' with an age mean of 12.67 (SD = 0.06) participated in study two. Sixty seven students were selected from the 119 students who participated in the first study. They were selected if their perceived instrumentality score in study one was below or equal to the median. Of the 67 students selected, five were absent on the day of the study.

Materials. The same three questionnaires used in study 1 were used in study 2. The Continuing Motivation Toward Mathematics Questionnaire was used to measure students' intentions to continue studying mathematics. The Global Affective Evaluation subscale from the revised Time Attitude Scale (Nuttin, 1985) was used to measure affective attitude toward personal future. The third questionnaire measured perceived instrumentality of mathematics for future goals. In addition to the questionnaires, students were required to indicate their surname, first-name and age.

As part of the experimental manipulation, two videos, a mock newspaper article and a real newspaper

article were used. One video and newspaper article emphasised the importance of mathematics for future career success (experimental). The second video and newspaper article were not related to mathematics (control).

The experimental video featured five people from different occupations who introduced themselves and their occupations, and then explained how mathematics was important for their present career and how doing well in mathematics enabled them to attain their present job (Appendix D). For example, one person was a psychologist who explained that having a background in mathematics enabled her to keep up to date with research journals.

The people in the experimental video included four females (a nurse, a psychologist, an english teacher and a senior consultant) and one male (a hairdresser). The people worked in the occupation they talked about, and were selected to increase the possibility that the video would be persuasive (Baron, Byrne & Suls, 1990). They were all physically attractive and four of them had expert role titles. All the people were in their twenties and four of them were female. This was to maximise the likelihood that the students may perceive themselves as similar to the people in the video. The people were selected from a wide variety of occupations, to increase the possibility that the participants may have been able to relate to at least one of them. Furthermore, the people were instructed

to be persuasive and expressive, as previous research has found that actors who were instructed to be persuasive and expressive were perceived as more persuasive than actors who did not receive the same instruction (Bowen, 1987).

The control video consisted of the same five people who introduced themselves, their occupation and briefly mentioned what their everyday work duties involve (Appendix D).

Both videos were of a duration of about three minutes, during which each person appeared for 20 - 40 seconds. Between each speaker there was a black screen for about four seconds.

The experimental newspaper article was a mock article which described a fictitious study conducted by a university associate professor (Appendix E). The article mentioned that 416 male and female Australians from a wide variety of occupations were interviewed regarding which high school subject they thought was the most important for their present career. Sixty seven percent said that Mathematics was most important and twenty seven percent thought English was their most important subject. The article was titled "Math Most Important: Survey" and on the same piece of paper as the photocopy of the article, was the name of a real newspaper and the date it was supposedly published.

The control newspaper article was a published newspaper article from a local newspaper, titled "More Information on Republic Urged" (1994). This article

discussed how a young medical student when asked about whether Australia should become a republic replied that she had yet to make up her mind and that young Australians need to decide whether or not Australia should become a republic. On the same piece of paper as the article was the name of the newspaper and the date it was published, as well as the question "Do you think Australia should become a republic?"

Design and procedure. Pretest questionnaires were administered to 119 students during math class by their mathematics teachers. The instructions were the same as in study one.

Only the three low perceived instrumentality subgroups were selected to participate in the experiment. This was because only students with low perceived instrumentality were of interest and the inclusion of students with high perceived instrumentality would have resulted in too many unnecessary comparisons and a resultant increase in the familywise error ratio (Keppel, 1983).

Within the three low perceived instrumentality subgroups, students were randomly assigned to either a control group (n = 32) or an experimental group (n = 30). The experiment was conducted separately for the two schools and was conducted during math class. For the all girl school, this was three weeks after the collection of the pretest data. For the co-ed school, this was one week after the collection of the pretest data. I conducted the experiment with the assistant of

a female research assistant. At the all girls school, I conducted the experiment for the experimental group, while the research assistant conducted the experiment for the control group. At the co-ed school this was reversed, so that I conducted the experiment for the control group and the research assistant conducted the experiment for the experimental group.

For the experimental group the procedure was as follows: The researcher/research assistant introduced him/herself as a psychology student from a Western Australian university. Students were asked to remember back to when they completed the questionnaire about attitudes toward mathematics. They were informed that this study was going to be continued with a video and a second questionnaire. Each student was then given a copy of the experimental newspaper article which was read out by the researcher/research assistant while the students read along. The students were then informed that on the basis of this article the researchers had interviewed five people from different occupations regarding how important they thought mathematics was for their present career or how mathematics enabled them to attain their present career.

The experimental group was then shown the experimental video. When the video was finished, students completed three questionnaires which were the same as the pretest questionnaires (i.e., the CMTM, global affective evaluation subscale of the revised TAS, and the perceived instrumentality questionnaire).

They were informed that the questionnaire was similar to the one they had previously completed. The students were asked to answer as honestly as possible and were assured of confidentiality.

The debriefing of the experimental group involved disclosing that the purpose of the study was to determine if their motivation toward mathematics would increase after watching the video and reading the newspaper article. They were then informed that the newspaper article was not a real newspaper article, but an article which was devised for the purpose of the experiment. It was confirmed that each person in the video really did consider mathematics important for their present career, except for the hairdresser who had said maths was important only for the purpose of the study.

Students were then informed that the video and article were created to increase their perception of how important mathematics was for future career success, and that this was expected to result in an increase in motivation for some students. The students were thanked for their participation and informed that the researcher would return at a later date to discuss the research results.

For the control group the introduction was similar to the experimental group's introduction. The researcher/research assistant introduced him/herself as a psychology student, and mentioned that the students were going to continue the study by watching a video

and completing a second questionnaire. Students were then informed that before watching the video they had a brief writing exercise. This involved writing about whether or not Australia should become a republic, after they read through the control newspaper article with the researcher/research assistant. The writing exercise was included because it was considered that a reading task on its own, unrelated to the study, may have left the students with a sense that the task was pointless, which may have been de-motivating. However, combined with a writing task, the reading task may have seemed like another school task and unrelated to the study. Thus the two tasks may not have impacted on motivation.

After the writing exercise, students were informed that they had a brief video to watch, in which five people from different occupations answer the question "what does your occupation involve?" The control video was then shown, after which the students were asked to complete the three questionnaires. They were asked to answer as honestly as possible and assured of confidentiality.

The debrief involved mentioning that the purpose of the study was to determine if their motivation toward mathematics would be influenced by watching the video. They were informed that the other group (the experimental group) watched a different video and read a different article, both of which emphasised the importance of mathematics for future career success.

The students were then told that it was predicted that the students in the other group would feel more motivated toward mathematics after watching the video, while they would experience no change in motivation. This was followed up by a brief description about the nature of research (e.g., having a control group and an experimental group). To conclude, the students were thanked for their participation and informed that the researcher would return at a later date to discuss the research results.

Results

Analysis of the data was through a series of planned comparisons. For each subgroup, pretest motivation scores were compared with posttest motivation scores. It was hypothesised that none of the comparisons would be significant, except for the positive affective attitude experimental group whose scores would be significantly greater at the posttest. Motivation means and standard deviations for each subgroup are presented in Table 5. Assumptions of homogeneity of variance and normality were met. The number of comparisons (6) did not exceed the degrees of freedom (*df* = 11), therefore an alpha level of .05 was suitable. Furthermore, the cross-products of the corresponding weights indicated that the comparisons were orthogonal (Shavelson, 1988).

Table 5

Means and Standard Deviations on Pretest and Posttest Motivation

Affective Attitude/ Group	n	Pretest M	Pretest SD	Posttest M	Posttest SD	t
Negative						
- Exp	13	41.38	5.68	42.31	8.00	-.72
- Control	12	41.67	6.17	39.00	6.63	2.31*
Neutral						
- Exp	11	45.32	7.32	43.64	7.05	1.9
- Control	10	38.90	11.60	37.40	9.26	.66
Positive						
- Exp	8	50.25	4.65	49.63	5.50	.78
- Control	8	43.63	7.91	41.13	8.79	2.95*

*$p < .05$

All planned comparisons were two-tailed except for the positive affective attitude experimental group. This group required a one-tailed test as it was hypothesised that their posttest motivation would be significantly greater than their pretest motivation. However, a one-tailed t-Test revealed no significant difference between pretest and posttest motivation

scores for this group, t (7) = .78, p = .54 (refer to Appendix F for SPSS output). The hypothesis was not supported. As can be seen from Table 5, the only significant differences were for the negative and positive control groups, t (11) = 2.31, p = .042, t (7) = 2.95, p = .021. In each case motivation was significantly lower at the posttest.

Manipulation checks were conducted to test the effectiveness of the experimental manipulation of perceived instrumentality. Means and standard deviations on pretest and posttest perceived instrumentality are presented in Table 6.

Analyses involved planned comparisons between pretest instrumentality and posttest instrumentality for each subgroup. Assumptions of normality and homogeneity of variance were met. The number of comparisons (6) did not exceed the degrees of freedom (df = 11), therefore an alpha level of .05 was suitable. Furthermore, the cross-products of the corresponding weights indicated that the comparisons were othogonal (Shavelson, 1988).

As can be seen from Table 6, there was no significant difference between pretest and posttest motivation for any of the subgroups. Thus the experiment was not effective in manipulating perceived instrumentality.

Table 6

Means and Standard Deviations on Pretest and Posttest Instrumentality

Affective Attitude/ Group	n	Pretest M	Pretest SD	Posttest M	Posttest SD	t
Negative						
- Exp	13	16.31	3.63	17.38	4.27	-1.36
- Control	13	15.54	5.15	15.54	3.55	1.67
Neutral						
- Exp	11	17.27	3.07	17.00	4.54	.25
- Control	10	17.40	3.10	16.60	4.33	.81
Positive						
- Exp	7	18.43	1.72	19.14	1.77	-.80
- Control	9	17.44	2.74	18.33	5.45	-.81

CHAPTER 5

General Discussion

The present study assessed the relationship between perceived instrumentality and affective attitude toward personal future on high school girls motivation. The hypothesised interaction between perceived instrumentality and affective attitude on motivation toward mathematics was not supported. Thus the relationship between perceived instrumentality and motivation was not mediated by affective attitude, nor was the relationship between affective attitude and motivation mediated by perceived instrumentality. This result was inconsistent with Van Calster et al.'s (1987) study which found an interaction between perceived instrumentality and affective attitude on high school boys study motivation.

Main effects were found for affective attitude and perceived instrumentality on motivation toward mathematics. Students who had a positive affective attitude were more motivated than students who had either a neutral or negative affective attitude. This finding was consistent with previous research which found affective attitude was a significant predictor of motivation to study (Van Calster et al., 1987; Lens & Decruyenaere, 1991). It was inconsistent with Rosseel (1989), who found affective attitude was not related to study motivation.

Students who had high perceived instrumentality were more motivated than students with low perceived instrumentality. These results were in accordance with the findings of De Volder and Lens (1982), Halvari (1991), Raynor (1970) and Van Calster et al. (1987). The effect size of both affective attitude and perceived instrumentality was relatively small, less than 10 %.

The two main effects of affective attitude and perceived instrumentality on motivation were from a correlational research design. Thus it is difficult to ascertain causality. Affective attitude and perceived instrumentality may cause motivation toward mathematics, the causal relationship may be reversed or it may be that other variables are responsible for the observed relationships.

The second part of the study assessed the effects of increasing perceived instrumentality on motivation toward mathematics. Given the finding of an interaction between affective attitude and perceived instrumentality in previous research by Van Calster et al. (1987), it was hypothesised that an increase in perceived instrumentality would result in an increase in motivation, but only for students with a positive affective attitude. This hypothesis was not supported as there was no increase in motivation for the positive attitude experimental group. However, manipulation checks revealed that the experimental manipulation had not been successful. Thus no conclusion can be drawn

from the experiment regarding the causal relationship between perceived instrumentality and motivation. Furthermore, the finding of a nonsignificant interaction between perceived instrumentality and affective attitude tended to negate the experimental hypothesis.

A question arises as to why the manipulation was unsuccessful? One explanation is that the persuasive intent of the experimental video may have been obvious to the participants. Secondly, the people in the video may have not been convincing enough. For the video to have been more persuasive, the people in the video may have needed to consider both sides of the issue and appear more like experts (e.g., speak faster and with greater confidence) (Baron, Byrne & Suls, 1990).

Another explanation may be that the students needed more time to absorb the information for it to have an impact on their reported motivation. A fourth explanation may be that perceived instrumentality is a relatively stable characteristic. This possibility, however, is inconsistent with Lens (1987) proposition that both perceived instrumentality and affective attitude are modifiable through experimental manipulation.

An unexpected result was the decline in motivation for the control groups, two of which achieved significance. Contrary to prior expectations, combining the two tasks may not have had the desired effect. That is, for the two tasks to appear as

another school task, unrelated to the research and not effecting student motivation. In fact, it may have been because the two tasks were unrelated to the research that student motivation decreased.

This unexpected result could have implications for future research and for teaching. Researchers may need to be careful when designing an experiment, that the treatment of the control group is related to the nature of the study. Otherwise, it may be de-motivating for the participants. Similarly, when teachers introduce a task, it may be beneficial to emphasise how the task is relevant to the subject being taught.

Two additional findings from study one are worth noting. The first finding pertains to the Continuing Motivation Toward Mathematics questionnaire (CMTM). Factor analysis identified three factors which could be defined as intentions to continue studying mathematics, intrinsic motivation and extrinsic motivation. These factors were significantly correlated with the conceptually similar factors found in the pilot study. Also these three factors appear consistent with the motivation literature, which identifies continuing motivation, intrinsic motivation and extrinsic motivation as distinct forms of motivation (Beck, 1990; Eccles (Parson) et al., 1984; Uguroglu & Walberg, 1986). This provides support for the factorial validity of the CMTM questionnaire.

The second noteworthy finding relates to the significant difference between the two schools on

affective attitude. The all-girl school students had a more positive attitude toward the future than the co-ed school. This could be interpreted in various ways. One possible explanation is that the all-girl school may have fostered a positive affective attitude. A second explanation may be that the difference in affective attitude was due to the difference in socio-economic status. That is, the students from the all-girl school had a more positive affective attitude because they were from a higher socio-economic background than the co-ed students. This explanation is consistent with Trommsdorf's (1983) proposition that people from lower socio-economic backgrounds tend to have less positive affective attitudes than people from higher socio-economic backgrounds.

One limitation of the present study is that the schools were not randomly selected. Thus caution must be exercised in generalising the results to all girls from private schools. Furthermore, the findings may not be generalisable to girls from public schools.

The second limitation relates to the questionnaires used in the present study. Research examining the validity of the TAS is limited to one study. The validity of the CMTM is also quite limited, and was only partially supported in the pilot studies. Furthermore regarding the CMTM, it was indicated by two students during the study that they did not understand two items. The first student indicated that she did not understand what "acquire" meant ("I intend to

acquire further knowledge of mathematics"). The second student indicated that she did not understand what "motivated" meant ("I am not motivated to work very hard on mathematics during lessons"). Also, some students had difficulty completing the global affective evaluation subscale. Students who had greater academic ability may have found this subscale easier to complete than students with lower academic ability. Thus the association between the two scales may have been partially due to their association with academic ability.

Implications

Efforts to increase girls motivation toward mathematics have tended to emphasise perceived instrumentality (Fear & Kapostasy, 1991). However, the present study indicates that affective attitude is also important. In fact, this may be more beneficial than trying to increase students motivation toward mathematics by emphasing the importance of mathematics for future career success for two reasons.

Firstly, affective attitude accounted for twice as much variance in motivation than was accounted for by perceived instrumentality. Secondly, previous research has found that affective attitude was associated with study motivation in general. Thus it would be reasonable to expect that affective attitude would relate to motivation in other subject areas. In contrast, perceived instrumentality of mathematics

would not be expected to relate to motivation in other subject areas.

A second implication of the present study addresses recommendations from Van Calster et al. (1987). Van Claster and colleagues found an interaction between affective attitude and perceived instrumentality on study motivation. On the basis of their results, they recommended that educators avoid trying to increase perceived instrumentality for students with a negative affective attitude, as this may result in a decrease in motivation. However, the present study casts doubt on these words of caution in relation to year 8 high school girls and mathematics. According to the present results, attempts to increase motivation toward mathematics by increasing perceived instrumentality may be beneficial to all year 8 high school girls regardless of their affective attitude.

There are two possible reasons why the interaction between perceived instrumentality and affective attitude on motivation toward mathematics was not found in the present study. Firstly, the proposition provided by Van Calster et al. (1987) may be wrong and their findings may reflect a Type I error. This possible explanation cannot be ruled out at this stage.

The second possibility is that Van Calster et al.'s (1987) findings may not be generalisable to the sample in the present study. A number of differences exist between the sample in their study and the sample in the present study. Firstly, their sample was from

Belgium while the present study involved Australian students. Secondly, their study was conducted with males and their findings may not generalise to females. This might be the case if males are more concerned about future career success than females. However, recent research by Lennings (1992, 1993) found no gender difference in how far into the future males and females think about their future career success. Thus it seems unlikely that males would be more concerned about future career success than females.

A third explanation why Van Calster et al.'s (1987) findings were not generalisable to the present study is that the present study assessed motivation toward mathematics, while Van Calster and colleagues assessed motivation to study in general. This explanation seems unlikely, as Boekaerts (1987) found motivation toward mathematics to be related to general academic motivation in girls and boys.

An additional and important difference between the present study and Van Calster et al.'s (1987) research is that they assessed 18-year-old students motivation, while the present study assessed 13-year-old students motivation. An important developmental difference between the two age groups is that only 20% of the younger adolescents may have acquired formal-operational thought, while over half of the older age group should have acquired formal-operational thought (Connell, Stroobrant, Sinclair, Connell & Rogers, 1975). As adolescents develop formal-operational

thought, they become more able to be concerned with intangible things about themselves; intangible things like the perceived future (Peterson, 1989). For adolescents who are more able to be concerned about the future, activities which take them to their future (high perceived instrumentality), should have greater impact on their behaviour, particularly if this activity takes them to a positive or bleak future. Thus, failure to find the predicted interaction between perceived instrumentality and affective attitude on motivation, may have been due to a large proportion of the students in the present study not yet having acquired formal-operational thought.

Another reason why Van Calster et al.'s (1987) results may not be generalisable to thirteen year-old students is that the goal of future career success may be too far into the future to have much of an impact on behaviour. This explanation is consistent with previous research by Seginer (1992) who found younger adolescents were less concerned with future career success than older adolescents. Furtmermore, according to conflict theory, the further people are from a future goal, the less this goal influences them to approach the attractive parts of the goal and avoid the negative parts of the goal (Miller & Murray, 1952). However, relative to the distance from the future goal, people's avoidance gradient tends to be steeper than their approach gradient. That is when people are a long distant from a future goal, their tendency to

approach is greater than their tendency to avoid. However, as people move closer to a future goal, their tendency to avoid increases more than their tendency to approach. Thus when a goal is relatively close, the two tendencies may be almost equal, or the tendency to avoid may outweigh the tendency to approach. In Van Calster et al.'s (1987) study, the future goal of career success would have been relatively close. For the participants with a negative affective attitude, the tendency to avoid this future goal may have outweighed their tendency to approach this future goal. Thus the interaction between perceived instrumentality and affective attitude was found in their study. In contrast, the participants in the present study would have perceived the future goal of career success as relatively distant. For all participants, the approach tendency may have outweighed the tendency to avoid the future goal.

Future Research

There are several possibile directions for future research in clarifying the relationship between perceived instrumentality affective attitude and study motivation. One possibility could be to ascertain if the the interaction between perceived instrumentality and affective attitude on motivation appears as goal distance decreases. Comparing the effects of these two independent variables for various age groups between 13 and 18 may be a useful way to test this proposition. In addition, it would be interesting to see if

perceived instrumentality of mathematics for future career success has a greater impact on older adolescents than on younger adolescents, as the future goal is closer in the former than in the latter.

A second possibility for future research could be to explore ways of manipulating affective attitude. According to Lens (1987) this aspect of future time perspective could be influenced by experimental manipulation, which would be useful to identify the causal relationship between affective attitude and motivation. However, Lens did not suggest how peoples' affective attitudes could be influenced.

Thirdly, future research attempting to increase participants perceived instrumentality and observe the effects on motivation, may need to consider self-efficacy (Feather, 1988; Schunk & Hanson, 1985). It is possible that the effect of perceived instrumentality on motivation toward mathematics may be mediated by perceptions of ability to do well in mathematics (self-efficacy). If participants have high perceived instrumentality and low self-efficacy, then they may have low motivation as the effect of the latter may outweigh the former. Also, the interaction between perceived instrumentality and self-efficacy may influence affective attitude. If people perceive mathematics as important for future career success, but believe they lack the ability to do well in mathematics and attain future career success, then the future may be perceived as bleak and negative.

The final possibility for future research is to further explore the role of affective attitude in continuing motivation for other subject areas. If affective attitude is associated with motivation in other subject areas, then this would be an important factor for educators when addressing poor academic motivation.

CHAPTER 6

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APPENDIX A

Original Continuing Motivation Toward Mathematics Questionnaire

Directions: Write your name and age at the top of the page. Indicate how strongly you agree or disagree with each statement by circling one of the letters for each statement: SD (Strongly Disagree), D (Disagree), U (Undecided), A (Agree), SA (Strongly Agree).

1. I don't intend to take any more mathematics than I have to (Future maths) *	SD	D	U	A	SA
2. I intend to acquire further knowledge of mathematics (Further knowledge) *	SD	D	U	A	SA
3. I plan to take as much mathematics as I can during my education (Math plans) *	SD	D	U	A	SA
4. I am not motivated to work very hard on mathematics during lessons (Class - work hard) *	SD	D	U	A	SA
5. When a math problem arises that I can't immediately solve, I intend to stick with it until I have the soultion	SD	D	U	A	SA
6. Figuring out mathematical problems does not appeal to me (Problems - appeal) *	SD	D	U	A	SA
7. I would rather have someone give me the solution to a difficult math problem than to have to work it out for myself (problems - persistence) *	SD	D	U	A	SA
8. I intend to do as little work in math class as possible	SD	D	U	A	SA
9. In the next math test, I intend to try hard to do my best	SD	D	U	A	SA

(Appendix A continued)

10. I would try harder in mathematics if I got a bad grade (Bad grade - try harder *	SD	D	U	A	SA
11. I don't want to work on any mathematical problems (Problems - want to work on) *	SD	D	U	A	SA
12. When I get math homework, I intend to work hard on it (Homework - work hard) *	SD	D	U	A	SA
13. I intend to work hard to get a good grade in mathematics	SD	D	U	A	SA
14. I intend to do as little math homework as possible over the next month (Homework - effort) *	SD	D	U	A	SA
15. If I had a math test tomorrow, I would spend a lot of time studying for it tonight (Test - study time) *	SD	D	U	A	SA
16. I don't intend to put much effort into my next math assignment	SD	D	U	A	SA
17. When I have a set of math questions, I would work through them as quick as possible	SD	D	U	A	SA
18. If I had a difficult math assignment, I wouldn't spend much time on it	SD	D	U	A	SA
19. I feel as motivated to do math homework, as I do to do homework from other subjects	SD	D	U	A	SA
20. I intend to have a positive attitude toward mathematics (positive attitude) *	SD	D	U	A	SA

* Items included in the final Continuing Motivation Toward Mathematics

APPENDIX B

Perceived Instrumentality Questions

1. Performing well in mathematics will enable me to make a lot of money	SD	D	U	A	SA
2. Getting a poor grade in mathematics will limit me from having high social status; power and a good reputation	SD	D	U	A	SA
3. Getting a good grade in mathematics will enable my future career plans to work out	SD	D	U	A	SA
4. Getting a good grade in mathematics will enable me to achieve a satisfying career	SD	D	U	A	SA
5. Performing well in mathematics will enable me to own a lot of things	SD	D	U	A	SA
6. Doing poorly in mathematics will limit my career opportunities	SD	D	U	A	SA

APPENDIX C

SPSS Output: ANOVA

```
-> MANOVA
->   motiv  BY tattitud(1 3) tinstrum(1 2)
->   /CONTRAST (tattitud)=Simple (2)/CONTRAST (tinstrum)=Deviation
->   /PRINT PARAM(ESTIM) HOMOGENEITY(BARTLETT COCHRAN) SIGNIF(EFSIZE)
->   /CINTERVAL JOINT(.95) UNIVARIATE(SCHEFFE)
->   /OMEANS TABLES( tattitud tinstrum tattitud*tinstrum)
->   /PMEANS TABLES( tattitud tinstrum tattitud*tinstrum)
->   /METHOD=UNIQUE
->   /ERROR WITHIN+RESIDUAL
->   /DESIGN  .

* * * * * * A n a l y s i s   o f   V a r i a n c e * * * * * *

      121 cases accepted.
        0 cases rejected because of out-of-range factor values.
        0 cases rejected because of missing data.
        6 non-empty cells.

        1 design will be processed.

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Univariate Homogeneity of Variance Tests

Variable .. MOTIV

      Cochrans C(19,6) =                    .27388, P =  .144 (approx.)
      Bartlett-Box F(5,15006) =            2.71801, P =  .019

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

* * * * * * A n a l y s i s   o f   V a r i a n c e -- design  1 * * * * * *

Combined Observed Means for TATTITUD
Variable .. MOTIV
     TATTITUD
     negative        WGT.     42.35849
                    UNWGT.    42.36714
      Neutral        WGT.     43.03947
                    UNWGT.    43.03947
     positive        WGT.     47.60000
                    UNWGT.    47.60000

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Combined Observed Means for TINSTRUM
Variable .. MOTIV
     TINSTRUM
       Low PI        WGT.     42.49194
                    UNWGT.    42.79131
      High PI        WGT.     45.32203
                    UNWGT.    45.87977

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Combined Observed Means for TATTITUD BY TINSTRUM
Variable .. MOTIV
                  TATTITUD    negative     Neutral    positive
     TINSTRUM
       Low PI        WGT.     42.21429    40.02632    46.13333
                    UNWGT.    42.21429    40.02632    46.13333
      High PI        WGT.     42.52000    46.05263    49.06667
                    UNWGT.    42.52000    46.05263    49.06667

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

* * * * * * A n a l y s i s   o f   V a r i a n c e -- design  1 * * * * * *

Tests of Significance for MOTIV using UNIQUE sums of squares
Source of Variation          SS      DF         MS          F  Sig of F

WITHIN+RESIDUAL          5787.81     115      50.33
TATTITUD                  562.91       2     281.46       5.59      .005
TINSTRUM                  273.13       1     273.13       5.43      .022
TATTITUD BY TINSTRUM      181.13       2      90.57       1.80      .170
```

(Model)	975.46	5	195.09	3.88	.003
(Total)	6763.26	120	56.36		

R-Squared = .144
Adjusted R-Squared = .107

- -

Effect Size Measures

Source of Variation	Partial ETA Sqd
TATTITUD	.089
TINSTRUM	.045
TATTITUD BY TINSTRUM	.030

- -

Estimates for MOTIV
--- Joint univariate .9500 SCHEFFE confidence intervals
TATTITUD

Parameter	Coeff.	Std. Err.	t-Value	Sig. t	Lower -95% CL-	Upper
2	-.67233083	1.50900	-.44555	.65676	-4.41463	3.06996
3	4.56052632	1.73265	2.63212	.00965	.26360	8.85745

TINSTRUM

Parameter	Coeff.	Std. Err.	t-Value	Sig. t	Lower -95% CL-	Upper
4	-1.5442272	.66288	-2.32956	.02157	-2.85727	-.23118

TATTITUD BY TINSTRUM

Parameter	Coeff.	Std. Err.	t-Value	Sig. t	Lower -95% CL-	Upper
5	2.86030075	1.50900	1.89549	.06054	-.88199	6.60260
6	1.54649123	1.73265	.89256	.37396	-2.75043	5.84342

* * * * * * A n a l y s i s o f V a r i a n c e -- design 1 * * * * * *

Adjusted and Estimated Means
Variable .. MOTIV

CELL	Obs. Mean	Adj. Mean	Est. Mean	Raw Resid.	Std. Resid.
1	42.214	42.214	42.214	.000	.000
2	42.520	42.520	42.520	.000	.000
3	40.026	40.026	40.026	.000	.000
4	46.053	46.053	46.053	.000	.000
5	46.133	46.133	46.133	.000	.000
6	49.067	49.067	49.067	.000	.000

* * * * * * A n a l y s i s o f V a r i a n c e -- design 1 * * * * * *

Combined Adjusted Means for TATTITUD
Variable .. MOTIV

TATTITUD		
negative	UNWGT.	42.36714
Neutral	UNWGT.	43.03947
positive	UNWGT.	47.60000

- -

Combined Adjusted Means for TINSTRUM
Variable .. MOTIV

TINSTRUM		
Low PI	UNWGT.	42.79131
High PI	UNWGT.	45.87977

- -

Combined Adjusted Means for TATTITUD BY TINSTRUM
Variable .. MOTIV

	TATTITUD	negative	Neutral	positive
TINSTRUM				
Low PI	UNWGT.	42.21429	40.02632	46.13333
High PI	UNWGT.	42.52000	46.05263	49.06667

- -

APPENDIX D

Mock Newspaper Article

Maths Most Important: Survey

IN a recent study, more than two thirds of Australians considered Maths as their most important subject in high school.

Monash associate professor, Dom Wardsworth surveyed 416 male and female Australian workers regarding the usefulness of their previous high school subjects for their present career. A wide variety of workers were surveyed including secretaries through to doctors, all aged between 19 and 35.

Mathematics was considered the most useful subject by sixty seven percent of the people surveyed. Twenty seven percent considered English as their most important subject.

Wardsworth said that mathematics was not just used by mathematicians and students, but "used by people from various occupations in their everyday work duties. Maths was also considered most important for getting into ones chosen career."

APPENDIX E

Experimental and Control Videos

Refer to file copy.

APPENDIX F

SPSS Output: Planned Comparisons

```
-> SORT CASES BY tattitud tgroup .
-> SPLIT FILE
->   BY tattitud tgroup .
-> T-TEST
->   PAIRS= motiv  WITH pmotiv (PAIRED)
->   /CRITERIA=CIN(.95)
->   /FORMAT=LABELS
->   /MISSING=LISTWISE.
```

TATTITUD: . TGROUP: .

- - - t-tests for paired samples - - -

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
MOTIV	0	.	.	.	.	.
PMOTIV				.	.	.

>Warning # 11834. Command name: T-TEST
>There are no valid pairs. This analysis cannot be performed.

TATTITUD: 1 TGROUP: .

- - - t-tests for paired samples - - -

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
MOTIV	0	.	.	.	.	.
PMOTIV				.	.	.

>Warning # 11834. Command name: T-TEST
>There are no valid pairs. This analysis cannot be performed.

TATTITUD: 1 TGROUP: 1

- - - t-tests for paired samples - - -

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
MOTIV	12	.806	.002	41.6667	6.155	1.777
PMOTIV				39.0000	6.633	1.915

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
2.6667	4.008	1.157	2.31	11	.042
95% CI (.120, 5.214)					

TATTITUD: 1 TGROUP: 2

- - - t-tests for paired samples - - -

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
MOTIV	13	.826	.001	41.3846	5.679	1.575
PMOTIV				42.3077	8.004	2.220

Paired Differences					
Mean	SD	SE of Mean	t-value	df	2-tail Sig
-.9231	4.609	1.278	-.72	12	.484
95% CI (-3.709, 1.863)					

TATTITUD: 2 TGROUP: .
- - - t-tests for paired samples - - -

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
MOTIV	0	.	.	.	.	.
PMOTIV				.	.	.

>Warning # 11834. Command name: T-TEST
>There are no valid pairs. This analysis cannot be performed.

TATTITUD: 2 TGROUP: 1
- - - t-tests for paired samples - - -

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
MOTIV	10	.784	.007	38.9000	11.590	3.665
PMOTIV				37.4000	9.264	2.930

Paired Differences					
Mean	SD	SE of Mean	t-value	df	2-tail Sig
1.5000	7.200	2.277	.66	9	.526
95% CI (-3.652, 6.652)					

TATTITUD: 2 TGROUP: 2
- - - t-tests for paired samples - - -

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
MOTIV	11	.917	.000	45.3182	7.322	2.208
PMOTIV				43.6364	7.047	2.125

Paired Differences					
Mean	SD	SE of Mean	t-value	df	2-tail Sig
1.6818	2.935	.885	1.90	10	.087
95% CI (-.290, 3.654)					

TATTITUD: 3 TGROUP: .
- - - t-tests for paired samples - - -

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
MOTIV	0	.	.	.	.	.
PMOTIV				.	.	.

>Warning # 11834. Command name: T-TEST
>There are no valid pairs. This analysis cannot be performed.

TATTITUD: 3 TGROUP: 1
- - - t-tests for paired samples - - -

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
MOTIV	8	.964	.000	43.6250	7.909	2.796
PMOTIV				41.1250	8.790	3.108

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
2.5000	2.390	.845	2.96	7	.021
95% CI (.501, 4.499)					

TATTITUD: 3 TGROUP: 2

- - - t-tests for paired samples - - -

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
MOTIV	8	.914	.001	50.2500	4.652	1.645
PMOTIV				49.6250	5.502	1.945

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
.6250	2.264	.800	.78	7	.460
95% CI (-1.268, 2.518)					

```
-> SORT CASES BY tgroup .
-> SPLIT FILE
->   BY tgroup .
-> T-TEST
->   PAIRS= motiv  WITH pmotiv (PAIRED)
->   /CRITERIA=CIN(.95)
->   /FORMAT=LABELS
->   /MISSING=LISTWISE.
```

TGROUP: .

- - - t-tests for paired samples - - -

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
MOTIV	0	.	.	.	.	.
PMOTIV				.	.	.

```
>Warning # 11834.  Command name: T-TEST
>There are no valid pairs.  This analysis cannot be performed.
```

TGROUP: 1 control

- - - t-tests for paired samples - - -

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
MOTIV	30	.831	.000	41.2667	8.642	1.578
PMOTIV				39.0333	8.006	1.462

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
2.2333	4.883	.891	2.51	29	.018
95% CI (.410, 4.057)					

TGROUP: 2 Experimental

- - - t-tests for paired samples - - -

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
MOTIV	32	.874	.000	44.9531	6.877	1.216
PMOTIV				44.5938	7.530	1.331

Paired Differences			t-value	df	2-tail Sig
Mean	SD	SE of Mean			
.3594	3.673	.649	.55	31	.584
95% CI (-.965, 1.684)					