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Student impulsivity in decision making with computer simulations

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A series of decision-making activities in real-life and life-like situations were undertaken by a class of year six primary school students over a period of three months. Students played the computer simulation *Shipwreck* before and after the activities. During the simulation sessions, interactions between pairs of students were audio taped. Other data recorded included the survival scores generated by the program, the time of play for each pair and responses to questions at the end of the game sessions and at the end of the experiment. A control class played the game at the same times and the same data were recorded. Results suggest that while the treatment group showed no reduction in impulsivity in decision making, they remained stable in this respect compared to the control group.

The *Common and Agreed National Goals for Schooling in Australia* as published by the Australian Education Council in 1989 affirms the need "to develop knowledge, skills, attitudes and values which will enable students to participate as active and informed citizens in our democratic Australian society within an international context" (Department of Education, Qld, 1992, p.6). To ensure that students develop the skills of active and informed citizenship, greater attention has been focused on student decision making and how decision making can be enhanced.

With the increasing availability of microcomputers in schools, the use of simulations to develop the decision-making skills of students has become a viable option. Stewart (1988) has suggested that "The computer will, undoubtedly, play an increasingly more important role in aiding the decision-making process" and that " ... it will still be necessary for human beings to make the ultimate decisions ... " (viii). What is problematic is whether the use of simulations per se can enhance the decision-making capability of students as some developers of this type of software claim.

Various contradictory statements have been forthcoming in the literature about the relative merits of simulations in educational contexts. Whiteside (1985/86) has claimed that " ... many games and simulations can be used to foster in individuals some process related skills such as decision making" (p.116). Brant, Hooper and Sugrue (1991), in a review of educational simulations, concluded "Research conducted over the past two decades on the effectiveness of instructional simulations has yielded less than encouraging results" (p.469). Little research to date however, appears to focus on the use of simulations to develop generalised decision-making skills, that is, to produce better decision makers.

While the present study considered transferability of thinking skills involved in decision making, it was not investigating transfer of skills from one knowledge-rich domain to another, as the knowledge domain in all instances related to social issues requiring limited specific knowledge. Rather, the focus was on the transfer of decision-making skills across contexts, in this case, from real-life and life-like decision-making contexts to a life-like computer simulation context. The aim was to reduce the impulsivity of decision making.

The CoRT-1 thinking skill program was chosen as the instrument to mediate the impulsivity of decision making in the simulation context because of its applicability to both the transfer issue and decision-making skill development. This program approaches the transfer problem using two major strategies. Firstly, CoRT practice situations purposefully avoid complexity of subject matter to ensure that the focus is on the processes of thinking. Secondly, CoRT explicitly details and labels specific skills, eg. PMI (plus, minus, interesting), so that they are easily recognised and applied in a purposeful manner. In relation to decision making, CoRT-1 purports to provide students with skills to suspend judgement when making decisions and developing plans of action. As de Bono (1985, p.371) proposes, the purpose of the CoRT Program is to provide a 'clear view' or 'perceptual map' of a situation. He claims that CoRT-1 "encourages pupils to look in a wider sweep round a situation instead of rushing off after the obvious short-term, egocentric, prejudged line of thought" (1976, p.129).

Since interactivity and the verbalisation of thoughts were important aspects of this experiment, students worked in pairs when using the simulation. This approach finds support from Trowbridge's (1987) investigation of interaction patterns of students working with computers which concluded that "interactivity was enhanced when students worked in twos or threes" (p 47)

In summary, the purpose of the study was to investigate whether training in decision making can produce a cognitive style shift, from impulsive to reflective, when using a computer simulation.

The sample and software

Two classes of Year 6 students in a provincial city primary school were chosen for this study. The average age of the students was 11 years 2 months. One class was used as the treatment group and the other as the control group. Both classes were mixed gender and mixed ability, and each functioned with one teacher during the period of the study. Some students arrived at and some departed from both classes during the course of the experiment. Ten pairs of students remained intact in each class for the entire study. Only data obtained from these intact pairs were used. Both teachers were experienced and one of the researchers was the teacher of the treatment class.

A public domain program called *Shipwreck* was used in conjunction with an Apple IIe microcomputer for the study. The program was chosen because it provides a rich environment for decision making, is easy to operate, and contains the motivating goal of survival on a deserted island after a shipwreck. The program also incorporates a survival score which is provided as a percentage after the operator makes each decision. The score varies after each of a series of five to eight decisions that the operator makes while playing one game.

Treatment and data collection

The treatment class received instruction on using four of the CoRT-1 thinking skills most relevant to decision making over a three month period after having initially played the simulation game. They also had the opportunity to apply these four skills to a planning strategy for real-life and life-like decision-making situations.

The teaching approach used followed the procedure detailed in the CoRT-1 Teacher's Notes booklet (de Bono, 1986) which includes an introduction to the skill, practice activities together with questions and principles to

stimulate discussion and evaluation of the skill. During the initial four weeks, students also applied these individual skills to various contemporary and everyday issues which arose during discussions. These practice activities involved an additional two hours. Total treatment time for the first four weeks was six hours.

Students were introduced to a planning strategy for decision making which incorporated the above four skills during the fifth week. The students had the opportunity to apply this planning strategy to a range of decision-making situations in the following five weeks. All these activities were relevant and meaningful to the students and did not require significant specialised knowledge. During this six week period of the treatment time, planning activities involved a total time of ten hours. The total CoRT-1 instruction and practice time during the 10 week treatment was 16 hours. During this 10 week school time, the control group continued with their normal class routine which did not include any explicit instruction on thinking skills; nor was the content of their instruction necessarily similar to that of the treatment group. The control-group teacher was only involved in student release for the study.

Pairs of students from both classes were audio taped prior to the treatment while making decisions relating to the computer simulation. The simulation required students to make decisions about what four objects from a list of 20 to take from their sinking ship so that they could survive on an island. The program then challenged the students selection by requiring them to choose one of their four items to survive in a particular situation, eg. Which of your items would you use to signal ships at night? The survival scores achieved for each scenario while playing each game were also recorded and averaged by the researchers. These scores provided immediate feedback as to the quality of the decision. The students played this game twice. The researchers measured the time of play for each pair in order to use it as an indication of students' covers use of decision-making skills.

The student pairs were interviewed immediately after completing their two-game session. These interviews were also audio taped. The questions asked were: "What did you think of this activity?"' end "How did you make decisions during this game?" Further questions were asked when considered appropriate. After the treatment, the same pairs of students played the simulation for another two-game session and data were collected in the same manner as for the initial game. When the treatment and the post-test sessions were completed, the treatment class was required to respond in writing as to how they made decisions when playing the game, how they thought when making decisions, what they knew about CoRT thinking and how CoRT thinking helped them make decisions. The questions were displayed on the blackboard one at a time

and students' written responses collected before the next question was displayed.

Results and discussion

Audio taped interactions

Audio taped interactions were analysed for each pair of students to ascertain the nature of the exchanges for both pre-treatment and post-treatment sessions. The interactions were organised into three main groups: those where a decision was made with no reason given (NR), those where a decision was made with a reason provided (WR) and those where a decision followed on from a discussion (WD). A discussion was defined as more than two interactions. The researchers selected these categories to ascertain the extent to which students were suspending judgement and reflecting on their decisions. The first two of the above main groups were further subdivided into those decisions where no partner response (NPR) was recorded and those where verbal agreement (VA) was forthcoming. The results of this analysis of audio taped interactions are presented in Table 1 as frequency of occurrence.

Table 1: Audio taped interactions as frequency data

		Decision (NR)		Decision (WR)		Decision (WD)
		NPR	VA	NPR	VA	
Treatment:	Pre	59	126	0	16	21
	Post	46	119	0	17	19
Control:	Pre	20	126	7	30	9
	Post	62	90	8	22	2

The two columns under Decision (WR) were combined for the treatment group to avoid low expected values in the chi-square analysis for the NPR column. A chi-square analysis was performed for both groups separately in order to test for significant changes in interaction patterns before and after the treatment. No significant effect was found for the treatment group (χ^2 = 0.90, for p = 0.83 and df = 3) suggesting that no change in interaction pattern occurred as a result of the treatment. The absence of significant increases for the treatment group in decision making with reasons (WR), or with discussion (WD) (Table 1), suggests that transfer of desired decision-making skills was not forthcoming as a result of the CoRT-1 treatment.

A significant effect was found for the control group (χ^2 = 33.11, for p < 0.001 and df = 4). An inspection of post-hoc cell contributions for the control group analysis indicated that an increase in impulsivity had

occurred for this group. This was manifested by a significant increase in decision making with no pawner response (NPR), with a concomitant reduction in verbal agreement (VA) from the partner, together with significantly less discussion (WD). This may have resulted from their previous experience with the game which could have provided them with a greater degree of confidence to make decisions without their partner's help. While this factor should similarly have had an impact on the treatment group, the lack of a observed effect in this group may have resulted from a mediating influence of the CoRT-1 program. Hence, while the CoRT-1 treatment had no positive effect in reducing impulsivity in decision making in the treatment group, it appears to have had a stabilising influence when compared to the control group.

End-of-session interviews

For the first question relating to interest in the program, all students in both groups responded positively for both pre- and post-test sessions. When asked how they made decisions during the game, analysis of the responses for both pre- and post-test interviews suggested that there was no change in students' awareness of the decision-making processes they used during the simulation. Students' responses focused on the content of the game rather than the processes used to make decisions; and in the main, they made their decisions based to a considerable degree on their past experience or beliefs.

Survival scores

The average survival scores were recorded and averaged for each student pair for both the treatment and control group before the treatment commenced. This was also done for the post-treatment game session. A two-factor repeated measures ANOVA with the pre-test and post-test scores as the repeated measure and the treatment and control groups as the between-groups factor indicated no significance for either the main effects or for the interaction. This implies that there was no difference in the pre-treatment performance of the two groups and that the treatment produced no significant effect on survival scores.

This suggests that the treatment group did not improve its decision-making ability, as measured by the computer program, from having undergone the treatment. However, the audio taped interactions indicated a level of ingenuity and laterality in some student decision making which was not often recognised by the program as deserving points towards survival. Students were quite often unruffled when their four choices of survival objects did not seem to fit the requirement of the scenario with which they were later presented. They came up with some ingenious

compromises. Examples included: using a saw, in lieu of a mirror which they had not chosen to bring, in order to attract a ship at noon; using a can of beans to reflect moonlight in order to attract a ship at night; and using a blanket to sieve water in order to catch fish. One player succeeded in convincing his partner that a small mirror would be useful to shine sunlight on fish in order to stun them.

Some alternatives provided real solutions which remained unrewarded by the program. While it needs to be recognised that the program used in this study was relatively unsophisticated in the way in which it processed student responses, the detailed analysis of student interactions does reveal insights as to the requirements of programs, like simulations, which attempt to raise the level of student decision making and thinking in general. It is essential that this type of program be flexible to student responses, either by being thoroughly evaluated at a trial stage to fully ascertain the range of student responses, or through a greater intelligence in processing responses. Tamashiro and Bechtelheimer (1991) suggest the use of expert systems for this purpose with young children, since these programs are capable of making explicit their own decision-making process.

Time of play

The time taken for each pair of students to play the pre- and post-test two game sessions was measured and averaged for the control and the treatment group. The average fumes were analysed using a repeated measures two factor ANOVA which indicated no significance for the main effects or for the interaction. This indicates that the treatment had no effect on the average time of play and suggests no increased reflectivity in decision making by either group.

Final written responses

Students from the treatment group were asked to respond to four questions at the completion of the treatment and the second game session, as outlined in the methodology section. The responses to the written questions were analysed for evidence of awareness of their own thinking skills employed in a decision-making context and knowledge of CoRT-1 thinking skills. Responses to the first question "How did you make decisions when you played shipwreck?" were analysed under the categories indicated in Table 2 below. Some student responses related to more than one of the categories used.

Table 2: Ways of making decisions with *Shipwreck*

Category	Number of Responses
By previous general experience	13
By previous experience with the game	6
By social interaction	4
By use of general cognitive processes	4
By use of CoRT thinking	3

Almost two thirds of the responses referred to previous experience, with an emphasis on knowledge rather than decision-making processes. Cognitive processes, including CoRT thinking, accounted for less than one quarter of the responses, with only one tenth explicitly referring to CoRT skills. This suggests that the CoRT treatment figured in a minor way in the students' expressed views on the way they make decisions. Responses to the question "How do you think when you make decisions?" were analysed according to the student perspectives outlined in Table 3. Some students' responses related to more than one of the categories used in the analysis.

Table 3: Ways of thinking for decision making

Perspective	Number of Responses
General cognitive	14
Specific CoRT	6
Social	2
Behavioural	2
Affective / Ethical	2

Responses relating to the general cognitive perspective included those which referred to general thinking processes such as: "I think of all the things that are going on in my head and try to solve them"; "I think of the things that would be most important about making my decisions"; and "I think what would be most effective or if it would suit the conditions provided". References by students to particular CoRT skills were included under the 'specific CoRT' category whereas responses were placed in the 'social' category when reference was made to joint decision making or talking with a partner. Behavioural responses referred to those in which a specific behaviour was mentioned such as "I think making a decision when I am working hard and trying" The lone affective and ethical responses included: "If I feel like it or not. If I like what decision it is, I will probably do it if I like it"; and "If I was making a decision, I would think - is it fair or is it unfair?".

While the students provided responses to the above questions which indicated some use of CoRT skills as well as general cognitive skills, this

was not reflected in the audio taped interactions, or covertly in the time of play for the second game session.

In response to the question "What do you know about CoRT thinking?", eighteen of the twenty students in the treatment group indicated knowledge of all the four CoRT-1 thinking skills taught in the classroom context while the remaining two students indicated knowledge of two and three of the skills respectively. As part of their responses, all except three students related the CoRT-1 thinking skills to the decision making or planning process. The students obviously possessed knowledge of CoRT-1 thinking skills but failed to apply this knowledge to the simulation context. Hence, their knowledge of decision-making skills was 'inert' (Whitehead, 1929). The Cognition and Technology group (1990) argue that the inert knowledge problem can be overcome by further anchoring the instruction in some way. The teaching of decision making through CoRT-1 skills in the present study might have been enhanced by greater or more realistic involvement of the students in the classroom decision-making situations.

The question "How does CoRT thinking help you to make decisions?" produced a range of positive but undifferentiated responses relating to ways in which they perceived CoRT thinking facilitated the decision-making process. For example: "It means thinking hard before you do something stupid"; "It helps me to decide what to do when I am stuck"; and "Information is easy to get if you use CoRT thinking". The one response which challenged the assumption in the question asked was: "Well it sometimes helps me, or sometimes I feel lazy to do all of the steps in CoRT thinking".

Concluding comments

A number of explanations are suggested for the apparent failure of the CoRT-1 treatment to significantly reduce impulsivity in student decision making. Firstly, some students may have become conditioned to the effects of playing computer games where instant decisions are required to avoid the multiplicity of electronic hazards which manifest themselves in this game genre. There seems to be a strong need for a braking device when attempting to use microcomputer simulations for decision-making skill development. The results of the present study suggest that an appropriate and necessary mechanism to force students into a more reflective mode when using computer simulations is to insert explicit prompts. These may, at the very least, serve to remind students of decision-making skills before they proceed to the decision-making stage.

Secondly, while the treatment in the present experiment involved practice in decision making in a variety of situations, it is not claimed that either a

high level of mastery or near automaticity was achieved during the treatment for the situations used and for the time available. Hence, an explanation for the apparent lack of transfer of generalised decision-making skills to the computer-simulated context may relate to a lack of intensity of instruction, insufficient length of time for skill development or a combination of the two. This raises the pedagogical question that if moderate instruction in thinking skills applied to appropriate contexts over a three-month period produces no apparent transfer of skills to other contexts, and if the perceived remedy is to increase the concentration of instruction, perhaps over a longer time frame, is the educational investment likely to be worthwhile? Alternatively, should we be looking for other ways which may produce the required result more efficiently?

Thirdly, Greeno (1989, p.135) argues that "thinking is an interaction between an individual and a physical and social situation". It is not just a cognitive process - physical and social contexts must be taken into account when viewing thinking. In the present study, challenging a partner's decision or reason for a decision may have been perceived by some students as an antisocial activity. This may have reduced the desire for considered debate during the simulation sessions.

Finally, as the average age of the sample was 11 years 2 months, many of the students in this study may not have reached the formal operational stage. It could follow that a majority had not begun "to experience the powers of reflective and internalised thinking" (Hunter, 1991, p.73). A repeat of this experiment with older students may help to provide evidence to support this possibility. Hunter also suggests that a thinker is one who is "committed to becoming more reflective, more self-aware, and more systematic" (p.75). It may well be that to achieve successful transfer of generalised decision-making skills which promote reflection, students need to learn and accept the value of suspending judgement as well as the skills of suspending judgement.

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