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The present study was aimed at examining the way in which novice (from 12 year- olds to 18 year-olds) and experienced soccer players (seniors) use different informational cues for deciding a quick restart of play during a soccer match. The many studies in cognitive psychology that have examined the nature of expertise in chess and mathematics or physics problem-solving have concluded that the superiority of experts, relatively to novices, was largely due to their domain-specific knowledge and the use of this knowledge to perceive and structure the available information (see Ericsson & Charness, 1994, and Ericsson & Lehmann, 1996, for recent reviews). In the domain of sport and exercise (collective as well as individual), the effect of domain-specific knowledge on sport performance has frequently been replicated.

Expertise has largely been explained by superiority in perceptual and cognitive processes related to the specific-knowledge bases available. As an example, Helsen and Starkes (1999) examined the relative importance in the determination of expertise in soccer of (a) attributes determined by the efficiency of the visual/central nervous system (e.g., reaction time, optometric and perimetric parameters), and (b) attributes determined by cognitive domain-specific skills (e.g., complex decision speed and accuracy, and number of visual fixations in solving game problems). They found that the only significant predictors of sport performance were the cognitive domain-specific skills (see also Starkes, Allard, Lindey & O'Reilly, 1994).

McPherson (2000), studying cognitive factors involved in planning strategies, showed that expert tennis players generated more varied and more sophisticated goals and actions than novices did. Experts planned for actions based on elaborated goals that are specific to sport situations whereas novices lacked these cognitive structures to plan their action (see also Vom Hofe, 1995, for a discussion of skill specificity in complex athletic tasks).

Lerda, Garzunkel and Therme (1996) have shown that experts were better than novices at adapting their responses to a standardized one-to-one task in soccer that was presented according various spatial constraints. These authors proposed the existence of schemata that organized information processing towards the relevant characteristics of the task. These schemata were conceived as expectation systems with invariant knowledge about the specificity of the situation. However, no indication was given in these studies, concerning the possible content of these schemata and their organization (Starks, Helsen & Jack, 2001).

Decision-Making Schemata in Sports

Despite the importance that has been attributed to these knowledge bases for explaining how experts perform (and why they perform better than novices), the way in which these knowledge bases develop, how they are structured, and how they are used to make faster and more accurate decisions has not received much attention (Thomas & Thomas, 1994). During a match, athletes must process more or less at the same time many kinds of information: the opponent's position, the team organization, the time constraint, the current score, and many other cues. The way the athletes decide "what to do" (Rink, French, Tjeerdsma and Bonnie, 1996); that is, the athletes' concrete decision, is a function of these various pieces of information, and also a function of their level of expertise. One possible factor responsible for sport performance might be the degree of organization and integration of this expertise in more or less efficient decision-making scheme, as suggested by Lerda *et al.* (1996). As most decisions are taken under stress and time pressure, the quality of these decision scheme plays an important role because appropriate schemata allows players to quickly and efficiently plan and program the movement before executing it with correct speed and precision.

What is the structure of these decision schemata ? How is information used for deciding which strategy should be implemented? Which cues are considered determinant? Which rule is used to combine these cues into a judgment? This type of question was examined by

Pâques, Fruchard, Dru & Mullet (submitted) in the case of soccer, basketball, and hand-ball. Their methodological approach was inspired by Vergeer and Hogg (1999) who analyzed coaches' decisions about an injured athlete's participation in competition as a function of several situational factors (injury severity, the gymnast's age, ability level and importance of the competition) they systematically varied in an orthogonal design. Using a similar methodology, Pâques *et al.* (submitted) presented their participants with hypothetical vignettes in which one player had to decide whether a quick restart of play strategy at the end of a match. These vignette were composed according to an orthogonal design, with importance of the game (friendly or championship), numerical status of the team (superiority, equality, or inferiority), current score (win, tie, lose), and time left to play (very few time or few time), as the four factors (Anderson, 1996). Participants were instructed to consider each vignette and to indicate on a continuous scale the appropriateness level of a quick restart of play strategy, knowing that the opposite team has just scored.

As regards soccer, Pâques *et al.* (submitted) showed that (a) current score and numerical status of the team were the most important factors for deciding a quick restart of play strategy, (b) importance of the game and time left to play were strong moderators of the score effect – the more important the game, the less the time left to play and the stronger the score effect on the appropriateness judgment, and (c) score and status interacted in a complex way – status played an important role only in case of score tie. This pattern of result also applied to basketball and handball.

Development of Decision-Making Schemata

In the present study we were concerned with the way knowledge schema evolve over time; that is, the present study had a developmental character. The same material as the one used in Pâques *et al.* (submitted) was presented to 12-14 year-olds, 15-16 year-olds, 17-18 year-olds who regularly practiced soccer, and also to senior soccer players. We were interested in

examining, (a) whether Pâques *et al.*'s were replicated on a new sample of senior participants, (b) to what extent a developmental trend, from 12-14 year-olds to 17-18 year-olds was discernable, and (c) to what extent the judgment pattern observed among the novice participants paralleled (or not) the senior participants' pattern.

The choice of soccer was guided by the fact that this sport is one of the most popular one in France; as a result it was easy to gather a wide population of novice and experienced players. The choice of the quick restart of play strategy at the end of a match was suggested by the sportsmen themselves. Quick restart is, for example, a strategy often enacted when the opposite team has just scored a goal. It consists in deciding to put the ball back into play as quickly as possible in the hope of preempting defensive action from the opposite team; that is, acting before the defense has been able to re-organize. This strategy involves risks. The major risk is the possibility of losing the ball when increased speed of play tends to reduce the precision of passes between partners. It is a tactic decision for which tangible rules appear to exist (Dracon, 1999). It is a complex decision which must take into account circumstances and various events which have occurred during the game: relative importance of the game, current numerical status of the team, score at the time of the decision and time left to play. The understanding and the mastery of this strategy is likely to be subjected to developmental trends.

Our research questions are based on the four kind of results shown in Pâques, Fruchard, Dru and Mullet (submitted). Do current score and numerical status of the team be the most important factors for deciding a quick restart of play strategy among every age group ? Do importance of the game and time left to play be strong moderators of score among every age group ? Do score and status interact in the same complex way among every age group ?

Method

Participants

The participants are 257 volunteers living in the North of France. They were all male members of junior or senior soccer teams. Their age varied from 12 to 25 years. They formed four age groups: 12-14 year-olds (71 participants, mean age = 12.9), 15-16 year-olds (60 participants, mean age = 16.1), 17-18 year olds (50 participants, mean age = 17.9) and seniors (76 participants, mean age = 23.4).

Material

The material consisted of 36 cards showing a short story of about four lines and a response scale. Each story contained four critical items of information in the following order: (a) the relative importance of the game (friendly match vs. competition match), (b) the current numerical status of the team (numerical inferiority, or equality or numerical superiority), (c) the current score (loss or tie or win), and (d) the time left to play (few time versus very few time). All possible combinations of these types of information yielded 2 x 3 x 3 x 2 = 36 stories. One typical story is the following: «Your team is playing a championship match. At present, your team's score is one goal more than the other team's and your team has one player more than the opposite team. The ball has left the playground. Very little time remains to play. Are you going to decide to adopt a quick restart of play strategy ?».

Beneath each story was a 19-point response scale with "Completely Sure I am not going to adopt a quick restart of play strategy" indicated at the left and "Completely sure I am going to adopt a quick restart of play strategy" indicated at the right.

Procedure

The participants were interviewed in 2002. According to the methodology in Functional Theory of Cognition (Anderson, 1996), the test was administered in two phases. Participants responded individually, generally during sport training or in sport club meetings. The researcher explained to participants their role in the study, in the first or familiarization phase, in which participants would read a certain number of stories indicating that during a match, a

player must decide whether a quick restart of play strategy has to be adopted or not. Their task was to identify with this player and express an opinion about the appropriateness of this kind of strategy in each case. In this initial phase, each participant was presented with the 36 stories. Each story was read aloud by the participant. Subsequently, participants provided the required ratings and were given an opportunity to compare their responses and change them.

During the following experimental or second phase, the 36 stories were resubmitted to participants in a different order. Participants provided their ratings at their own pace and were not allowed to compare responses or to go back and make changes as in the familiarization phase.

Results

Participants' ratings from the second, experimental phase were converted to a numerical value expressing the distance (measured with a ruler) between the point on the response scale, and the left anchor which served as the point of origin. These numerical values were then subjected to graphical and statistical analyses.

Insert Figures 1 and 2 about here

Figure 1 presents an illustration of the two main effects and their variation as a function of age. The score effect clearly was the dominant effect (15.62 – 5.53 = 10.09), $F(2, 506) = 1426.33$, $p < .0001$. A strong effect was observed in each of the four age groups. The more the team was losing, the more appropriate the quick restart of play strategy. Among the 12-14 year-olds, however, this effect was weaker than among the three other age groups. The Age x Score interaction was significant, $F(6, 506) = 9.59$, $p < .0001$.

The team effect was also significant (12.04 – 9.57 = 2.97), $F(2, 506) = 290.68$, $p < .0001$. A moderate effect was observed among the seniors and the 17-18 year-olds. The more

numerous the team, the more appropriate the quick restart of play strategy. This effect was weaker among the 15-16 year-olds. It was absent among the 12-14 year-olds. The Age x Team interaction was significant, $F(6, 506) = 43.28$, $p < .0001$.

Although comparatively weak, the importance (11.22 – 10.64 = 0.58) and time (11.24 – 10.62 = 10.68) effects were also significant, $F(1, 253) = 15.65$, $p < .0001$ $F(1, 253) = 62.86$, $p < .0001$. The more important the game and the less the time left to play, the more appropriate the quick restart of play strategy.

Figure 3 shows three of the six 2 x 2 combinations of the four factors. On the top panels (a), score values are posited along the horizontal axis, from win to lose. Each curve corresponds to one level of the relative importance factor. Each panel correspond to one age group. Judgments are plotted along the vertical axis. In each panel the Important curve is clearly steeper than the Not Important curve. The score factor had more impact on appropriateness judgment when the game was important than when it was not important. The Score x Importance interaction was significant, $F(2, 506) = 98.75$, $p < .0001$. The Age x Score x Importance interaction was not significant.

On the middle panels (b), each curve corresponds to one level of the time left to play factor. In each panel the Very Little Time curve is clearly steeper than the Little Time curve. The score factor had more impact on appropriateness judgment when very little time was left to play than when little time was left to play. The Score x Time interaction was significant, $F(2, 506) = 109.43$, $p < .0001$. The Age x Score x Time interaction was not significant.

On the bottom panels (c), each curve corresponds to one level of numerical status of the team. In the three panels on the right, the overall shape of the curves was similar. When the team was winning or losing, the effect of the current status of the team (numerical inferiority or numerical superiority) was much weaker than when the current score was the same for both teams. In the left panel, the effect of the score was not dependant on the numerical status of

the team. The Score x Team interaction was significant, $F(4, 1012) = 225.49$, $p < .0001$. The Age x Score x Team interaction was significant, $F(12, 1012) = 8.89$, $p < .0001$. A complementary ANOVA conducted among the 12-14 year-olds showed that the Score x Team interaction was not significant.

Insert Figure 3 about here

Another three-way interaction was significant: Score x Team x Time, $F(4, 1012) = 20.89$, $p < .0001$. Figure 3 illustrates this interaction. When time left to plat was very few, the Score x Team interaction was stronger than when time left to play was only few. One four-way interaction was significant: Age x Score x Team x Time, $F(12, 1012) = 2.50$, $p < .001$. This effect of time left to play on the Score x Team interaction was only observed among 15-16 to seniors age groups.

Discussion

The present study examined the way in which novice and seniors soccer players use different informational cues for deciding a quick restart of play during a soccer match. Our first research question was about the impact of current score and numerical status of the team on appropriateness judgments among each age group of participants. Pâques, Fruchart, Dru and Mullet (submitted) showed that these factors were the most important factors for deciding a quick restart of play strategy among senior players. Do these factors also be the ones with the most impact among the novices ? As regards the 17-18 year-olds, the answer can be clearly affirmative: These factors appeared as the most important. As regards the 12-14 year-olds, the answer is different. Score appeared as the most important factor but numerical status of the team did not seem to be taken into account. Finally, as regards, the 15-16 year-olds, the

picture was intermediate. Numerical status of the team was taken into account for judging but to a lesser extent that among the older groups.

Our second research question was about the moderator role of score played by importance of the game (friendly or championship) and time left to play (very little time versus little time). Pâques, Fruchart, Dru and Mullet (submitted) showed that among senior players the more important the game, the less the time left to play and the stronger the score effect on the appropriateness judgment. Do these factors also play a moderator role on score among the novices? Irrespective of the age group considered, the answer can be clearly affirmative: These factors appeared as moderator of the effect of score on judgment.

Our third research question was about the complex interaction between score and status. Pâques, Fruchart, Dru and Mullet (submitted) showed that among seniors status played an important role only in case of score tie. When score was tie, the more the team is superior the more appropriate the quick restart of play strategy. When score was win or loss, the numerical status of the team only played a minor role. Do these factors also show the same pattern of interaction among the novices? As regards the 17-18 year-olds, the answer can be clearly affirmative: These factors interacted in the very same way as among seniors. As regards the 12-14 year-olds, the answer is definitely no. As already discussed, the numerical status of the team was not taken into account. Finally, as regards, the 15-16 year-olds, the picture was intermediate, closer to the one offered by the 17-18 year-olds than to the ones offered by the younger group.

One more result deserves comment: the one regarding the moderator role of time left to play on the score x team interaction. Among seniors and 17-18 year-olds, when the score was tie, the numerical status of the team played a still stronger role when time left to play was very little than when it was little.

Looking at the results in another way, it can be observed that, among seniors, a quick restart of play strategy was judged very appropriate (mean score > 16) when at least one out four sets of conditions were fulfilled: (a) losing in a championship game and very little time was left to play, or (b) losing in a championship game and little time was left to play but with the condition of numerical superiority, or (c) losing in a friendly game but with the conditions that very little time was left to play and actual numerical superiority, or (d) tie in a championship game and very few time left to play with the condition of numerical superiority.

Among 12-14 year-olds, the sets of conditions were more restricted. A quick restart of play strategy was judged very appropriate (mean score > 16) in only two cases: (a) losing in a championship game and very little time was left to play, and (b) tie in a championship game and very few time left to play with the condition of numerical superiority. This is what Figures 1-3 illustrate.

Implications for Sport Education

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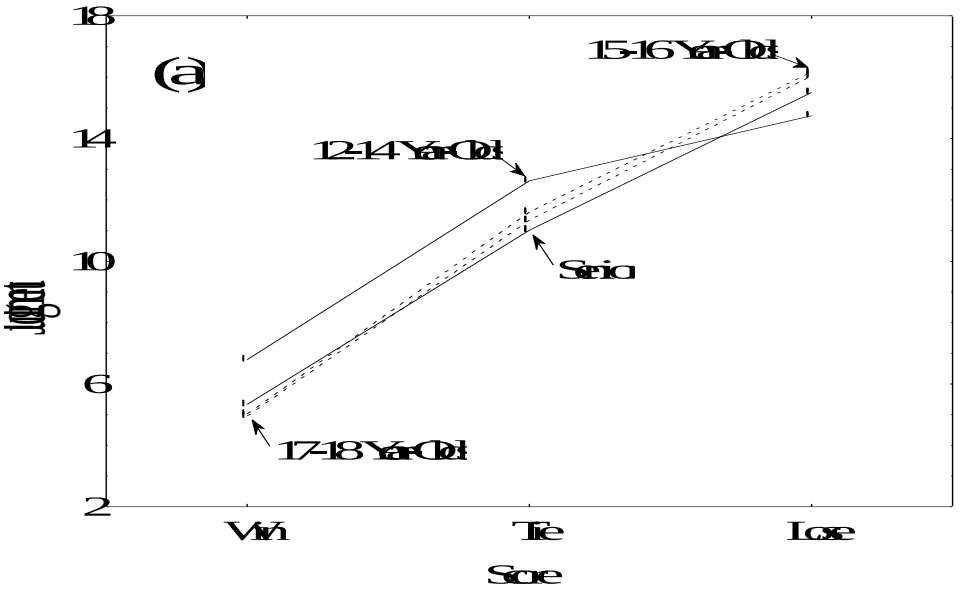
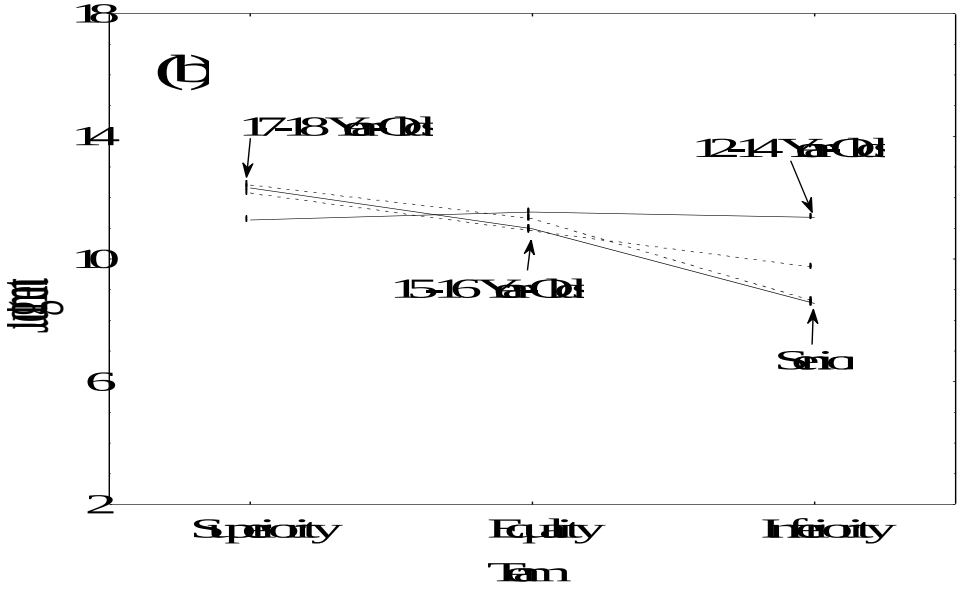
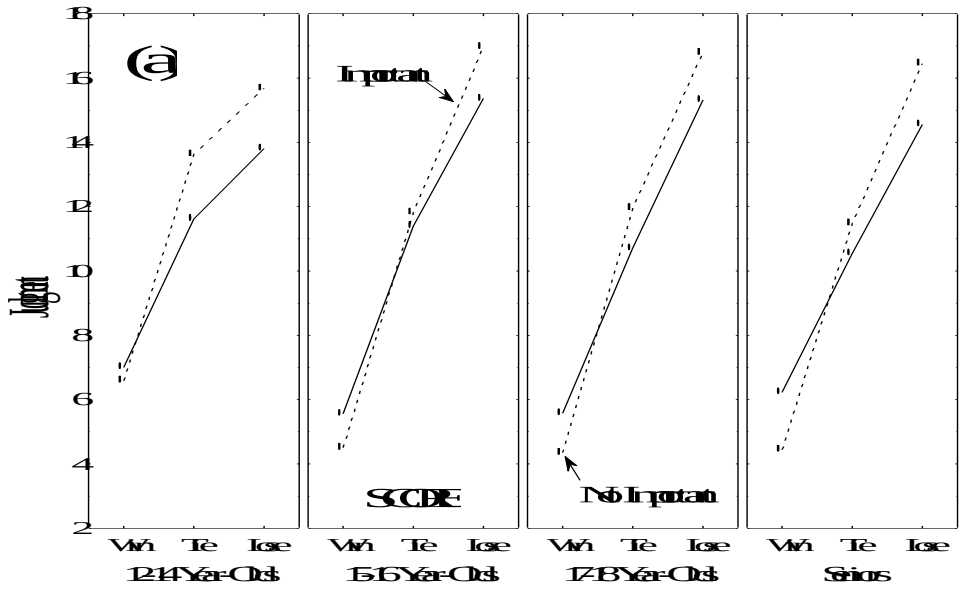
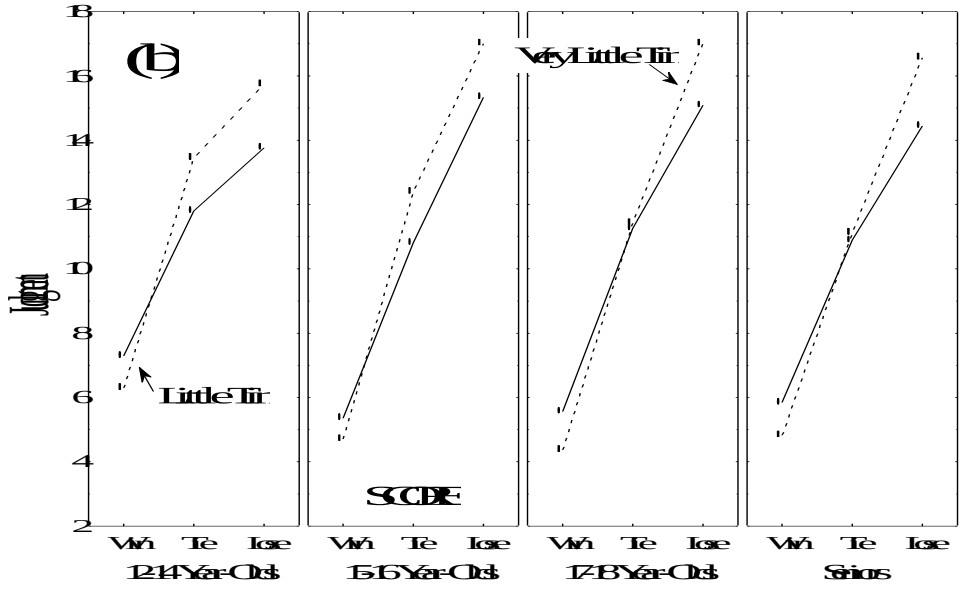
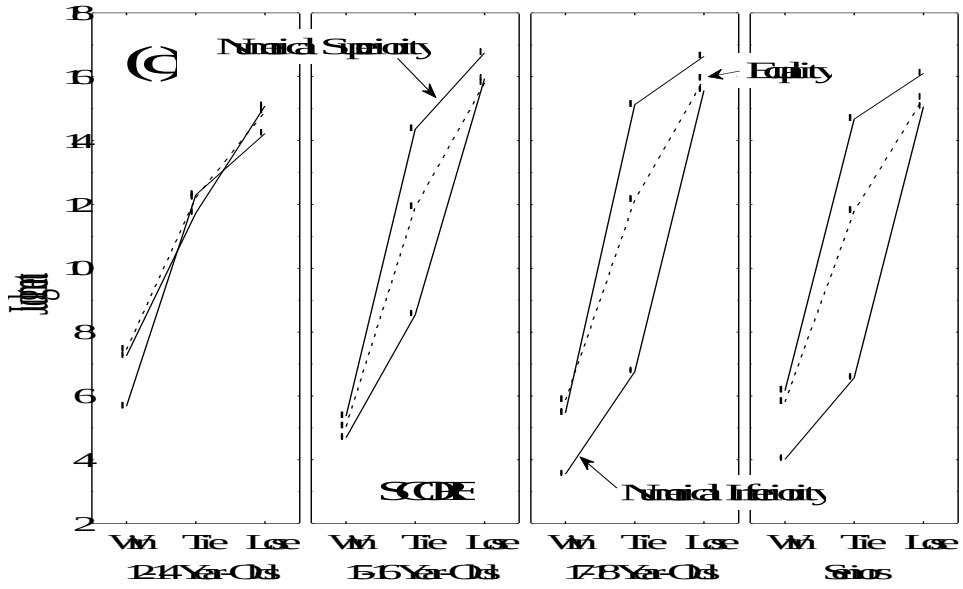
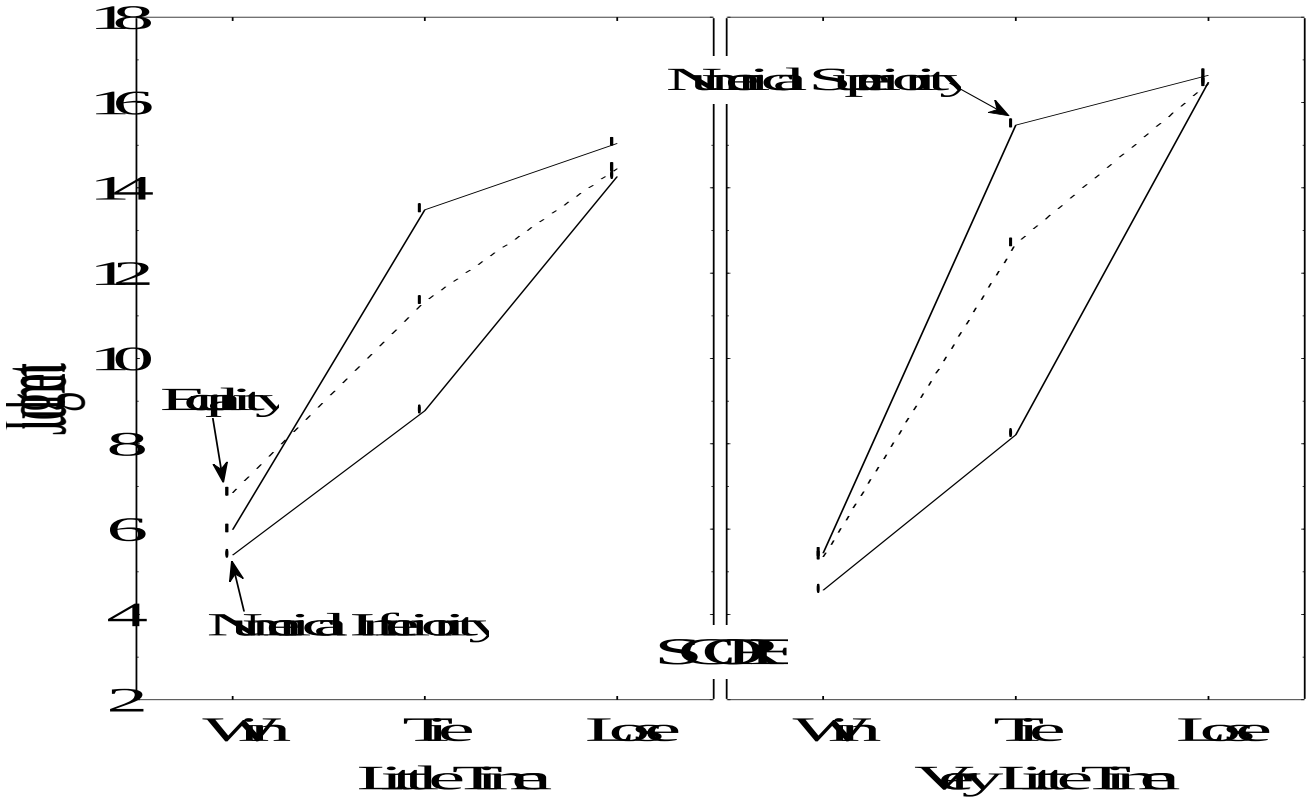

(a)
18
14
10
6
2
15-16 Year Old
12-14 Year Old
Serie
17-18 Year Old
Win
Tie
Lose
Score


(b)
18
14
10
6
2
17-18 Year Old
12-14 Year Old
15-16 Year Old
Serie
Superiority
Equality
Inferiority
Team


(a)
Important
SCORE
Not Important
Win
Tie
Lose
12-14 Year-Olds
15-16 Year-Olds
17-18 Year-Olds
Seniors


(b)
Very Little Time
Little Time
SCORE
Win
Tie
Lose
12-14 Year-Olds
15-16 Year-Olds
17-18 Year-Olds
Seniors


(c)
Numerical Superiority
Equality
Numerical Inferiority
SCORE
Win
Tie
Lose
12-14 Year-Olds
15-16 Year-Olds
17-18 Year-Olds
Seniors


18
16
14
12
10
8
6
4
2
Judgment
Equality
Numerical Inferiority
Numerical Superiority
SCORE
Win
Tie
Lose
Win
Tie
Lose
Little Time
Very Little Time