TeamTris: A Research and Training Paradigm for Team Work in Dynamic Environments

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Modern society requires organisations and individuals to work faster, safer, and cheaper while subjected to more regulations and rules. This requires efficient coordination and a shared understanding between team members to reach the organisational goals and to meet constraints (Salas & Fiore, 2004). Much training and research has been directed to team processes in the last decade. And yet, high performance team work is not easily facilitated. It requires a considerable learning process and the ingredients for excellent team work are still not completely disclosed.

In order to support research on complex team work in dynamic task settings, a game environment TeamTris has been developed. During TeamTris three persons perform a well-known individual task, Tetris™, but need to work co-operatively to deal with new rules and a shared goal. TeamTris is based on the well-known Tetris™ game. The level of complexity as well as domain specific task and team characteristics can simply be adjusted to particular professions. This paper (1) outlines the development of TeamTris, (2) gives a short description of the tool, and (3) identifies possible areas of application.

Development of TeamTris

Game criteria

Studying team processes in dynamic environment, such as for example air traffic control, has been a strong driver in designing TeamTris. The goal was to create an abstract gaming environment, which is easier to set up than high fidelity simulators, allows observing team processes, and can be used by non-professionals as participants. If carefully designed, a game includes relevant elements of the modelled task while offering experimental control. During a needs analysis several requirements were identified. The game shall be/shall contain:

- a dynamic environment for three or more players
- tasks require individual but interdependent actions
- co-operative game play (i.e., shared game world, inter-play interaction, complementary skills)
- game rules and procedures
- intrinsically motivating
- easy to learn, but hard to master
- easy to adapt for different purposes (e.g. allow for various experimental conditions, training applications)

Based on these requirements the game Tetris™ was considered to be a suitable basis for the aimed purposes. Tetris™ captures some of the defined requirements, such as intrinsic motivation - it “provides natural goal striving in a nutshell” (Wentura, Voss, & Rothermund,

2009, p. 172). Moreover, the game has successfully been used as a research tool in various domains (Breukelaar et al., 2004; Button, Behm, Holmes, & Mackinnon, 2004; Hoogeboom & Kosters, 2004; Wilson, 2009; Zafrina, Veksler, Gamard, & Gray, 2006). However, Tetris™ does not include any teaming aspects. Therefore, a new game concept was developed to allow several players to cooperatively play the game. TeamTris was designed as a distributed application, which means that each player controls the game from his/her own computer. All involved computers are part of a client-server environment with one computer acting as the server. The server maintains the state of the game and evaluates any request made by a client.

Description of TeamTris

The interface of TeamTris is pictured in figure 1. In TeamTris the traditional game principles of Tetris™ are still included. However, three players need to perform the task cooperatively. Responsibilities are divided between two Controllers, who basically have the traditional tetris task, and a Planner. The Controllers move shapes in their dedicated area and the Planner selects appropriate shapes for the two Controllers. The aim of the game is to fit the shapes together so that they form one or more complete lines on the ground. In addition to the multiple player function, TeamTris comprises several other aspects that increase the need for teamwork and mutual understanding. For example, the two Controllers can exchange shapes if needed or the Planner can put a shape into the Holding for later use. In order to increase game complexity, some shapes show deviant behavior – they cannot be rotated.
The specific rules of TeamTris can be very easy or very challenges, depending on the settings. In other words, the game behavior can be modified according to the needs of the users. Which and how the settings can be changed will be described in the next section.

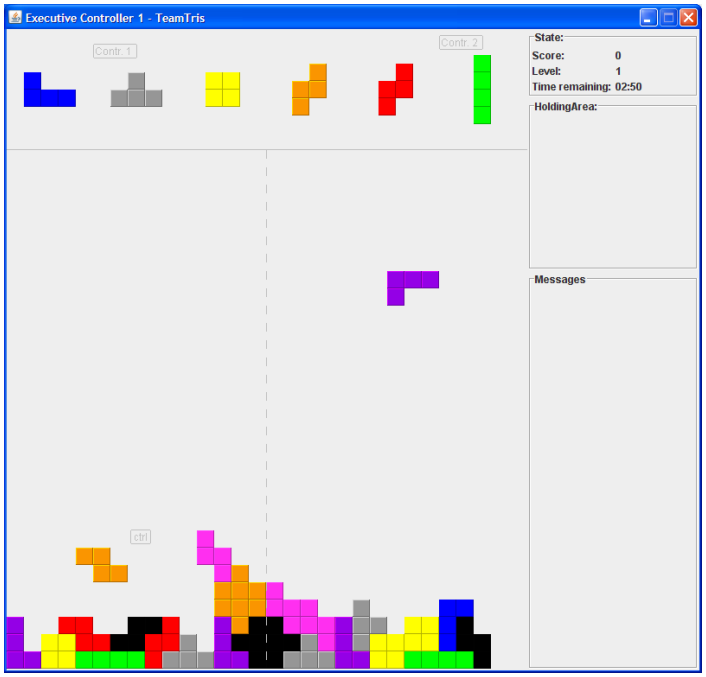

Figure 1. The TeamTris interface.

Game variations

There are multiple adjustments possible to customize TeamTris for specific research or training goals.

Physical appearance

The size of the game matrix can be defined in pixels. A differentiation is possible between the Planner area and the Controller area. The shape size adjusts accordingly to the size of the playing field, but can also be defined individually. A long but narrow field requires other playing strategies than a short but broad playing field.

Shape list and shape properties
The shapes, which fall from the planner area into the playing field, are either randomly chosen from a predefined list, or cyclically chosen from a predefined list. Shapes defined in the shape list will appear in the planner area. Specific shapes can be defined individually according to the hex colour code. For example, shapes that cannot be rotated by one or both controllers, forces them to coordinate effectively and increases the workload of the planner. The definition of the shape list and shape properties can have big impact on the complexity of the game.

Point system & complexity levels
The settings in TeamTris allow defining how long the game takes and how much points are assigned for specific actions. It is possible to assign penalty points as well. Actions for which (penalty) points may be assigned are cleared lines, exchange of shapes, collision with other shapes, delayed planning of shapes etc. In addition, it is possible to increase the complexity level if a specific amount of points is received. Complexity levels differ in terms of dropping and accelerating speed. If the complexity gets very high, players tend to focus on their own task instead of trying to cooperate. The situation awareness decreases although it is especially needed in such demanding situations.

Shared or unshared display
The default option of TeamTris shows the same interface for all players. In other words, every player can see his/her own area of responsibility and those of the other players. The unshared display option causes that only specific parts of the playing field are visible. For example, the controllers only see their own area whereas the planner may see all areas. This option again may encourage team members to cooperate more. Communication is a key factor in the unshared display mode.

Communication channel
TeamTris requires coordination and therefore communication between the players. One channel is verbal communication, but TeamTris also offers communication by means of messages (see figure 1), similar to the so-called datalink services of air traffic control. Datalink messages are predefined messages that are sent through the system. They need to be build up by an action icon (e.g. turn, give, take), a shape icon and receiver icon (planner, controller 1 or 2). Once a message is sent the receiver can confirm or reject the request that is communicated back to the sender. The datalink option allows communication without speech but is commonly very challenging for the players.

Application of TeamTris

TeamTris was conceived as a tool for multiple purposes, namely research, training, and selection. For all applications the focus clearly is on the assessment of knowledge and skills of teamwork and coordination. However, depending on the specific objectives the settings can be adapted more specifically. An important aspect for all three applications is game control. For example the possibility to adjust the complexity level is useful in many ways: (1) teams can easily be compared for research purposes, (2) task difficulty can slowly be increased to facilitate learning curves, and (3) complexity can be defined according to selection criteria.

All movements or electronic communication is logged during game play and can be reviewed afterwards.

Recently TeamTris has been used in several experimental studies regarding team cognition, cross-training, electronic communication and team adaptation (e.g., Justen, van Doorn, van der Pal, & Zijlstra, 2010). These studies reflect the broad variety of topics that can be covered using TeamTris, and they all relate to practical problems that are difficult to assess in the operational field. For example, in one study the unshared display option in TeamTris is used to simulate a system breakdown. Team members suddenly need to adapt to a new situations with less information available. The presumption is that only teams who developed a good team strategy and a shared mental model in the beginning will later be able to effectively deal with the sudden change.

Further developments

Currently, we are working towards enhancing the tool for professional training and selection. This will for example require development of a secure student database. As a training tool, we anticipate addressing team aspects in a much earlier phase of training than currently is possibly as a result of the complexity of the operational tasks. Air traffic control increasingly requires teamwork within and between teams. Young controllers therefore must be open minded, communicative, and have a good understanding of their teammates. Similar team aspects can be found in for example medical teams and crisis co-ordination teams. During TeamTris, the players usually discover the importance of a shared goal and effective coordination. Acquiring such awareness can help young trainees to change their attitudes and behaviour towards a more team-centred perspective in a very early stage of training Selection on teaming abilities and early provision of team training is expected to enhance quality and reduce training costs.

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