Visualizing Group Dynamics Signals

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ABSTRACT
The group dynamics visualizer is a solution to the problem healthcare workers are facing when working with social therapeutic groups. It is a well known problem that their reflection ability is affected negatively by the group dynamics. Healthcare workers become part of this groups dynamics and are no longer able to objectively observe and intervene. In this paper we describe the process of measuring group dynamics, a part of the 'group prevention plan'; more specific, giving feedback on the tension level of groups inside a psychiatric ward. A software application, 'group dynamics visualizer', is developed to measure and visualize the data. The visualization methods allow the user to quickly explore the data in order to find relations and abnormalities. This information is then used to prevent high-tension build up. Furthermore the software serves as an objective observation tool.

Author Keywords
Matrix representation grid, visualization, data exploration.

ACM Classification Keywords
H5.m Information interfaces and presentation: Miscellaneous, H.1.2 User/Machine Systems: Human information processing

BACKGROUND
By measuring and using group dynamics signals the healthcare worker is able to predict and prevent aggressive patient behavior within psychiatric units. Experience learns that if tension increases within a group of patients, the staff's reflection abilities are affected. A prevention plan supports the reflection abilities of the health care worker. This makes a collective intervention possible even when tension in the group continues to stay at a high level. Doing so, the autonomy of the staff increases. This prevention plan

based on group dynamics signals consists of two parts.

1. A written part called 'group prevention plan' in which signs and signals of tension build up are described, including interventions based on de-escalation of the patient group and support of the staff.

2. An instrument which measures the tension building called 'Grid'. This is an important element because the health care workers themselves are part of or influenced by this tension building. So this Grid is an important objective monitor.

GROUP PREVENTION PLAN
The group prevention plan is based on a crisis development model [3]. This model is based on the solid phases of the development in crisis including the set of possible actions and interventions to de-escalate.

The basic situation is called phase 0 (the normal value; tension level is normal) to indicate the basic level of tension in a certain group. By internal or external influences this tension level can increase. This is described in level 1 to 3, as shown in the following table.

Tension level	Signs and Signals	Intervention on patient- and staff level
Level 0: "Normal value"	Grid-level 0 Relaxed environment	Normal routine, Self coaching
Level 1	Grid-level 1 Irritated environment or busy group	De-escalate Self coaching Aimed at result
Level 2	Grid-level 2 Group- and staff destructives	Directive acting External coaching
Level 3	Grid-level 3 Aggression out of a group	Physical intervention Management makes decision External support

Table 1. Four stages of tension.

The most important characteristics of each phase, each level and the possible interventions are determined. Also agreements are made for daily measuring by filling in the Grid. Action must be taken, if the Grid shows abnormalities.

THE GRID
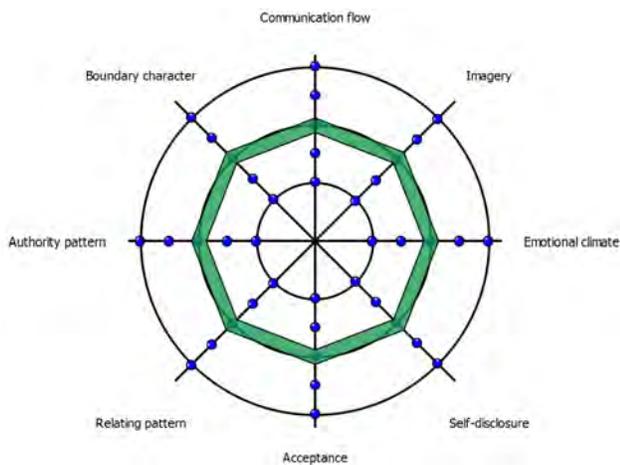The Grid is an instrument which visualizes the tension building.

Figure 1. The matrix representation grid.

Many group indicators are hidden in the communication and the relation level between mutual group members and of the group members with the team. The health care worker who cooperates closely with patients is by definition part of this group's dynamics as well. Hence we often see that the reflection ability reduces within the staff on the communication and relation level if the tension in the patient group mounts.

The reflection of staff members, on the increased tension level of the patient group, will decrease. For this reason a prevention plan on noticeable group indicators is not sufficient, there is also a need for an objective monitor. We found such instrument in the Matrix Representation Grid by G.Ahlin [1,2]. The Matrix Representation Grid, hereafter

referred to as 'Grid', measures the communication and relation level in the patient group by means of 8 dimensions:

1. Communication flow.
2. Imagery.
3. Emotional climate.
4. Self disclosure.
5. Acceptance.
6. Relating pattern.
7. Authority pattern.
8. Boundary character.

The 8 dimensions of the group functioning are described on 8 axes. Staff members value which level the group functions on for each of these 8 dimensions on a 5 point scale. The points on the outer circle represent score values of 1, and the points on the innermost circle represent score values of 5.

If enough measurements are available, a typical normal tension level emerges. The score values indicating the tension level are characteristic for this group. If the tension level in the group deviates from typical values this becomes visible in the Grid.

Regular daily measuring is achieved by entering the scores to the automated version of the Grid. The routine scoring reveals increased tension levels. In combination with the group prevention plan it helps the further diagnosis of the tension build up and the adequate action which should be undertaken.

VISUALIZATION
There are four proposals for visualizing group dynamics. The first visualization proposition is the Matrix Representation Grid (see Figure 1). GDV (group dynamics visualizer) allows users to see data in a Grid with additional visual features to gain insight. The interpretation of the Grid will be explained in the next section.

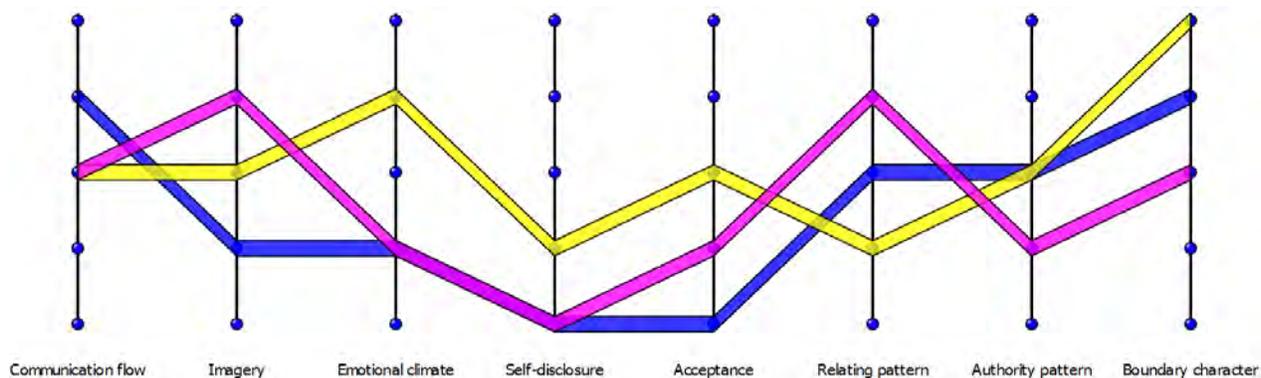Each dot on this Matrix Representation Grid represents a

Figure 2. The parallel axes plot.

score on one of the eight axes. This visualization is used to see the results of one particular measurement.

If one wants to get a deeper understanding of the relation among multiple aspects of a score the parallel axes plot (see Figure 2) is used.

This visualization presents essentially the same data, however, it also provides the possibility to plot multiple evaluation moments thereby visualizing correlation of different aspects among multiple evaluation moments. Also multiple evaluation moments of different groups can be plotted to explore group-correlations.

The downside of the parallel axes plot is that it does not provide a broad overview of evaluation in time. The next visualization, the stacked line diagram, provides this feature (see Figure 3). It reveals evaluation moments in time, providing the user with ongoing trends and giving the possibility to analyze events that lead to an extreme score.

The next visualization is called the scatter plot matrix (Figure 4). It visualizes the occurrence of a score on two aspects. The main advantage of this visualization is that is provides the possibility to explore a large dataset and discover correlations or patterns specific to a group. Correlation between two group dynamics aspects are visualized by color coding. A brighter color indicates a higher correlation between two aspects. This aids health care workers on the long term to further optimize and steer group behavior.

INTERACTION
Exploration of the data is only effective if the user is provided with an overview, is able to zoom, filter and see details on demand [4]. Interactive exploration of the data is provided by linking the above described visualizations together and providing the user with extensive exploration possibilities. For example, a user can click on a point of
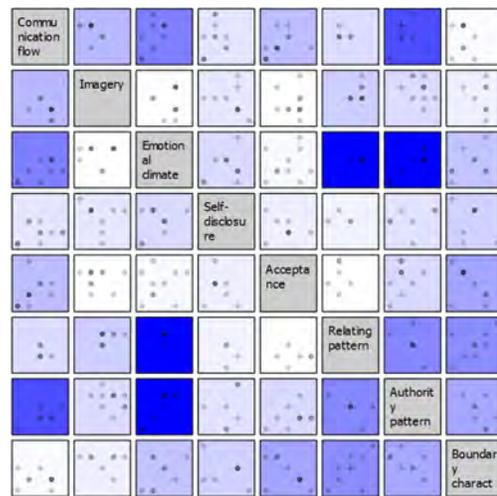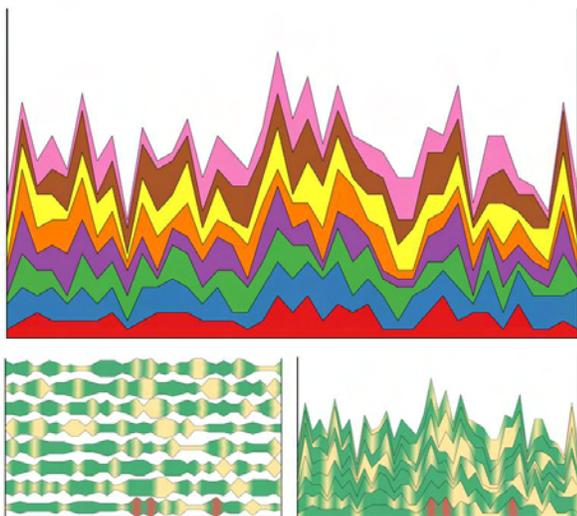

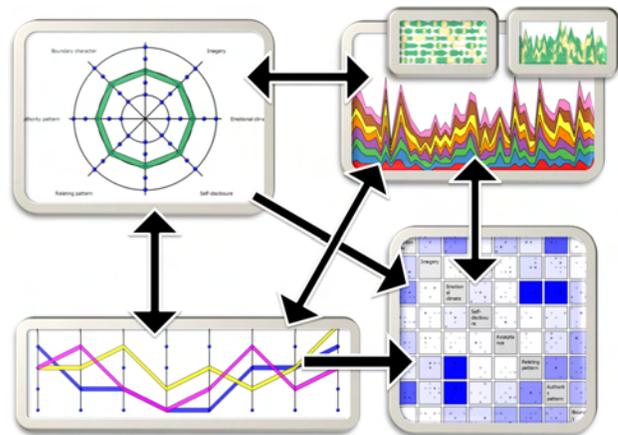
Figure 4. The scatter plot matrix.

interest in the stacked line diagram and explore the according Grid. Another example is to show the parallel axes plot of all groups for a certain theme. This might reveal interesting relations; for example certain themes may always build up significantly more tension inside a group compared to other themes. All visualizations are linked to provide the user with easy navigational means to allow for extensive data exploration. Figure 5 shows the possible transitions between the visualizations.
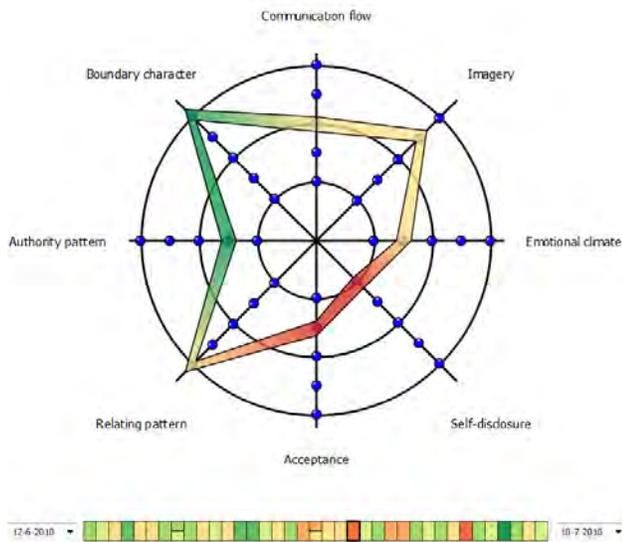
INTERPRETATION
Most features in the visualizations, for example color, are group dependent. Each group has its own normal level of tension. For example, the tension in a group of children will be much higher compared to a group consisting of adults. Therefore the group of children will score high on certain aspects, which does not mean there is reason to take action. In order to determine the standard tension level of a group, the median value (x) for each of the aspects is calculated. To be able to detect abnormalities or high-tension build ups, the standard deviation (s) is calculated. If the current

Figure 3. The stacked line diagram.

Figure 5. Interaction between visualizations.

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Figure 6. Fast tension level insight through use of color coding.

tension of one or more of the group dynamics aspects lies outside the (safe) range $[x - s; x + s]$, this is an objective warning to the responsible health care workers. Tension levels which lie inside the safe range are colored green in the visualizations, whereas tension levels which lie outside the range are encoded by a red color. Furthermore a timeline, again color coded, shows the aggregated tension level of a group. This enables the user to determine very fast whether the tension level of a group is normal or not. An example is shown in Figure 6.

FUTURE WORK

The concept of visualizing group dynamics signals as well as the group dynamics visualizer is not limited to the field of psychiatry. It could easily be applied to other fields of interest in which an objective observation about the groups dynamics is desired. Furthermore the group dynamics visualizer could be coupled with other systems which take action if abnormal group behavior is observed. To conclude we think that the visualization of group dynamics in order to provide an objective observation can be successfully applied in many fields.

REFERENCES

1. Ahlin G. Exploring psychotherapy group cultures. Stockholm: Kongl Carolinska Medico Chirurgiska Istitutet, 1996.

2. Kristina Herlitz, Göran Ahlin, Christer Sandahl and Ingela Brimberg. Developing the matrix representation grid (mrg): A method for observing group processes. findings from time-limited group psychotherapy for alcohol-dependent patients. *Behavioral Science*, (1996), 145–173.

3. Kuijpers E. Signaleringsplannen ter voorkoming van agressie. *Psychopraxis*, *7* (2005), 155-161.

4. Brock Craft and Paul Cairns. Beyond guidelines: What can we learn from the visual information seeking mantra? In IV '05: Proceedings of the Ninth International Conference on Information Visualization, pages 110-118, Washington, DC, USA, (2005). IEEE Computer Society.