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Where to Sit? The Study and Implementation of Seat Selection in Public Places

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Abstract. The way people behave in public places when selecting a seat should be of interest to anyone working with virtual people and environments such as in the simulation, movie, or games industry. This study, conducted in a café and a restaurant, was meant to gather information about this behaviour. In particular whether a behavioural pattern could be found and whether there is a notable difference in the behaviour of individuals and groups. The study found that specific behavioural patterns exist in these situations. These results lead to some guidelines for behaviour design as well as a model of seat selection based on utility. The model was implemented in the CADIA Populus Social Simulation engine.

Keywords: Seating behaviour, seat selection, seat preference, virtual people, social simulation, artificial intelligence

1 Introduction

Virtual people are all around us: In movies, on the television, and in video games. They are people who are created in computers and displayed as though they were real individuals, even sometimes in the company of real actors. The animation of these people has for the most part been in the hands of animators, but automatic animation, performed by artificial intelligence, is gaining popularity. This automatic animation is possible with the help of algorithms that control the responses of the virtual people to their environment. This technology is dependent on our ability to describe human behaviour in an algorithm.

While virtual people often find themselves in combat situations, interest in peaceful behaviour is growing, for example with the emergence of computer games that focus on social interaction. One of these game environments is a new addition to CCP's EVE Online computer game, where players can meet one another and other narrative characters in space-cafés and bars. The narrative characters have to behave realistically in such places, so empirically based algorithms need to be in place to control their responses and behaviour.

The behaviour that this study focused on is how individuals select a seat in places where other people are present, for example in restaurants and cafés. By studying this behaviour and analysing it in the field, it was possible to create an algorithm for use in an artificially intelligent animation system to elicit similar behaviour in a virtual environment.

2 Related Work

Research on seat and/or table selection of individuals and groups alike has been limited. Especially for the express purpose of using the obtained data to create algorithms for describing this selection. The studies that have been done in the field, and that we know of, have been limited to certain venues and locations, city squares for example [5], but not cafés, bars, or restaurants. We implemented the result of our research as a behaviour module in the CADIA Populus system, which is a platform for producing realistic group conversation dynamics in shared virtual environments [6]. Empirically based behaviour modules have successfully been added to CADIA Populus before, for example for public gaze behaviour [1], terretorial behaviour [7] [8], and turn taking behaviour [2]. The main influences in shaping CADIA Populus's approach to behaviour modelling is, the work of Adam Kendon and Albert Scheflen respectively; especially Kendon's definition of the F-formation system [3] [4] and Scheflen's concept of k-space [9] [10]. This was also the basis for our preliminary theories that the k-space could be a factor in individual seat selection, after the selection of a table has occurred. We speculated that individually chosen seats would be outside the k-space of other individuals nearby, and the furniture would then form an F-formation.

3 Research Methodology

A field study was conducted in two locations chosen to fit the game application: one restaurant/café and one bar/café, both located in downtown Reykjavik. The purpose was to observe seat selection behaviour in three types of entities: whole groups, individuals within groups, and individuals. Our methodology was rooted in Behaviour Analysis, which has been used by Context Analysts such as Adam Kendon and Albert Scheflen to study human behaviour. In order to not interfere with the natural setting, background information was assessed by observing the subject. This was information such as age, gender, and possible purpose in the space (for example, dining, resting, or drinking). We also speculated whether each individual (in a group or alone) displayed extrovert or introvert personality traits, such as sitting quietly in the corner or talking loudly in the center of the space. Standardized observation forms were created for both individuals and groups. To maintain the integrity of the data collected the groups/individuals were chosen in a systematic manner. Each time an observed group/individual left the location, the observer who had been observing them would choose the next group/individual to walk through the door as her next subject. Data collected for each group/individual consisted of a description of the entrance and selection of a table as well as positioning around table when first sitting down. Each session was three hours long, 52 pages of observational field notes and diagrams (see Figure 1) were collected during the whole study.

In total, sixteen groups were observed. Group size ranged from two members to five, and the most common size was two members. Observed individuals were ten. Four of the ten observed individuals were a part of a group at the time of observation.

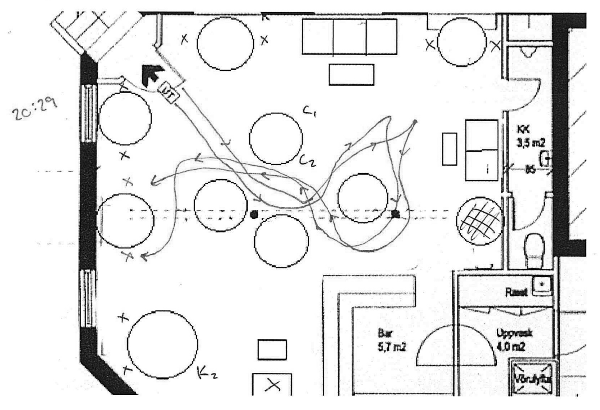

Fig. 1. A sample of observation data. Lines depict entrance path of subjects.

4 Results

Distinct and structured seat selection behaviour was observed, but groups behaved differently than individuals. The assessment of personality types also led us to notice difference in individual behaviour. For example, people who preferred to sit out of the way and others who seemed to want to be the centre of attention.

4.1 Selecting a Table

The table selection can be described in the following manner: After an individual enters the environment, he scans it with a clear goal in mind. The most valuable table, based on that goal, is found. The individual walks directly to the chosen table, thus showing his intention of sitting there and so reserves the table. In table selection for groups there is the added complication that the majority has to agree on the selected table. For these negotiations two types of behavioural patterns were observed. The former is when a dominant individual within the group takes control and selects a table. The latter is when an individual group member suggests a table to the group, this suggestion is then either approved or a different suggestion is made. This is repeated until the majority of the group approves of a table. The group's approval was found to be expressed in two ways, either by vocal consent or silent consent, for example nodding.

Both these behavioural patterns depend heavily on the elapsed amount of decision time. Decision time is the amount of time used for scanning the environment, selecting a table based on the value of the table and a possible goal. For an individual, we speculate that it is particularly important that the decision time is as short as possible, for the longer the decision time the more attention he seems to draw to himself and this seems to be undesirable. This attention can possibly be explained by the curiosity that unusual behaviour draws from others in the environment. Groups seem to have more decision time than individuals. This is likely because the number of people in the group complicates the selection of a table by an individual in the group. He has to seek approval of his selection from others in the group. However, there does seem to be a limit to the decision time of a group and the aforementioned attention focuses on them when that limit is reached.

4.2 The Value of a Table

By observing the general preference for seating we propose that the value of a table is roughly based on two general factors:

1. The location of the table in the environment. Tables located at the perimeter of the environment seem to have more value than tables located near the middle.
2. The size of the table and the number of seats.

The location of the seats around the table also matters a great deal, especially if other individuals or groups are present in the environment during entrance. The proximity to the next table/chair is also a factor and the privacy radius of the table (see Implementation) should preferably not intersect the privacy radius of another table. The value of the perimeter can possibly be linked to the individual's need for a diverse view since the perimeter, especially in many cafés and bars, has windows. We break the location-value of the table into the following factors:

1. The proximity to other tables and chairs in the environment.
2. The view: If a view through a window or over the environment is possible.
3. Weather: In regards to whether a seat inside or outside is preferable.
4. Distance to the entrance.
5. Which tables are already occupied.
6. Access to the table.
7. Presence of a friend: If a friend is present his/her table becomes more valuable, especially for individuals.

These results can be used to make virtual environments, especially ones inhabited by non-playable characters, much more realistic. If agents in the environment behave in a way that a user is accustomed to seeing in the real world, the virtual world becomes much more immersive than it otherwise would have been.

5 Implementation

To showcase our findings we chose to integrate them into the CADIA Populus social simulation engine. As mentioned above, different personalities seem to prefer different placements in the environment. Since this directly influences their seat selection, we decided to utilize this in the implementation. Each table is represented by a feature vector:

$$T = (Pe, Pr, Di, Ba)$$

Where Pe is the proximity to the perimeter of the environment, Pr is the degree of privacy, Di is the relative distance to the exit, and Ba is whether this is a bar table. The privacy feature of a table is based on the environment it is placed in. The tables farthest from the entrance and most out of the way are given the highest privacy rating. Tables are given lower ratings the farther we get from those most-private tables. The tables closest to the entrances and those likely to attract attention (e.g. the bar) are given the lowest privacy rating in the environment. We kept a couple of additional table features outside the feature vector because they represent simple facts that can be dealt with separately, whether the table is un-occupied (U) and the number of seats at the table (S). Each person's affinity for a table depends on that person's personality traits. We represent a person's personality with a personality vector:

$$P = (P_{priv}, P_{self}, P_{bar})$$

Where P_{priv} represents the person's need for privacy, P_{self} represents the person's level of selfconsciousness and P_{bar} represents the person's affinity for sitting at the bar. We made a specially tuned affinity vector that indicates how important each of the table features is for that personality trait. These affinity vectors were chosen to be: $A_{priv} = (0.9, 1.0, 0.8, 0.0)$, $A_{self} = (0.6, 0.6, 1.0, 0.0)$, $A_{bar} = (0.0, 0.0, 0.0, 1.0)$. With these vectors we can now determine a person's affinity (F_T) for a certain table:

$$F_T = \frac{(P_{priv} * \frac{A_{priv} * T}{N_{feat}}, P_{self} * \frac{A_{self} * T}{N_{feat}}, P_{bar} * \frac{A_{bar} * T}{N_{feat}})}{N_{trait}} \tag{1}$$

Here the constants N_{feat} and N_{trait} represent the number of features and number of traits. They are introduced to normalize all results to the range [0.0, 1.0]. As an example, let's pick a person with a selfconscious personality (we created profiles for several stereotypes), P = [0.5, 0.9, 0.1] and a table T = [0.5, 0.8, 0.0]. The person's affinity for this table will then be 0.16.

F_T is further modified by table size and occupancy. Table size smaller than group size multiplies it by 0.0, equal multiplies by 1.0 and larger by 0.5 (we found that groups are less likely to choose tables that have more seats than group members). Occupancy multiplies it by 0.0 if occupied, 1.0 otherwise. After calculating values for all tables in an establishment, an agent simply picks the highest ranking table.

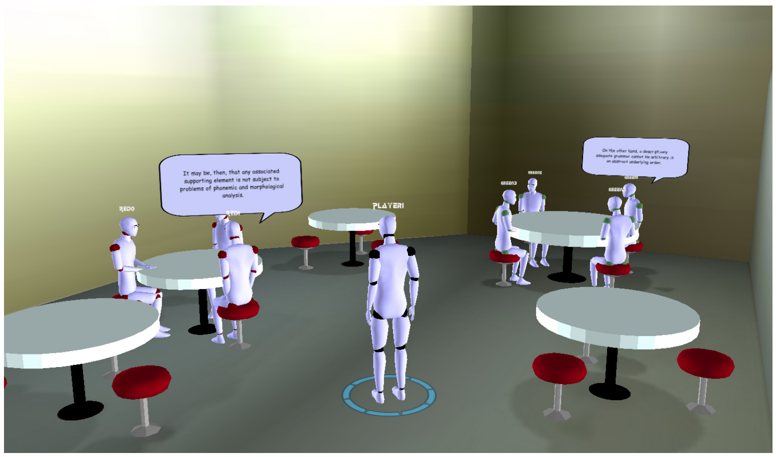

Fig. 2. A screenshot from CADIA Populus.

6 Conclusion and Future Work

This paper has discussed a field study of seating behaviour in public places. Some observations were described and an efficient seat selection algorithm was shown. The algorithm has been integrated into the behavioural module collection for CADIA Poplulus, so this behaviour is now available to any game using that engine.

We still need to assess the impact of our algorithm on the user experience, so we plan to conduct a user study where we ask people to compare the behaviour to random seat selection.

We believe that the addition of our new behaviour has made the agents in CADIA Populus more realistic, especially when combined with the existing behaviours. However the current implementation only supports one designated group leader, who always chooses a table without seeking the approval of other group members. We propose that improving this in a future version will further improve the results.

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