

We had originally hypothesized that passengers' choice of seating reflects their perception of the length of their trip—the longer the trip, the greater the need to create a personal private space on the bus. Through our experiment, we found our hypothesis confirmed by the overwhelming preference for passengers to take the window seats. By taking the window seat, a passenger was ensured that he or she would only have to come in contact with one other person—his or her seatmate. The window seat is an obviously more private option than the aisle or sideways facing seats where one sitting in such a seat would be sandwiched between two other people.

Moreover, we discovered that the longer passengers perceived their trips to be, the farther to the back they sat. Those taking the bus for a short period clustered near the front because of easy access to the exit. This is most evident when passengers from Oakland going to Squirrel Hill stood near the front, even though there were seats available further back in the bus. On the other hand, people on longer trips sat near the back even though there was no practical reason to do so because the access to the exit is more remote. It was interesting to see how the more permanent one perceived his or her stay in a place, the greater the need to make the place a private and personal one.

Still, we noticed that on the long articulated buses, the benefit of a private space in the back was counteracted by the effort needed to reach the back (see perspective sketches of buses to get a sense of the spatial difference between the long and regular buses). In the long buses, just the front half was almost the length of the entire regular-length 50XX/51XX series buses. After realizing that length of bus also played an important factor in seating pattern, we updated our hypothesis to say that sitting on a window seat offered enough privacy for passengers, so that sitting in the back of the longer buses was not worth the extra effort required.

We suggest that on the articulated 3000 series buses, the seats in the front should increase the number of sideways aisle-facing seats and non-paired seats in the front half of the bus. This will create more freedom of movement for those passengers who are on short trips and will also encourage those with longer trips to sit in the back of the bus where the seats are still paired and front-facing. On the 50XX/51XX series buses, we suggest similarly to the articulated buses, the front-half seats be sideways aisle-facing and non-paired. This should prevent the paradox of an artificially filled bus with standees in the front and vacant seats in the back.

Controlling the Experiment

Primarily, because so many different bus types* serve Pittsburgh, we decided to isolate the type to Neoplan. There are two Neoplan bus types, the forty-foot low-floor (50XX and 51XX Series) with a platformed rear, and the sixty-foot articulated bus (3051 to 3075) that bends in the middle. The lighting and upholstery are the same in both Neoplan bus types are consistent, and data collection is facilitated by a distinct boundary, because both are divided in half allowing two data collectors to divide the work.

Secondarily, we chose the 61C route to prevent variation in boarding, exiting, and demographic patterns. This route allowed us to document consistently from Downtown to Squirrel Hill (outbound). And, by controlling the documenting time to early evening, we were able to a degree control demographic, boarding, and exiting patterns.

Collecting the Data

Using the philosophy of divide and conquer, Mike documented the front half of the bus while Morgan took the back. Data collection was fairly easy because each of the buses already have distinct halves. Knowing which buses we were to take ahead of time, we prepared paper plans of the buses before boarding them, so that we could write directly on them each time the bus “changed states.”

On Monday February 2, we boarded the 6:53 bus at Forbes and Grant at the courthouse. Since this was our first trip, collected flow, but only minimal demographic and activity level of passengers. Another problem with this trip was the “stacking” effect in which our bus was the leader through Oakland, which resulted in overloading. We exited at Murray and Phillips in Squirrel Hill, when we ran out of bus plan sheets.

On Wednesday February 4, we boarded the 7:29 bus at the same stop. This time in addition to traffic flow, we documented demographics by age and gender. The bus was reasonably loaded. We exited at Ann St. at Eighth Ave. in Homestead (The end of the line).

On Thursday February 5, we boarded the articulated bus at 5:00 at the Courthouse. We documented this bus in the same manner as the previous trip. We exited at Forbes and Murray when ran out of sheets.

Observations

In general, the passengers choose window seats when they are available. Some passengers decide to take an aisle seat even when the window seat is empty. This is more prevalent when the bus is not too crowded. The low-floor bus keeps

a relative equilibrium with only a small front bias while there is a moderate load. When the bus is nearly empty, or overcrowded, the front bias is stronger; such so that there are three empty seats when there are about 25 standees, 18 of whom are in the front. In the articulated bus, passengers continuously prefer the front, but the bus still has a relative equilibrium when it becomes moderately loaded. With twelve open seats, six passengers decide to stand in the front half instead of sitting in the back, where the majority of the empty seats are. While there seemed to be a minor trend for people with similar demographics to sit near one another. Generally, the males (blue dots) seem to form clusters as well as the female (red dots). Another interesting example is when Morgan noticed an Asian Man standing even though there were a couple open seats near him. The man remained standing until another seat was open, a seat that was next to another Asian female.

6:53 Low-Floor Bus (Monday, February 2)

This bus experienced overcrowding because of the “Stacking Effect” that Pittsburgh bus schedules have, referring to a cluster of about three or four buses that leave within a couple minutes after a ten to fifteen minute gap without buses. Since this bus was the “leader” of that cluster, the bus became full at Forbes and Bouquet and could not board any passengers until Forbes and Murray in Squirrel Hill. Compounding matters, both wheel chair slots were used, therefore taking up six more seats that the bus would normally have. However, there were three empty seats in the rear and room for three people to stand, also in the rear. The standees quickly alighted in Squirrel Hill and cleared out before we left at Murray and Phillips, all of whom boarded near University of Pittsburgh in Oakland.

7:29 Low-Floor Bus (Wednesday, February 4)

Since this bus was in the rear of a stack in Downtown, only three people boarded and continued past Downtown. After heading to the front of the stack, the bus quickly received passengers in Oakland, but the maximum amount standing was six at Forbes and Margaret Morrison, but that happened while ten empty seats were available evenly spaced throughout the bus. Moments before at Hamburg Hall, only two people stood with six open seats. Five of the six standees were student aged passengers taking a short trip between Carnegie Mellon and Squirrel Hill. As the bus slowly emptied throughout the lower portion of Squirrel Hill and Greenfield, all but one remained in their seats and most of them were already at the window.

5:00 Articulated Bus (Thursday, February 5)

The Articulated bus had a unique seating pattern. While on its loop through Downtown, the nearly all passengers sat down along the window seats in the front. Only four out of 16 adults chose to sit in the aisle, two of which went to the

rear at Fifth and Ross. The front bias is still evident at the Carnegie Music Hall in Oakland when 22 out of 35 passengers sat in front of the pivoting portion of the bus while one sat in the pivot. At Carnegie Mellon, the bus becomes close to balanced with 27 in the front, 4 on the pivot, and 21 in the rear. Six people stood as twelve empty seats were available. All six standees boarded near Carnegie Mellon and left before the completion of the study at Forbes and Murray. As people exited in Squirrel Hill, the bus remained in equilibrium. Also, similar age groups and genders tended to sit in close proximity; however that often is a result of the people knowing each other, as evidenced by conversation.

Our interference as observers

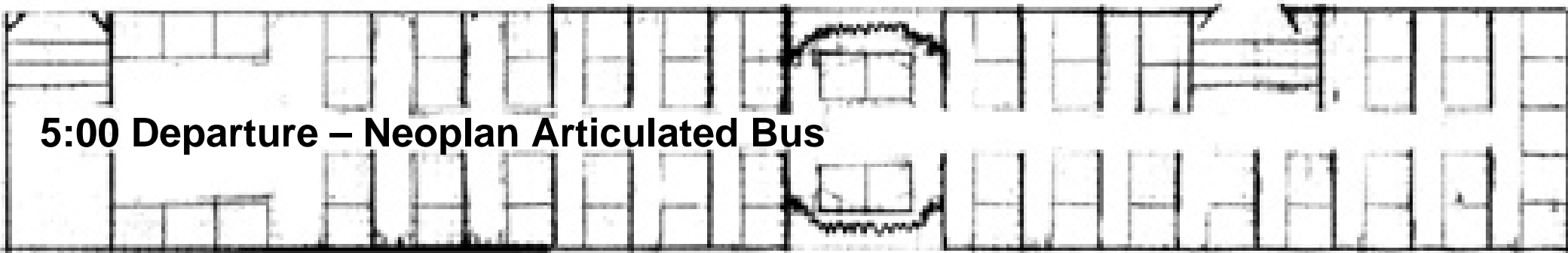
When taking the first trip on the Monday trip, Morgan was taking pictures of the bus to supplement our data collection. Two teenagers who sat next to Morgan noticed the digital camera. One asked what Morgan was doing with the camera, and asked if Morgan could give it to him. While the teenagers may have been less affected by the fact that Morgan was taking notes about their behavior than they were by the expensive-looking camera, we nevertheless have to take into consideration that Morgan's visible documentation could have affected the passengers' behavior. After this incident, Morgan stopped using the camera to become less conspicuous.

On that same trip, Randahl, a second year architecture student, noticed Morgan in the rear of the bus, and obviously had the look of confusion, because Morgan usually would not be on the bus on a weekday. However, he probably did not suspect anything until he saw Mike taking notes. Randahl asked what was going on, and Mike told him about the project. Since Randahl was one of the many standees going to Squirrel Hill, others may have overheard the conversation and knew that they were being observed.

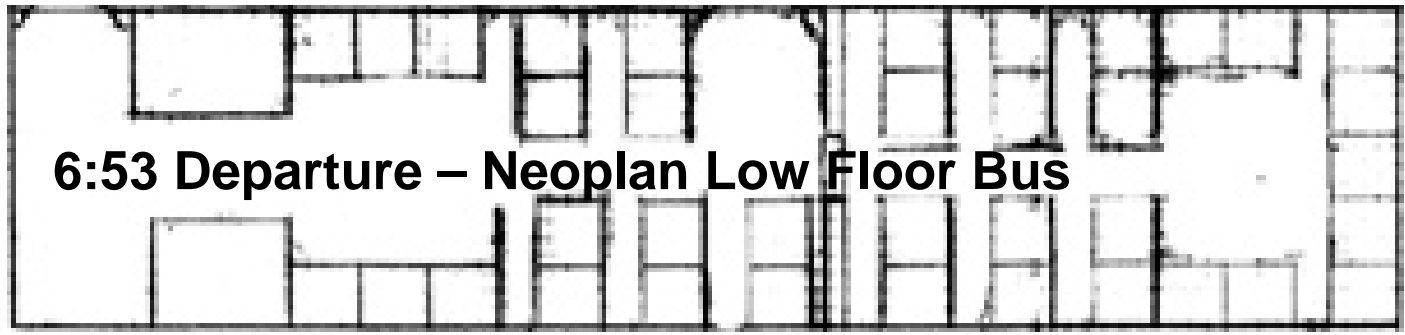
NOTE:

We had compiled our bus seating pattern diagrams into a Microsoft PowerPoint file to facilitate our understanding of passenger flow patterns. This file can be accessed in the enclosed zip disk, in the BusProject folder. The name of the file is BusPres.ppt. We have already printed out the slides of the PowerPoint presentation four-up printing.

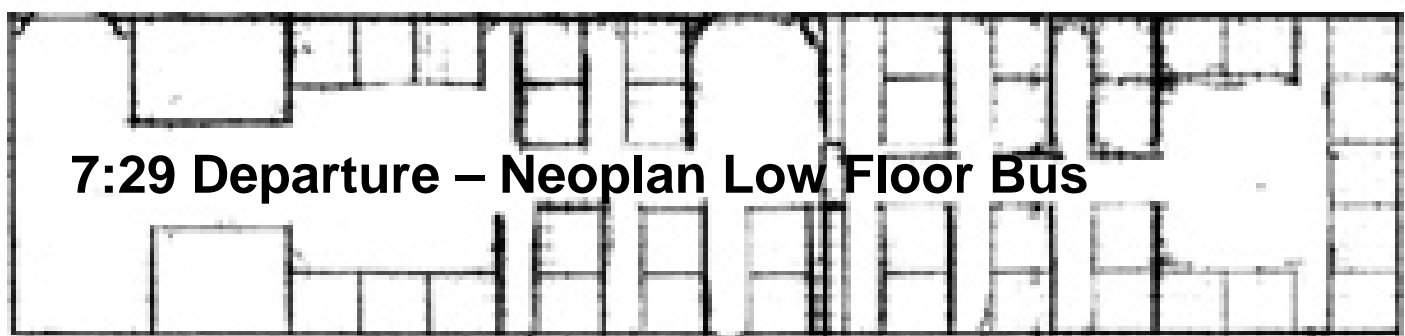
PowerPoint Version of Notes



5:00 Departure – Neoplan Articulated Bus

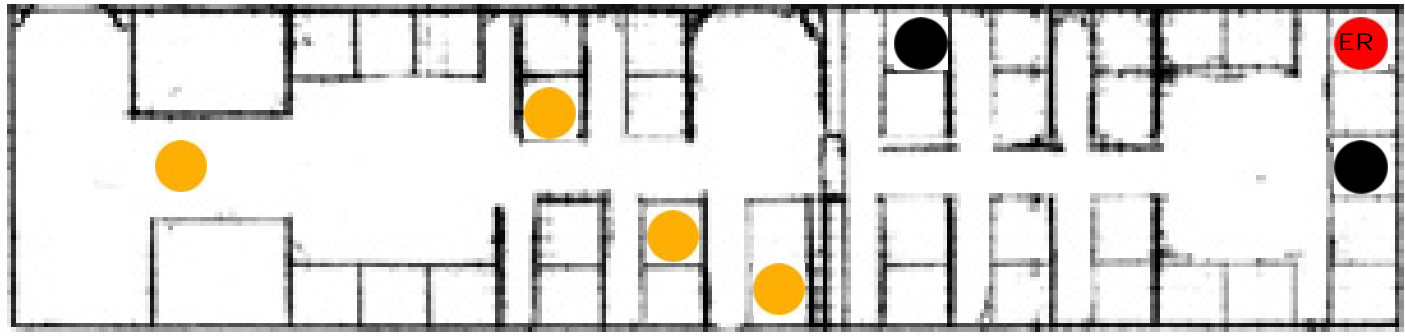
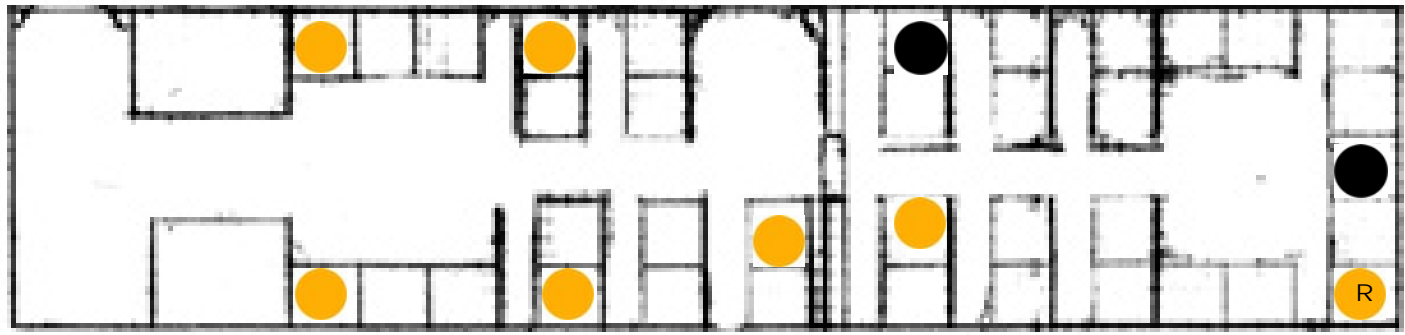
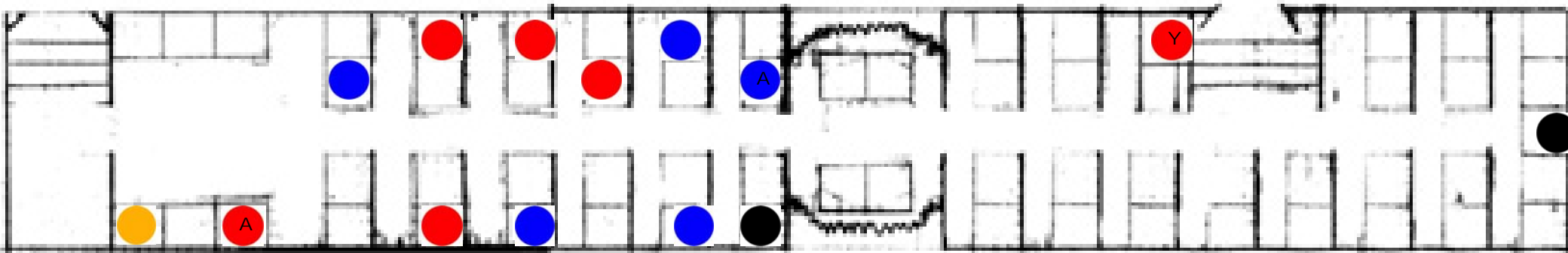


6:53 Departure – Neoplan Low Floor Bus



7:29 Departure – Neoplan Low Floor Bus

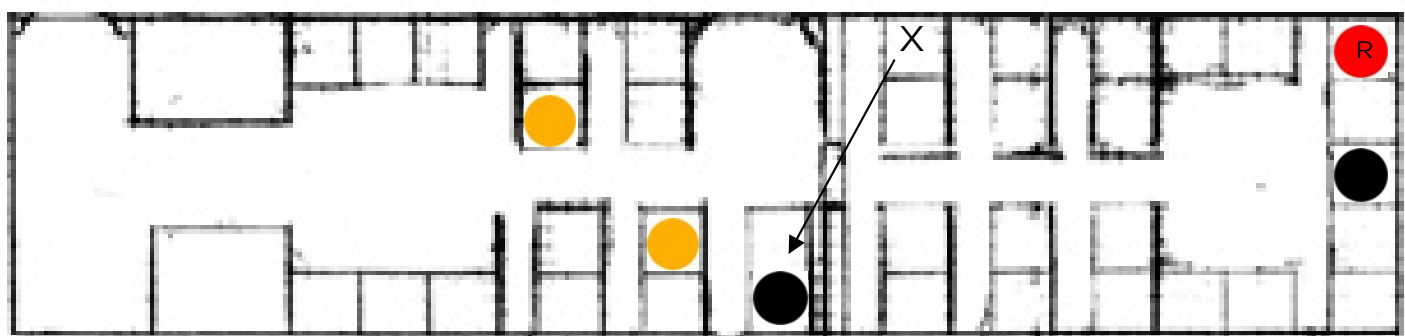
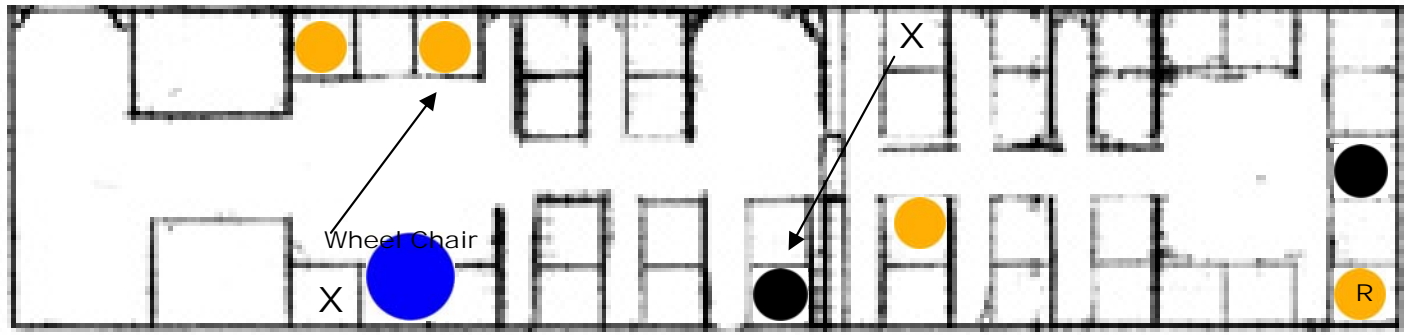
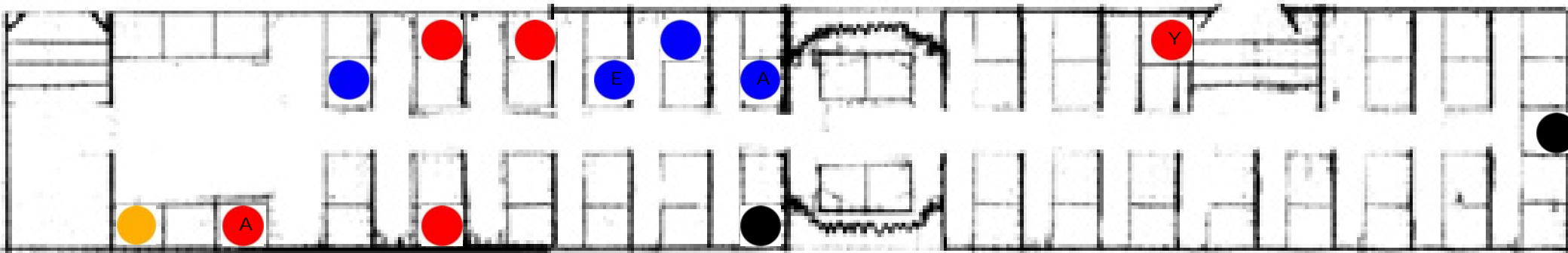
Forbes & Grant



- Our locations
 - Male
 - Female
 - H Listening to headphones
 - T Talking to adjacent person
 - R Reading
 - Z Sleeping
 - P Talking on Cell Phone
 - Undocumented gender
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| Y | Young (18-29) |
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Age groups are estimated

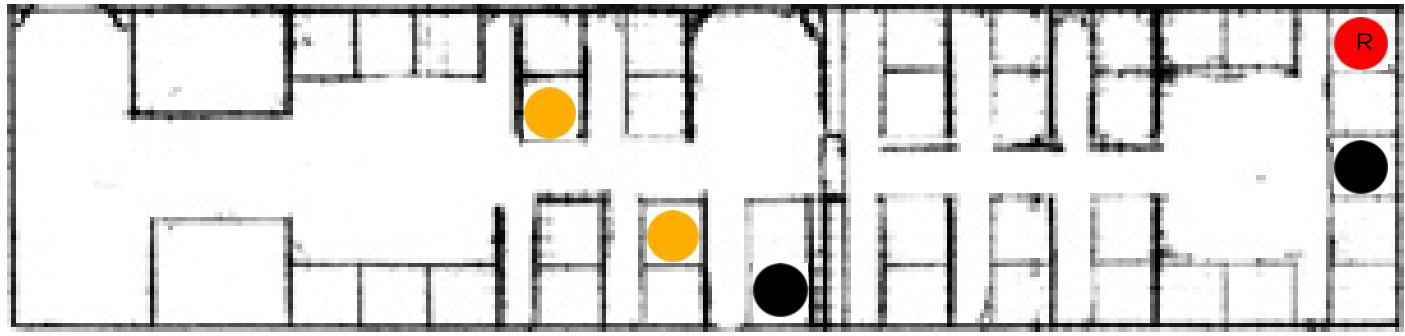
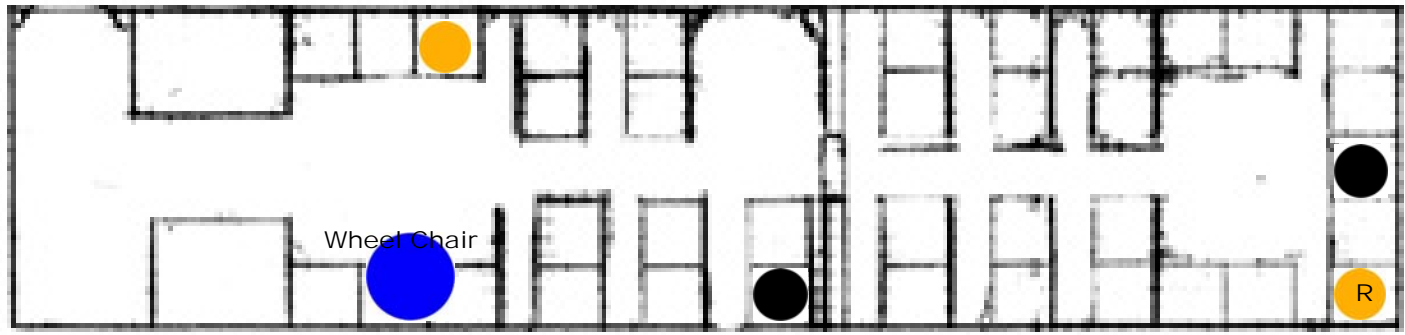
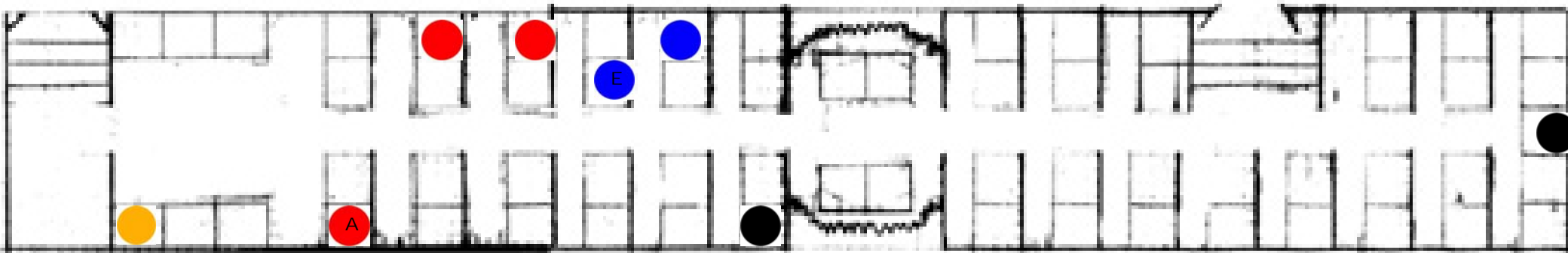
Forbes & Smithfield



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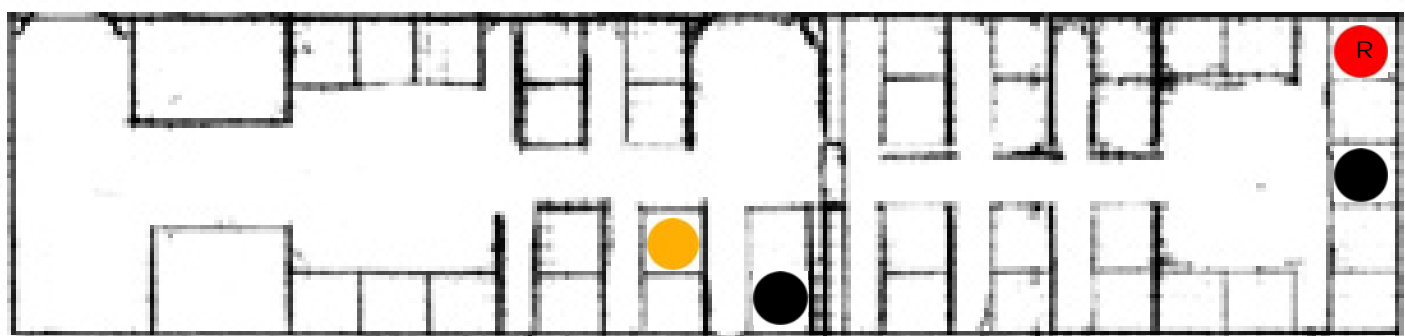
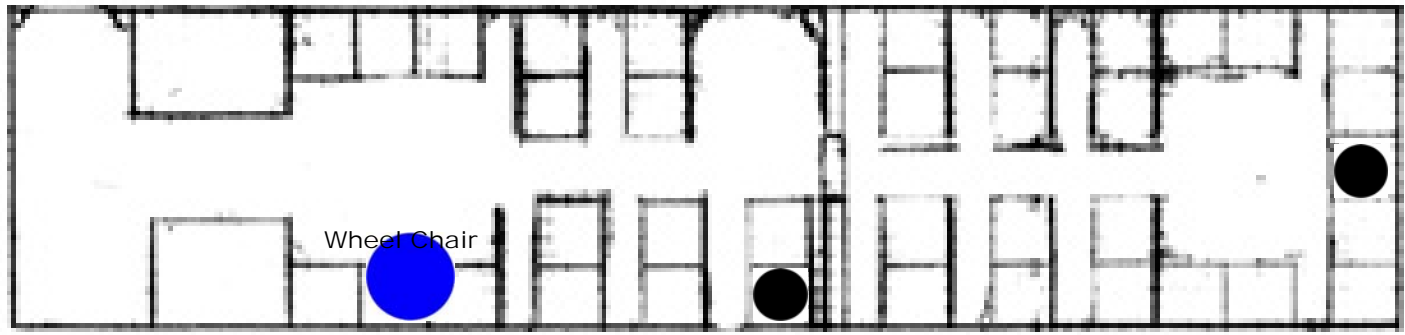
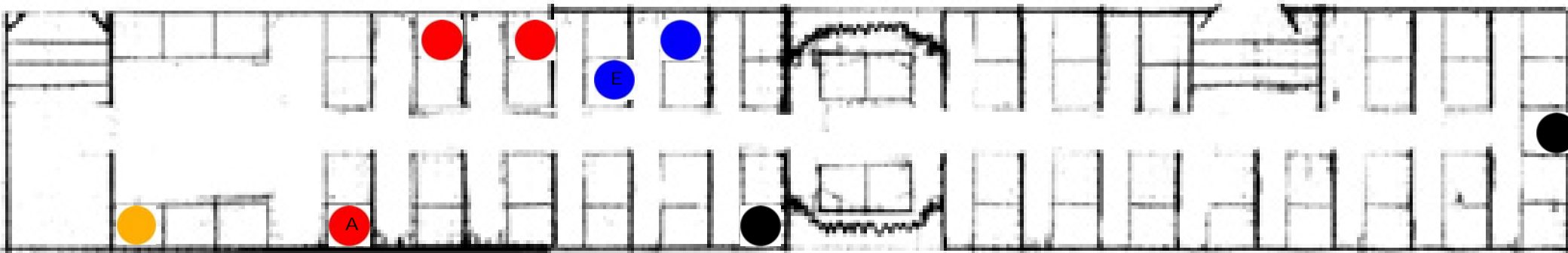
Forbes & Wood



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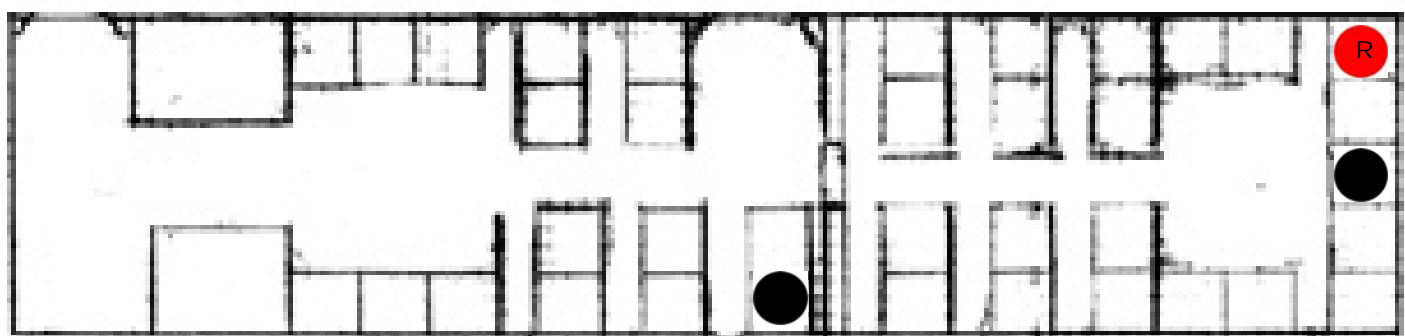
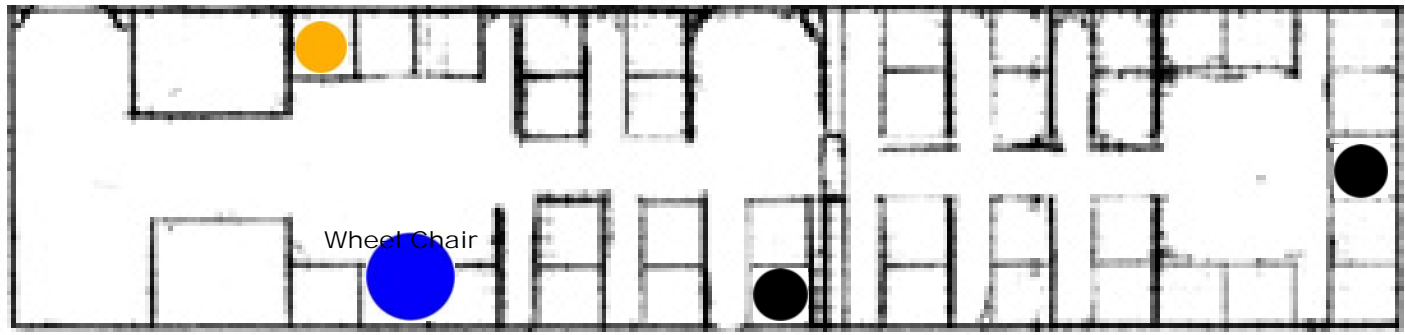
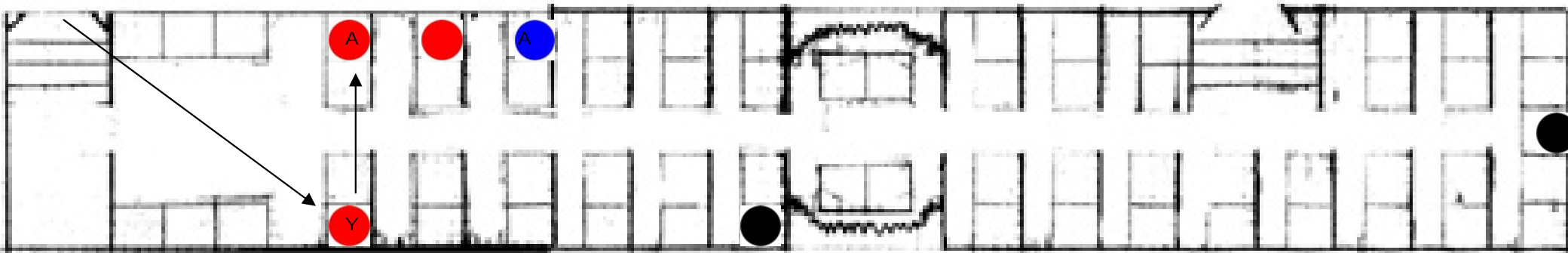
Forbes & Market



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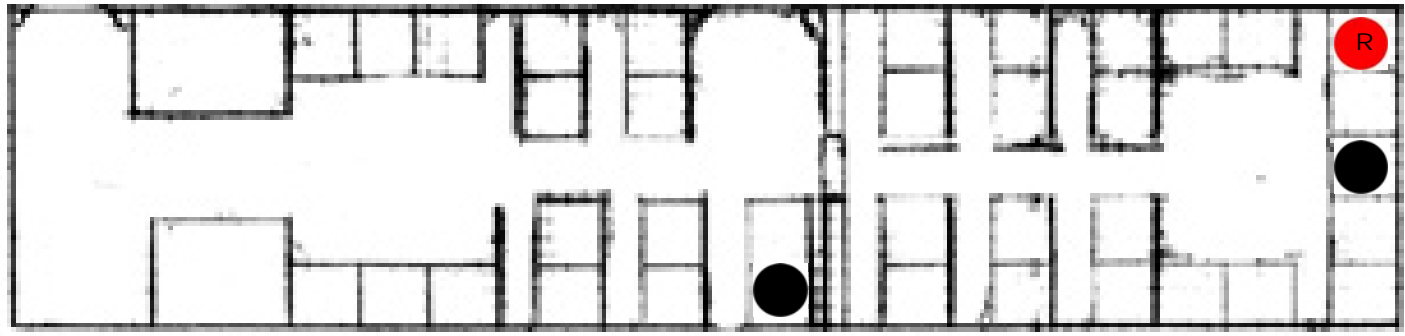
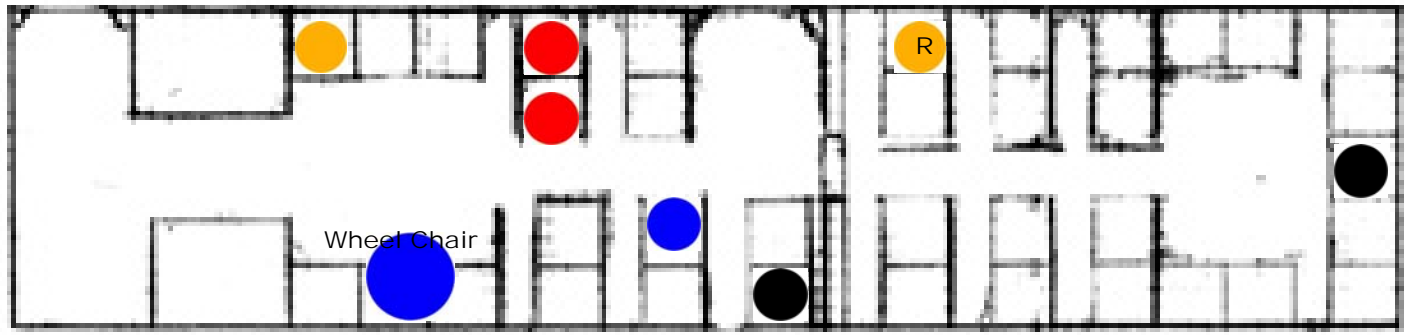
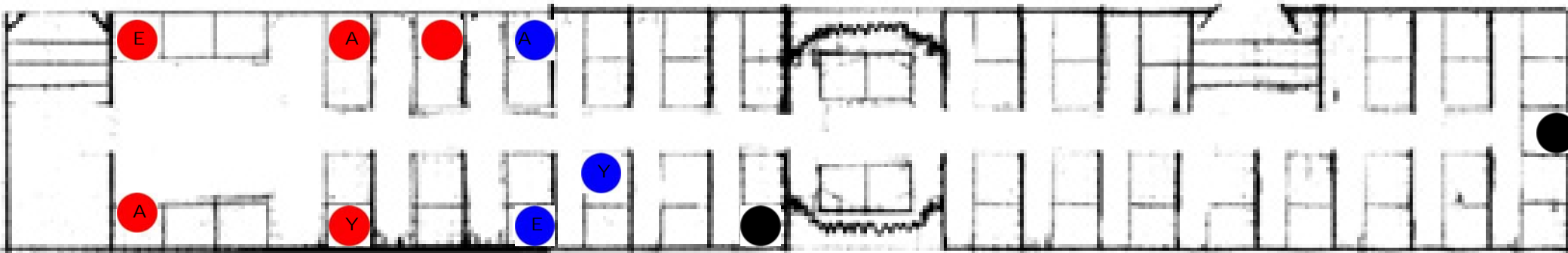
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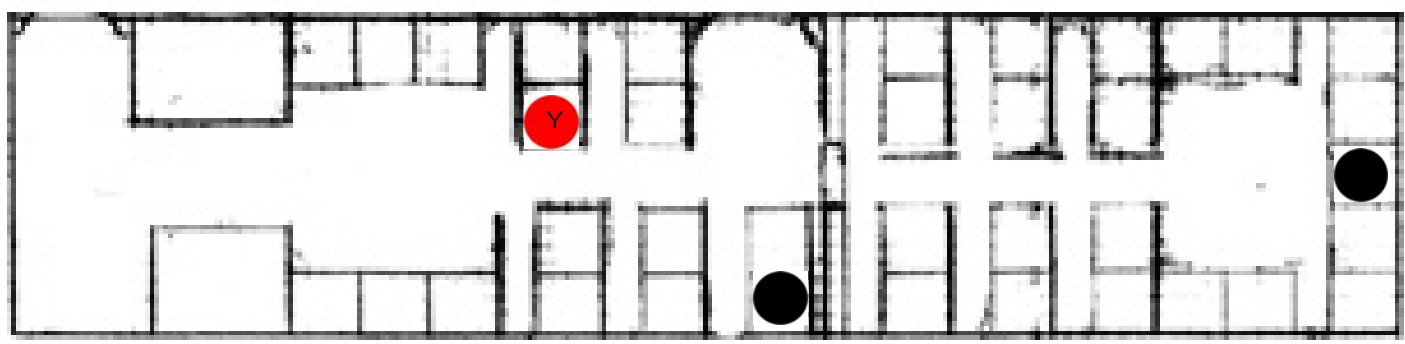
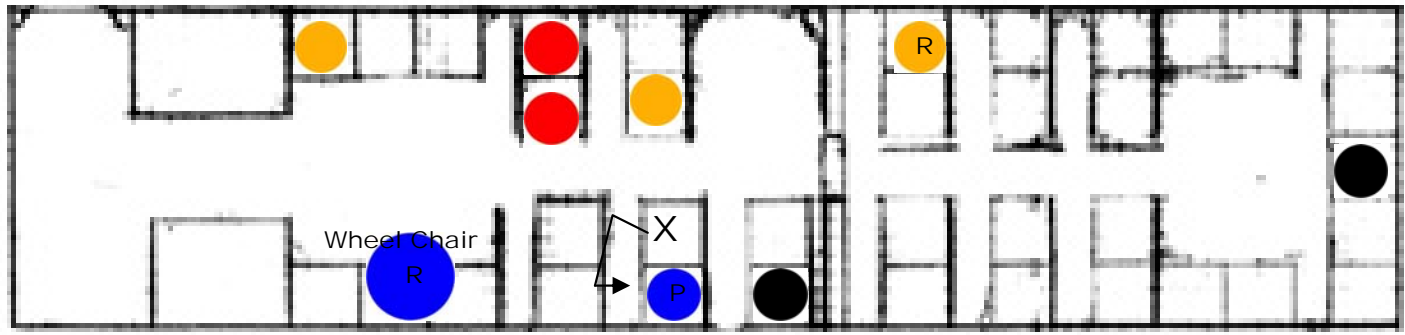
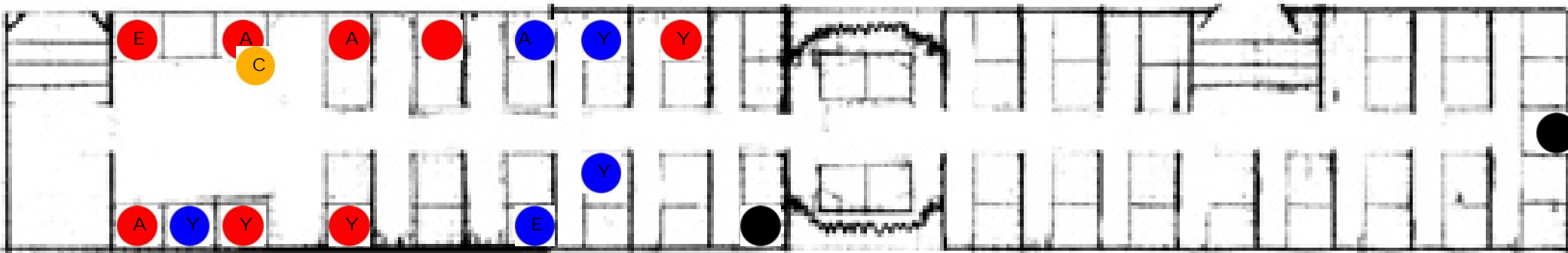
Fifth & Market



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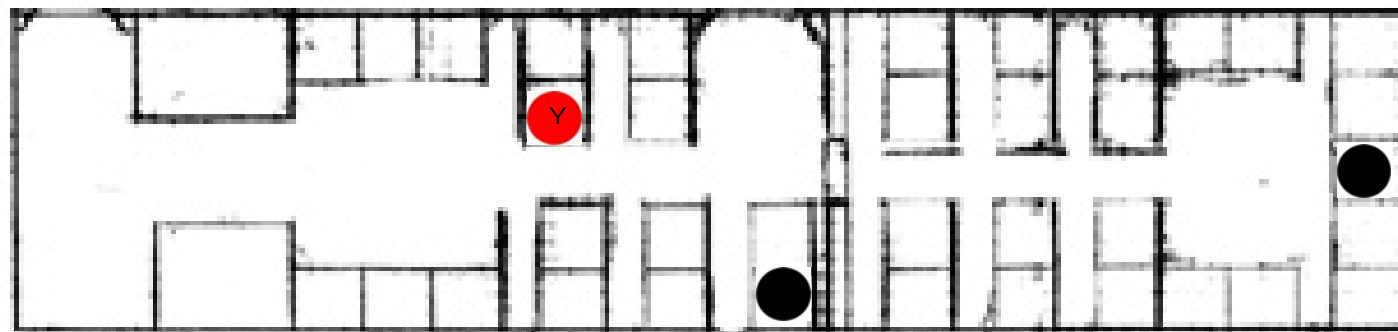
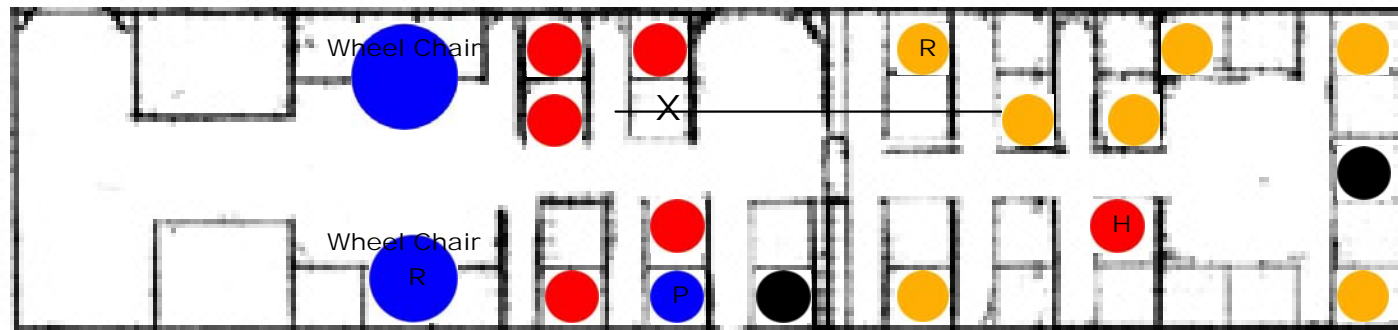
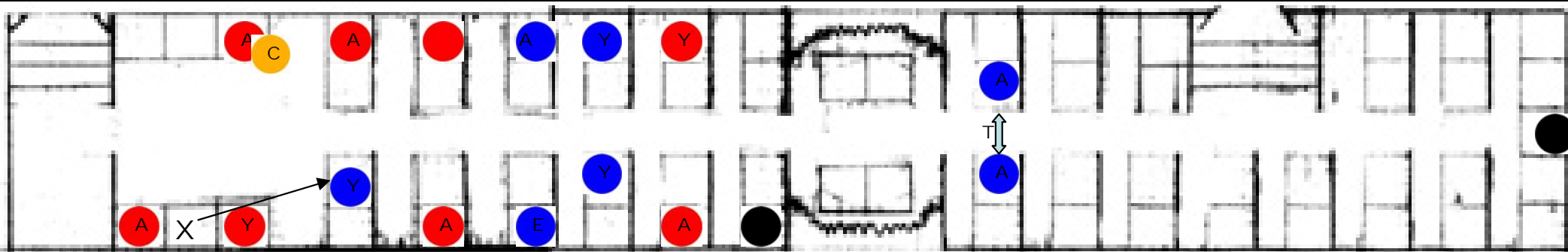
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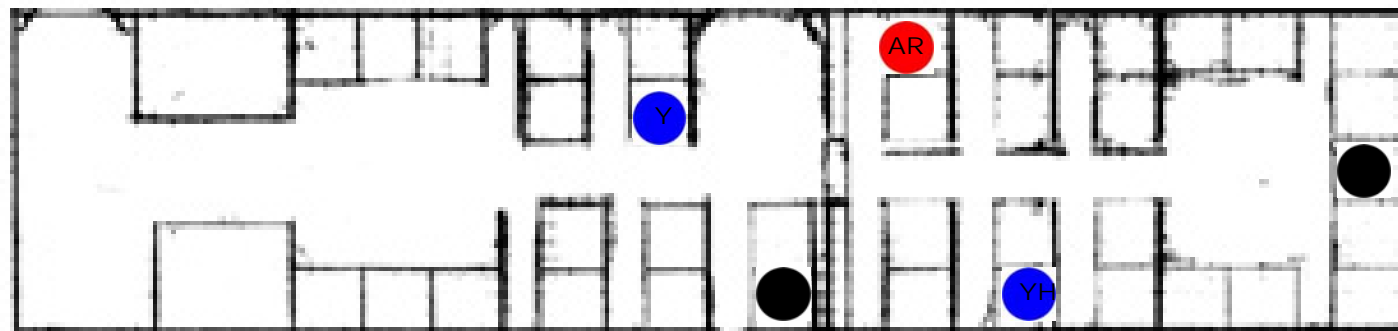
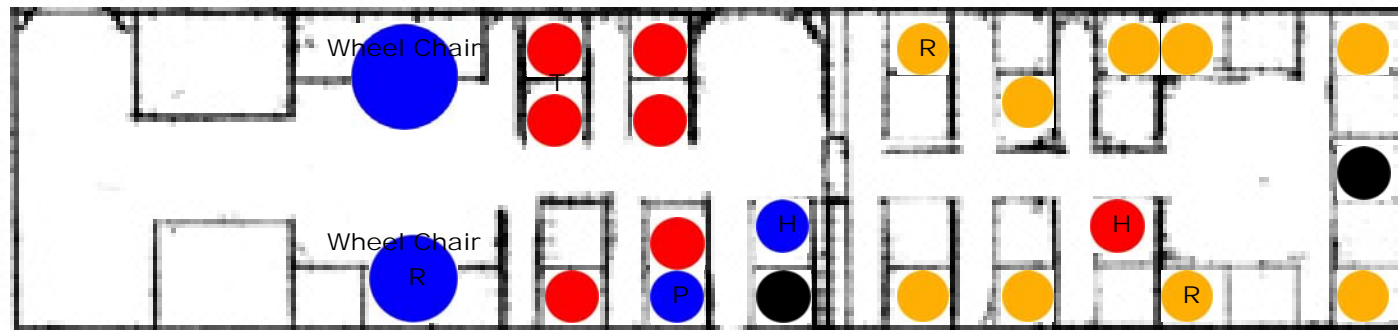
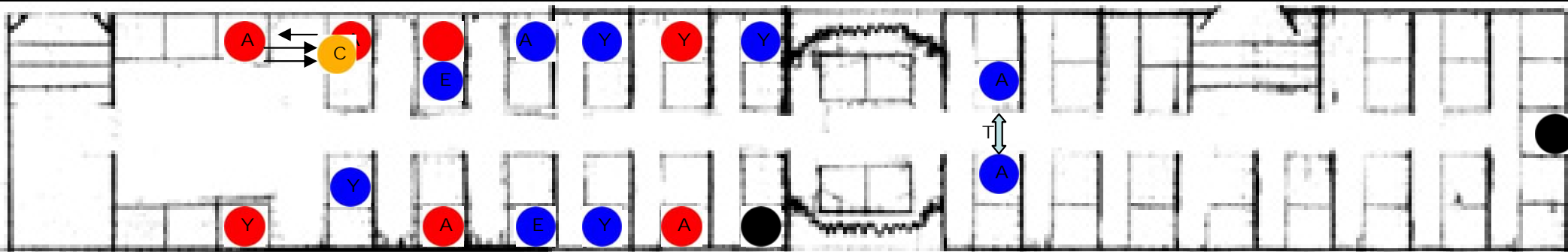
Fifth & Smithfield












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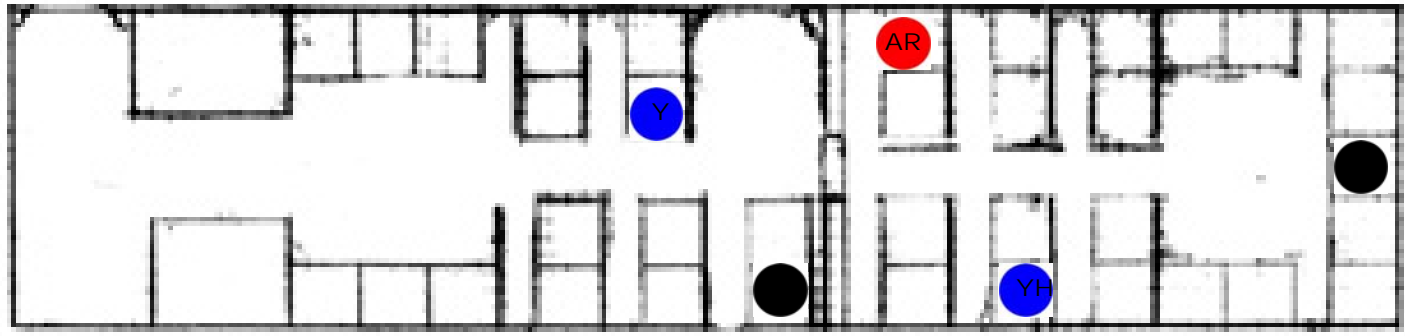
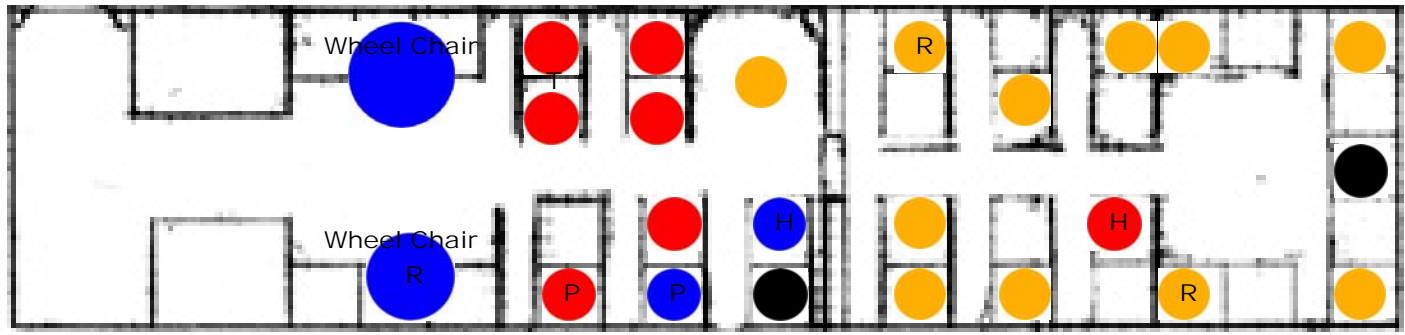
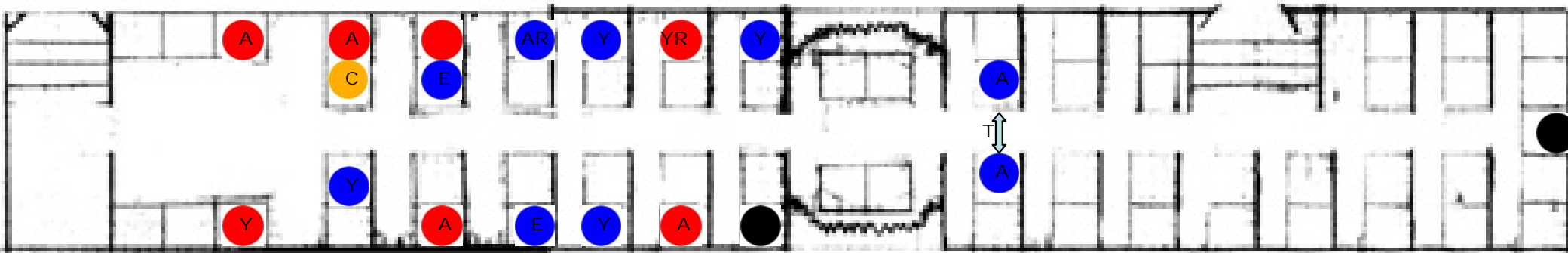
Fifth & Ross



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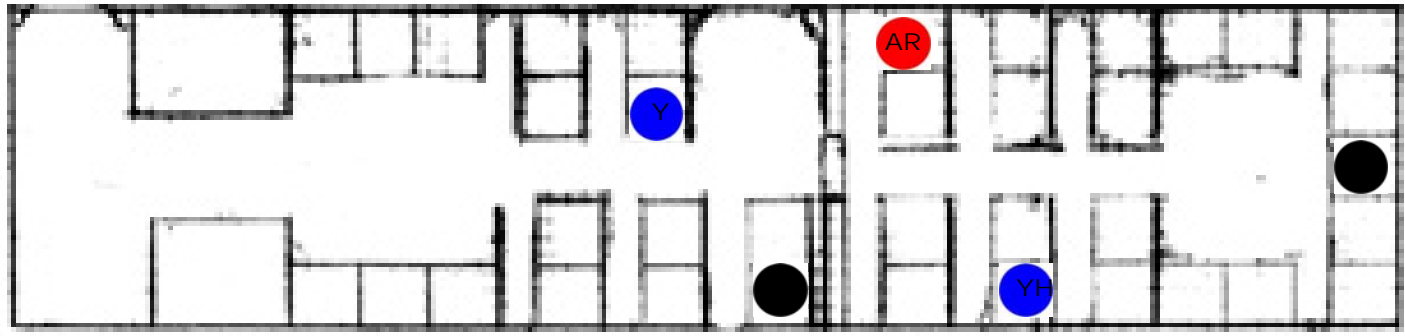
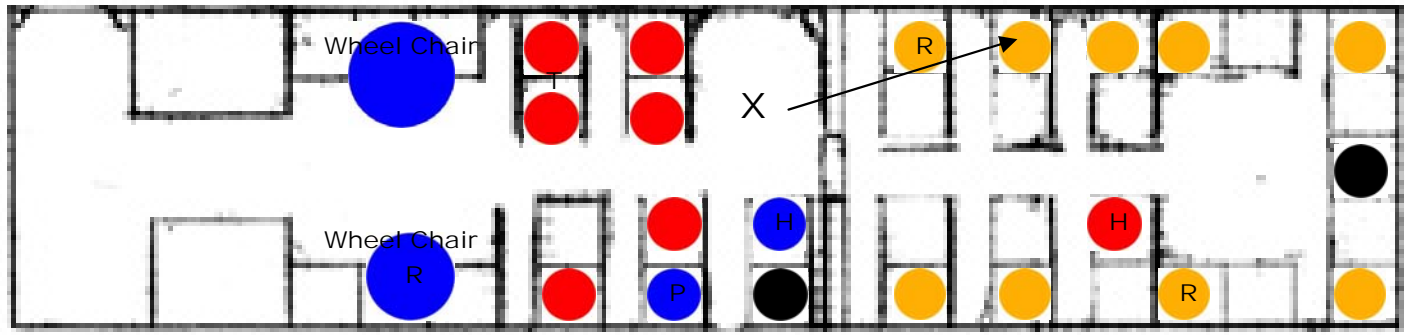
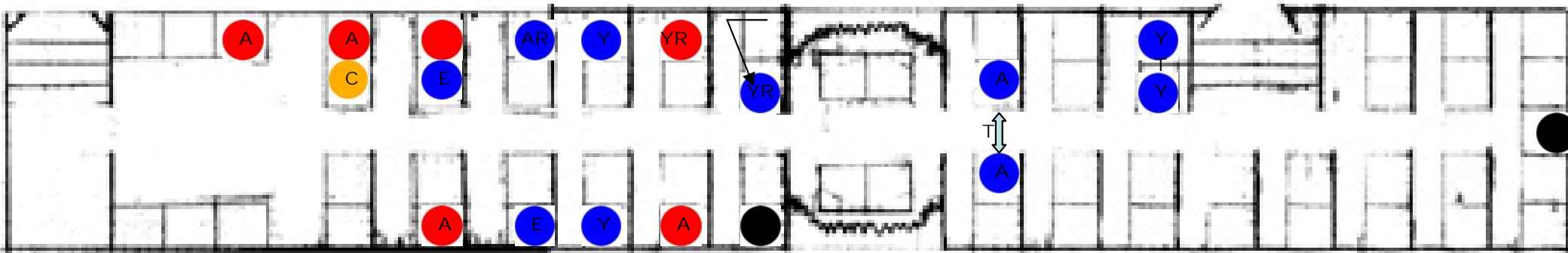
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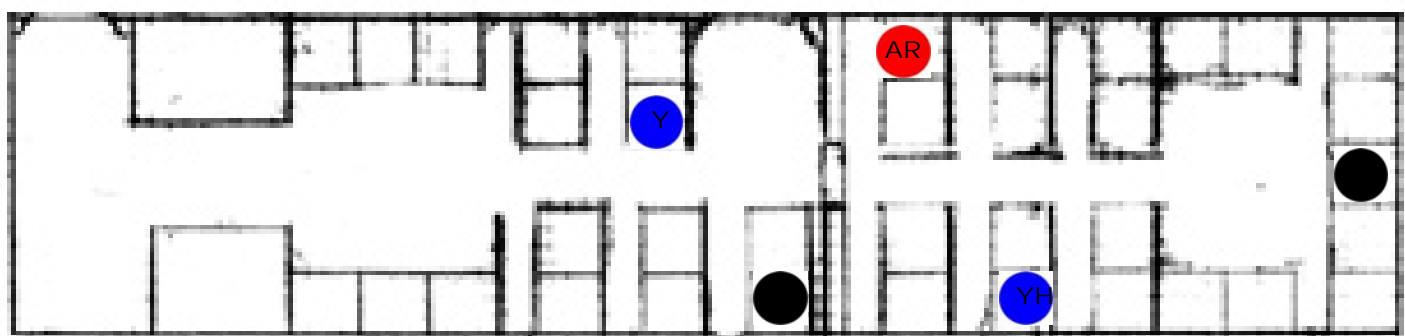
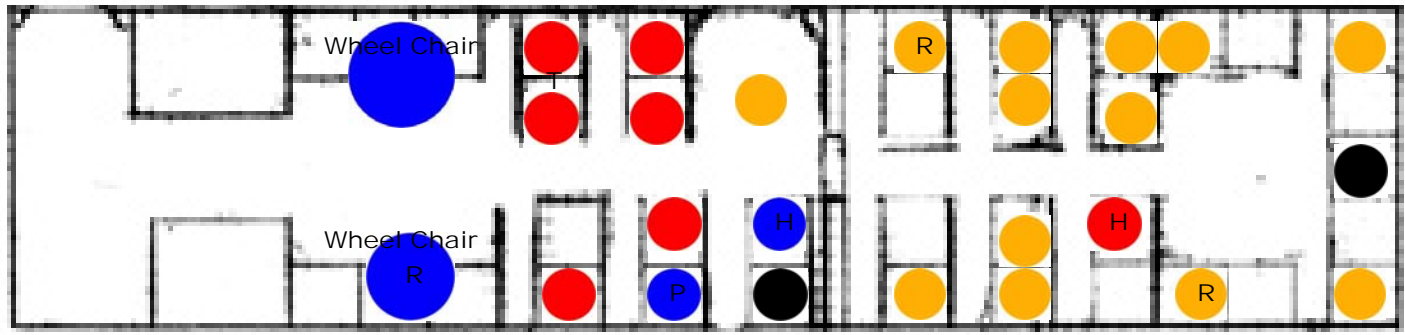
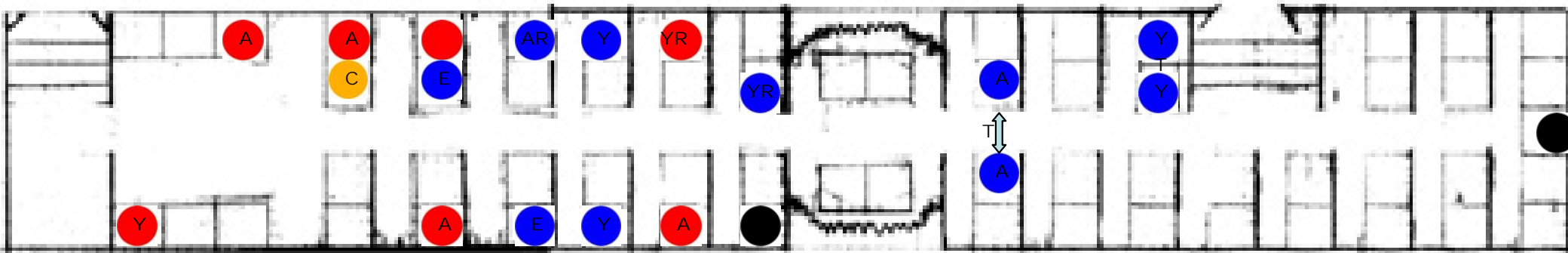
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







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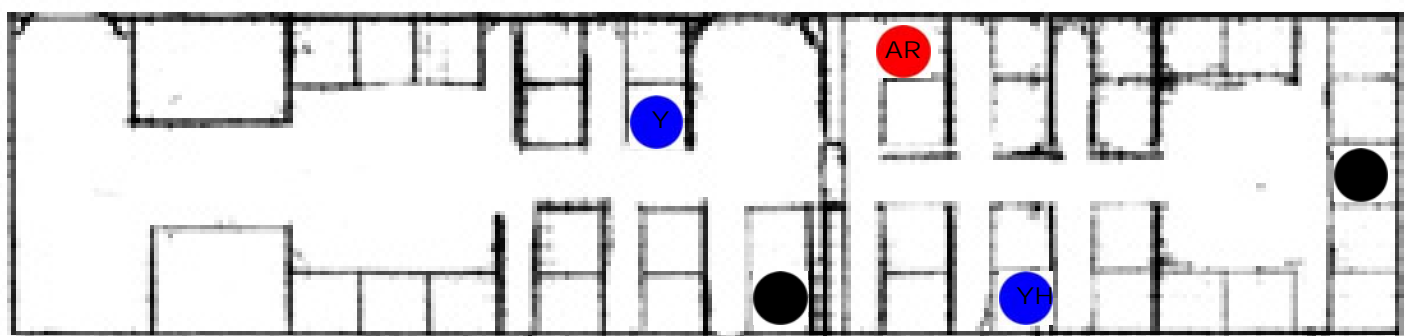
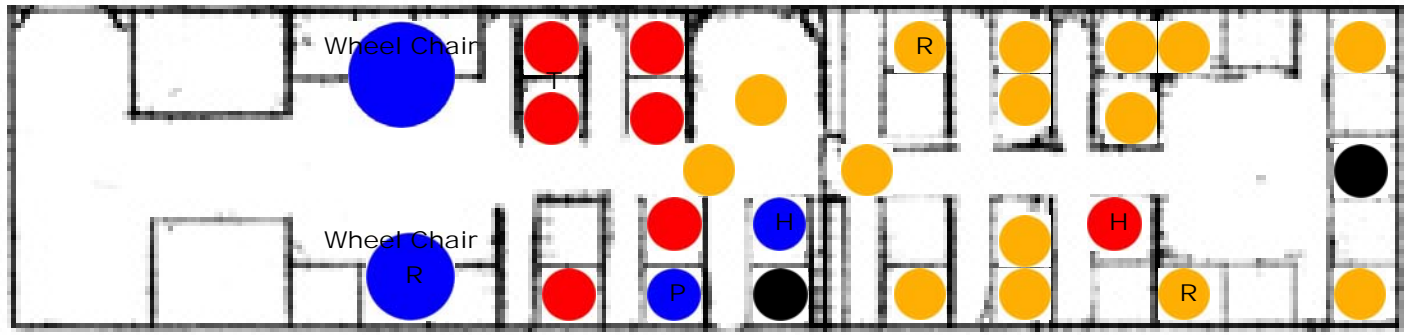
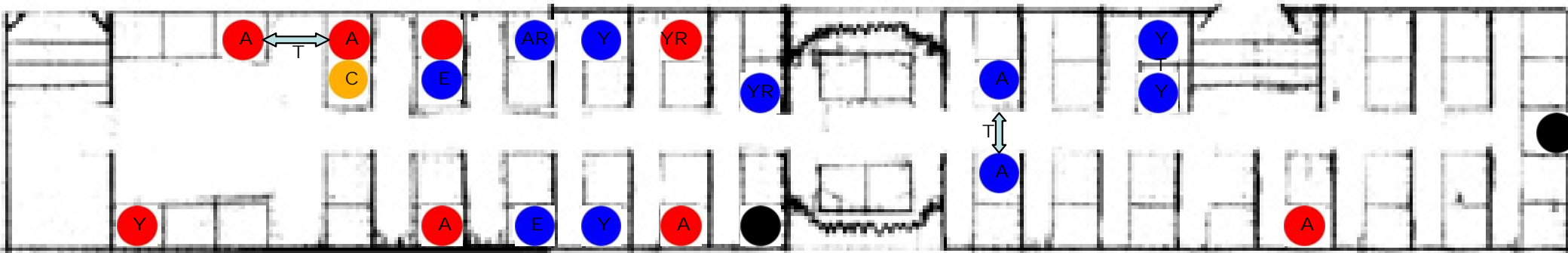
Forbes & Craft



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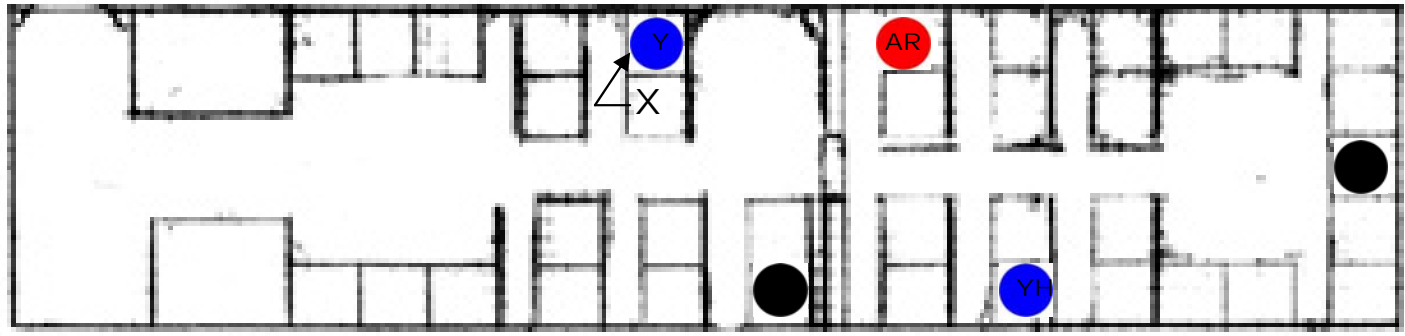
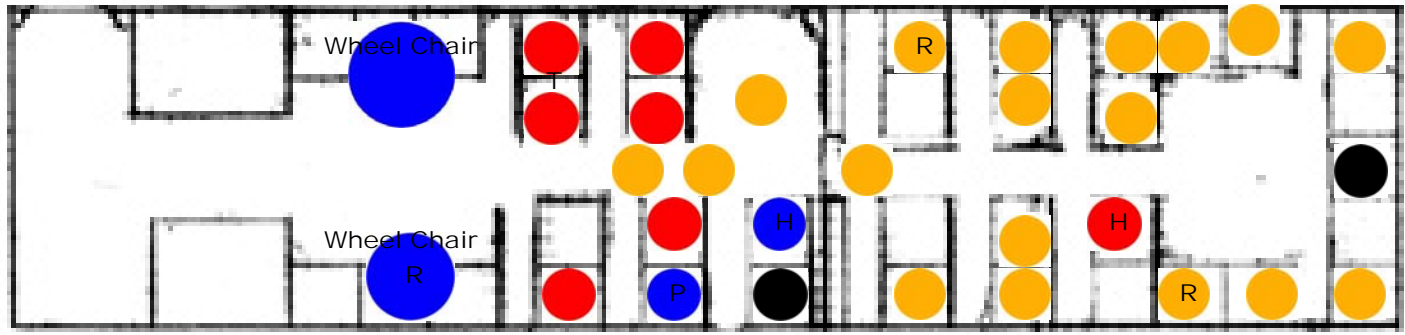
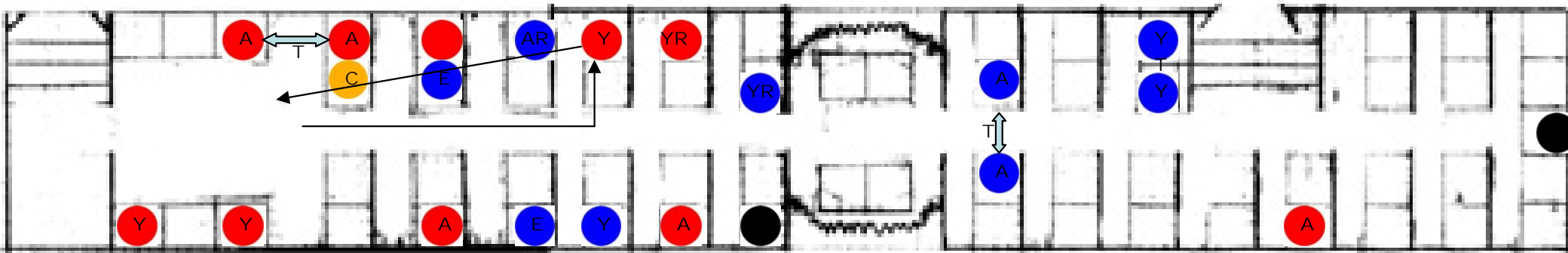
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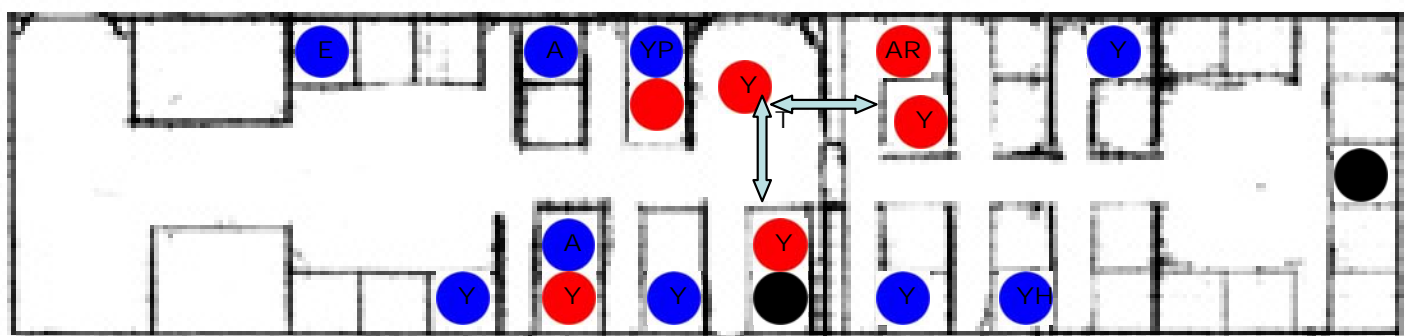
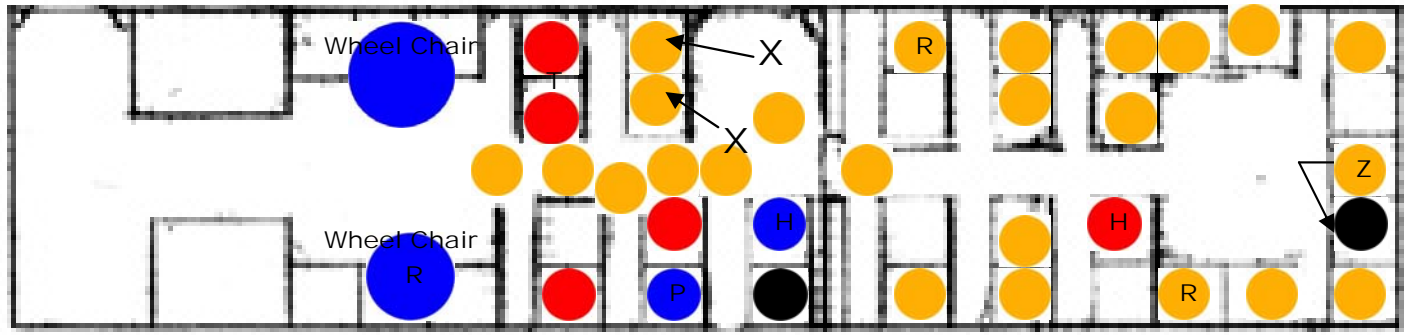
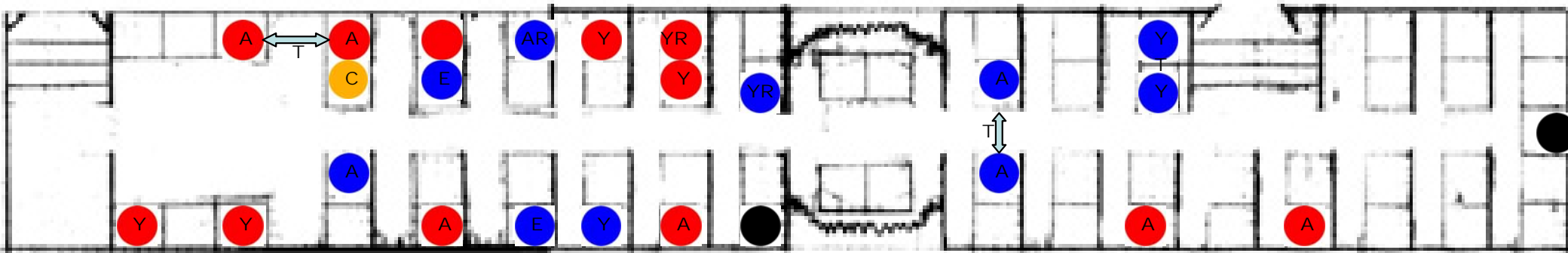
Forbes & McKee



- Our locations
 - Male
 - Female
 - H Listening to headphones
 - T Talking to adjacent person
 - R Reading
 - Z Sleeping
 - P Talking on Cell Phone
 - Undocumented gender
- | | |
|---|------------------|
| C | Child (Under 18) |
| Y | Young (18-29) |
| A | Adult (30-54) |
| E | "Senior" (55+) |

Age groups are estimated

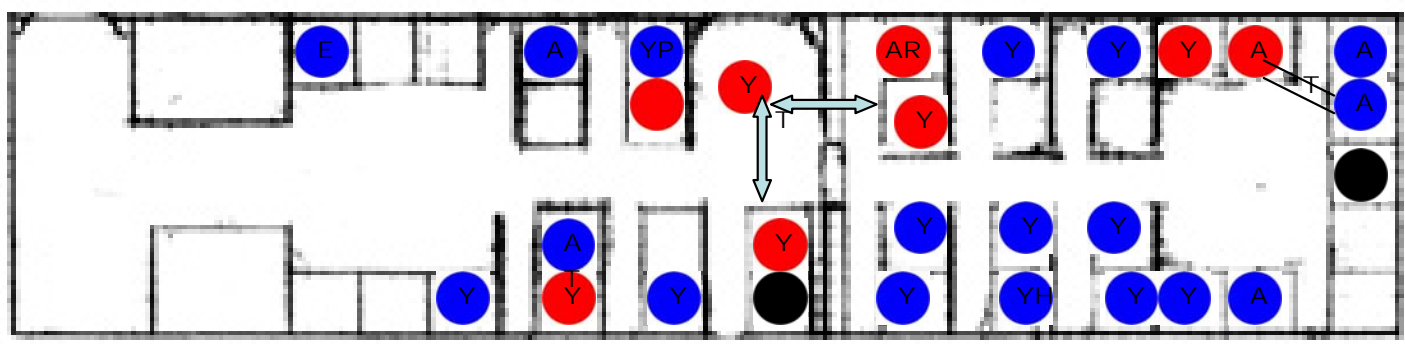
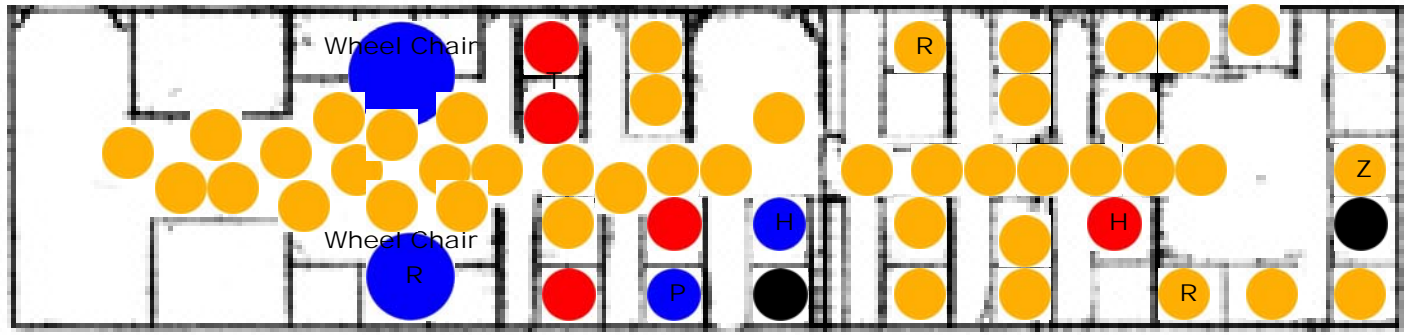
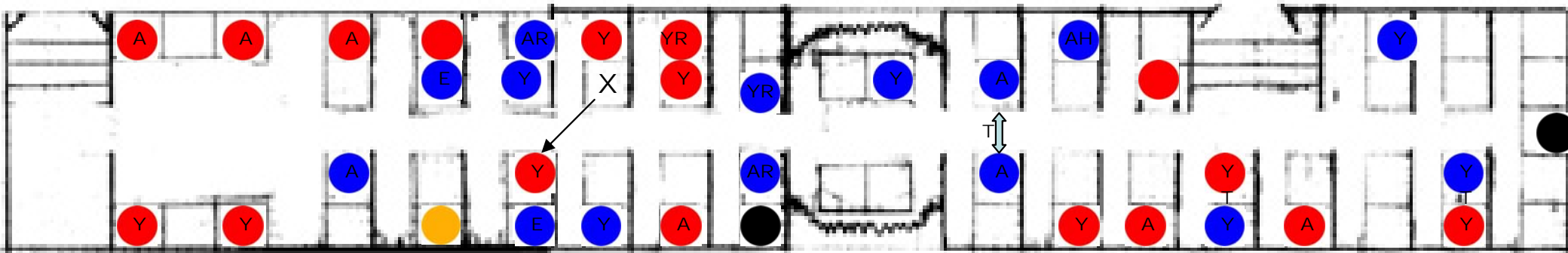
Forbes & Atwood



- Our locations
 - Male
 - Female
 - H Listening to headphones
 - T Talking to adjacent person
 - R Reading
 - Z Sleeping
 - P Talking on Cell Phone
 - Undocumented gender
- | | |
|---|------------------|
| C | Child (Under 18) |
| Y | Young (18-29) |
| A | Adult (30-54) |
| E | "Senior" (55+) |

Age groups are estimated

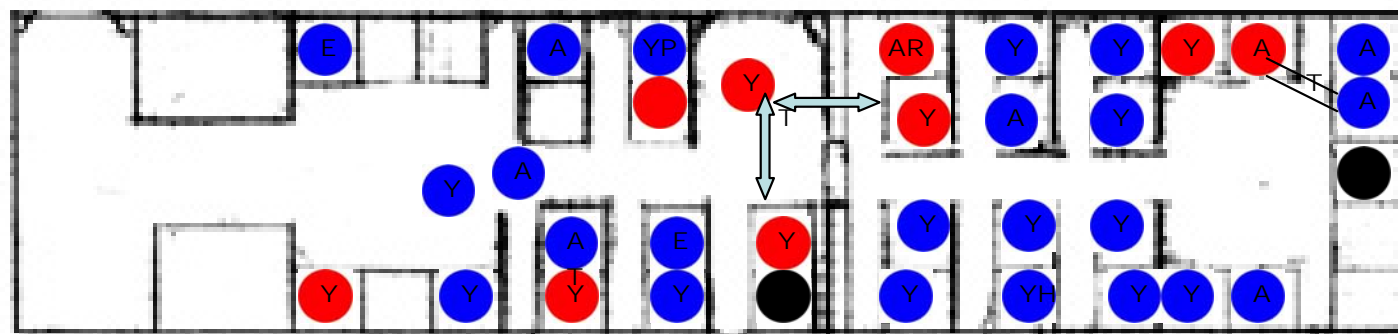
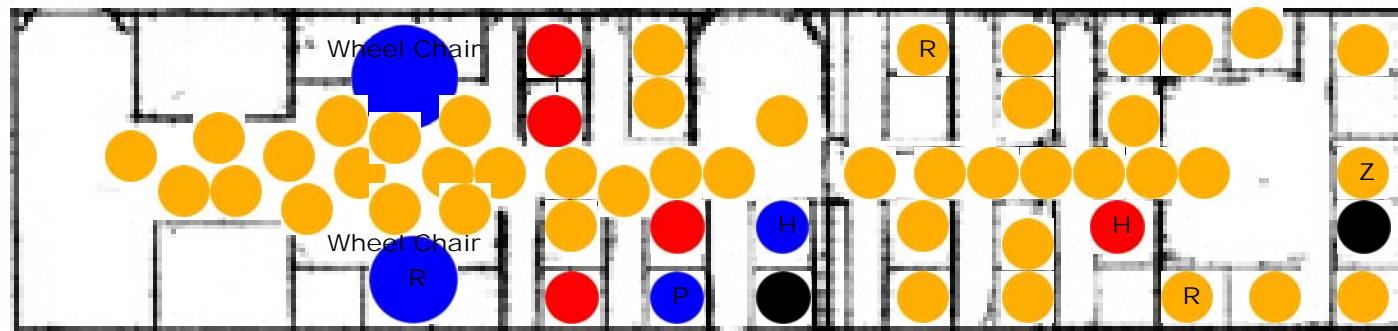
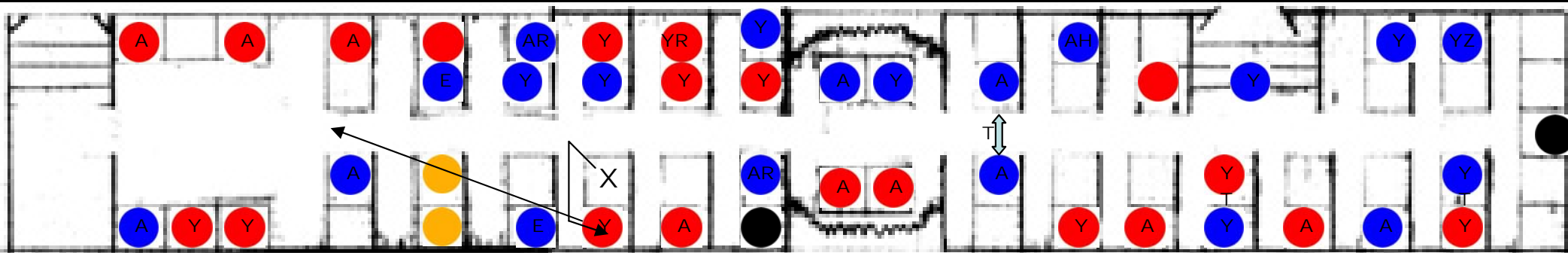
Forbes & Bigelow (Pitt)



- Our locations
 - Male
 - Female
 - H Listening to headphones
 - T Talking to adjacent person
 - R Reading
 - Z Sleeping
 - P Talking on Cell Phone
 - Undocumented gender
- | | |
|---|------------------|
| C | Child (Under 18) |
| Y | Young (18-29) |
| A | Adult (30-54) |
| E | "Senior" (55+) |

Age groups are estimated

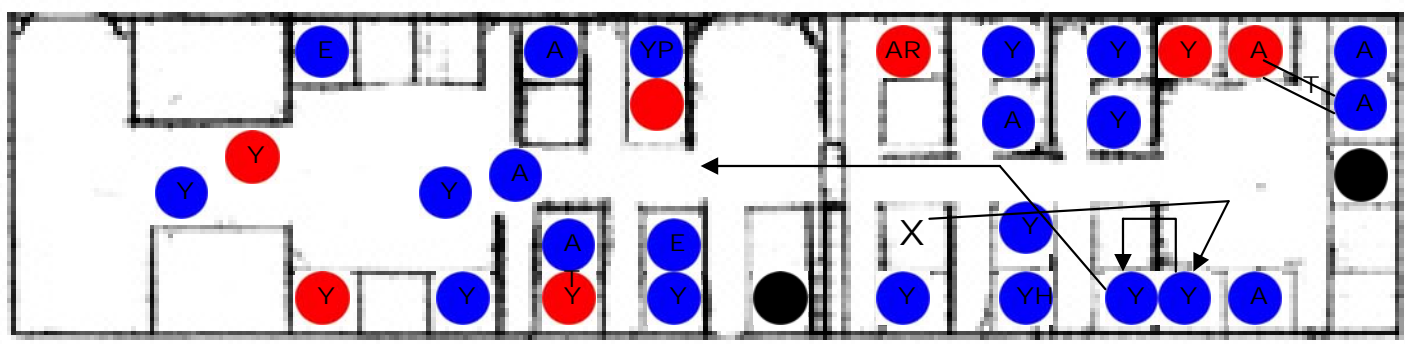
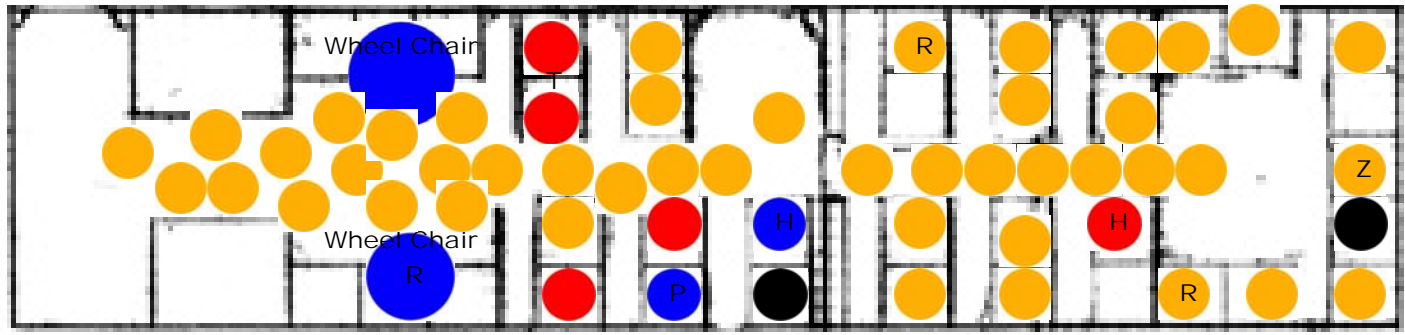
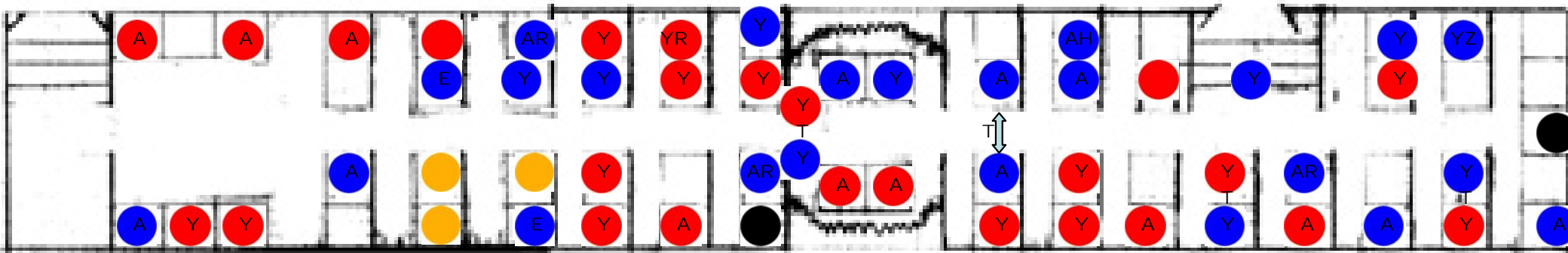
Forbes & Hamburg Hall



- Our locations
 - Male
 - Female
 - H Listening to headphones
 - T Talking to adjacent person
 - R Reading
 - Z Sleeping
 - P Talking on Cell Phone
 - Undocumented gender
- | | |
|---|------------------|
| C | Child (Under 18) |
| Y | Young (18-29) |
| A | Adult (30-54) |
| E | "Senior" (55+) |

Age groups are estimated

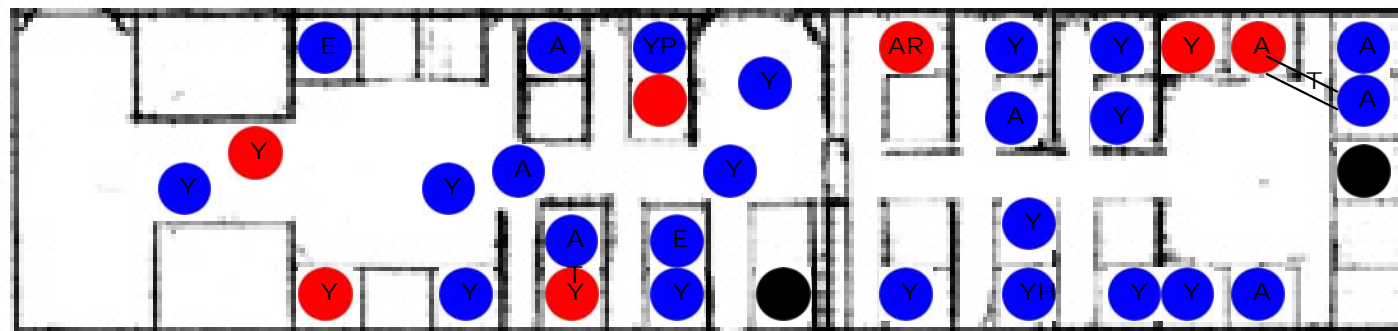
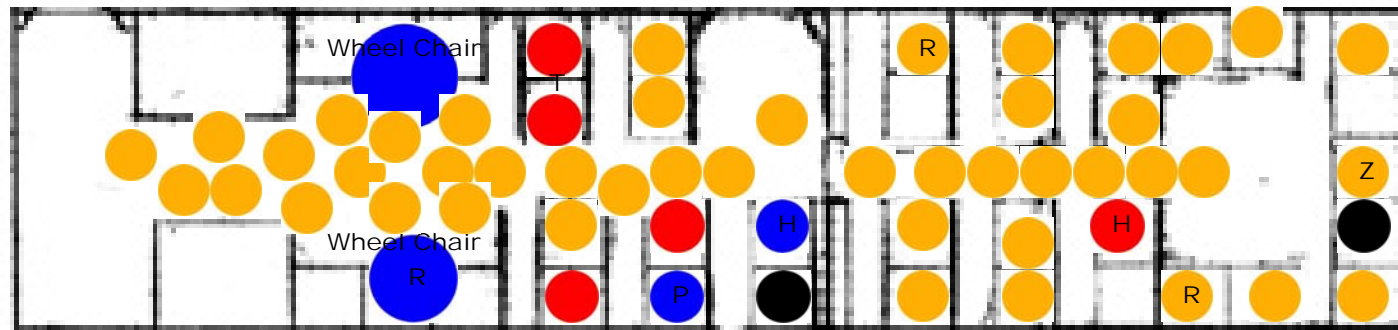
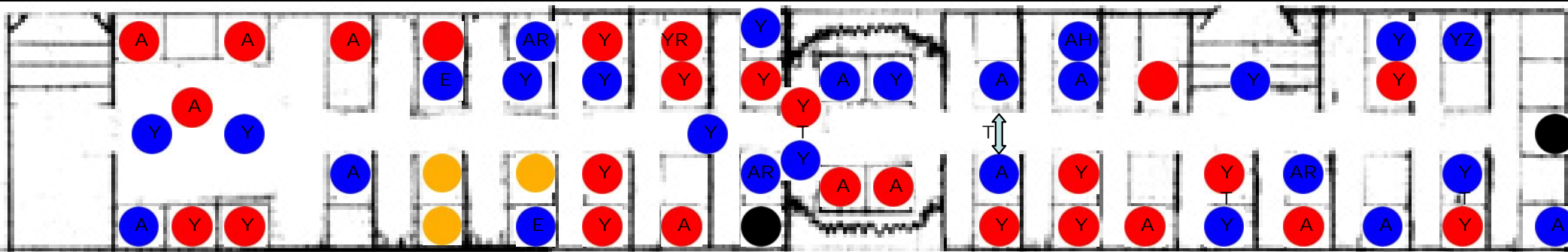
Forbes & Morewood (CMU)



- Our locations
 - Male
 - Female
 - H Listening to headphones
 - T Talking to adjacent person
 - R Reading
 - Z Sleeping
 - P Talking on Cell Phone
 - Undocumented gender
- | | |
|---|------------------|
| C | Child (Under 18) |
| Y | Young (18-29) |
| A | Adult (30-54) |
| E | "Senior" (55+) |

Age groups are estimated

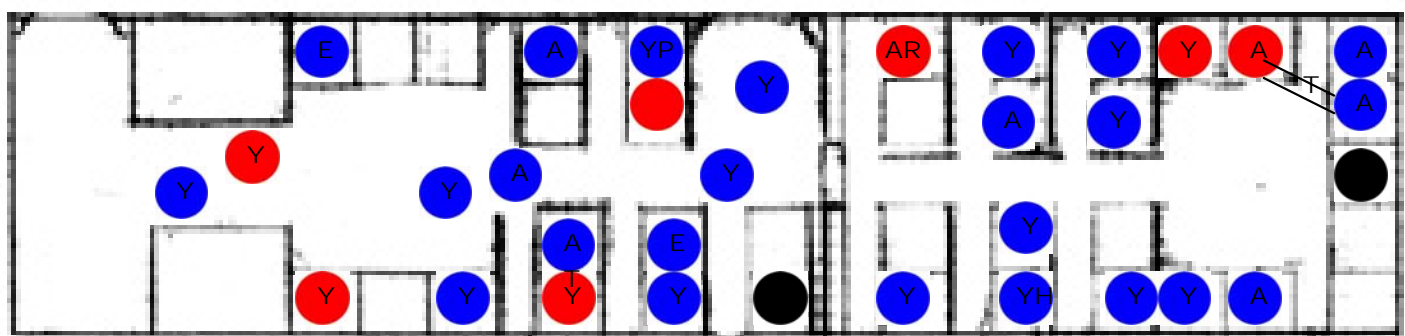
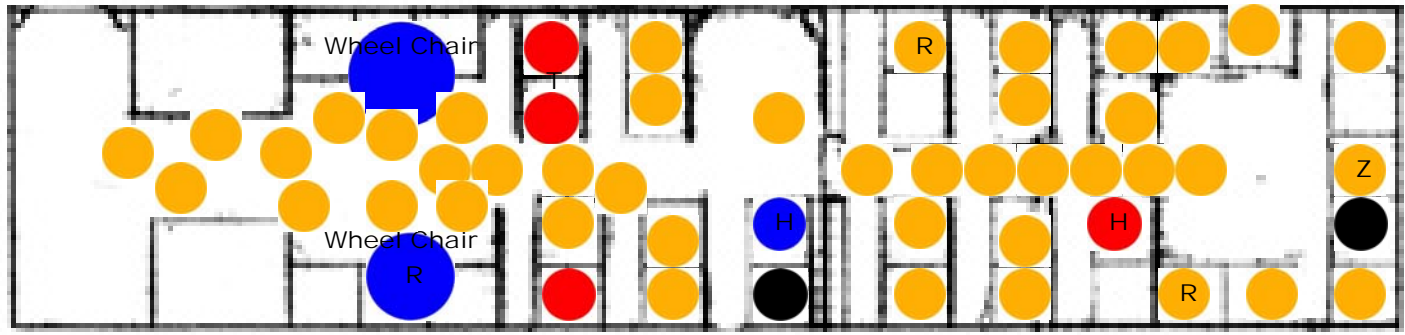
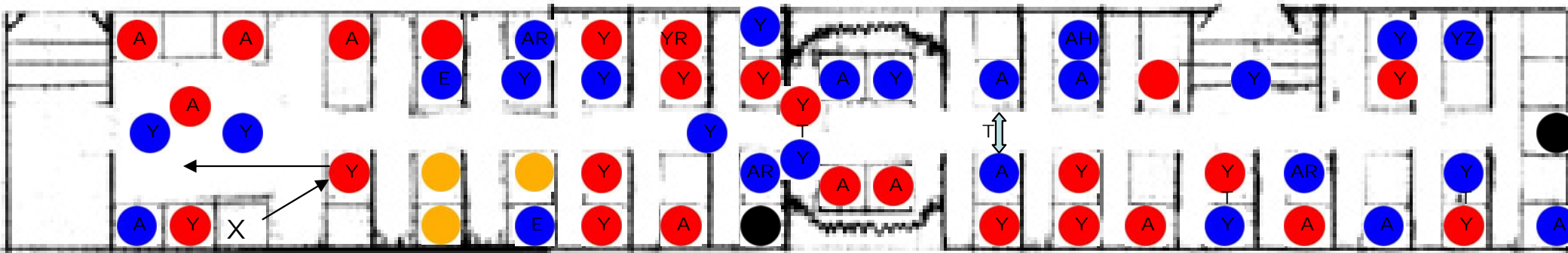
Forbes & Margaret Morrison



- Our locations
- Male
- Female
- Undocumented gender
- C Child (Under 18)
- Y Young (18-29)
- A Adult (30-54)
- E "Senior" (55+)
- H Listening to headphones
- T Talking to adjacent person
- R Reading
- Z Sleeping
- P Talking on Cell Phone

Age groups are estimated

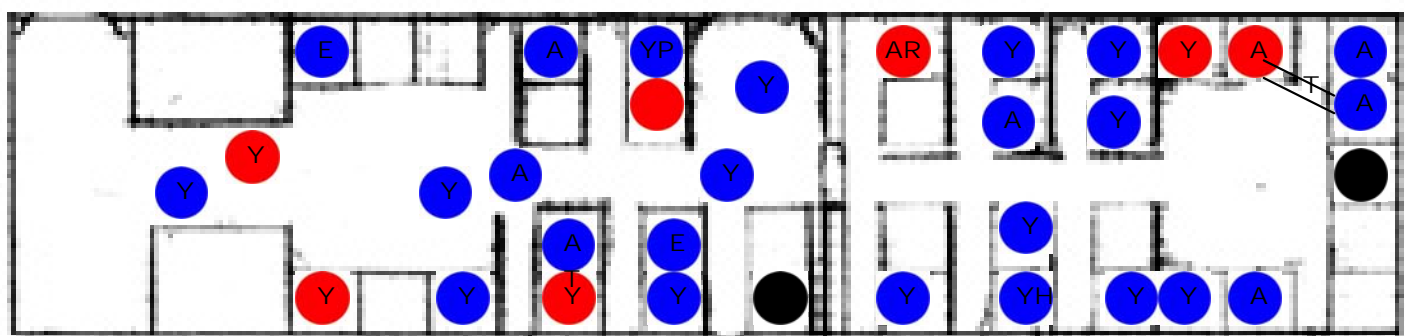
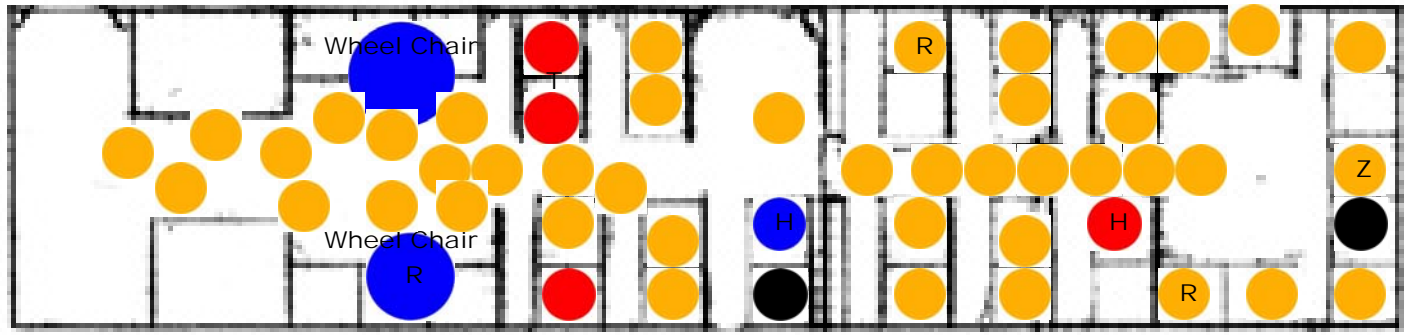
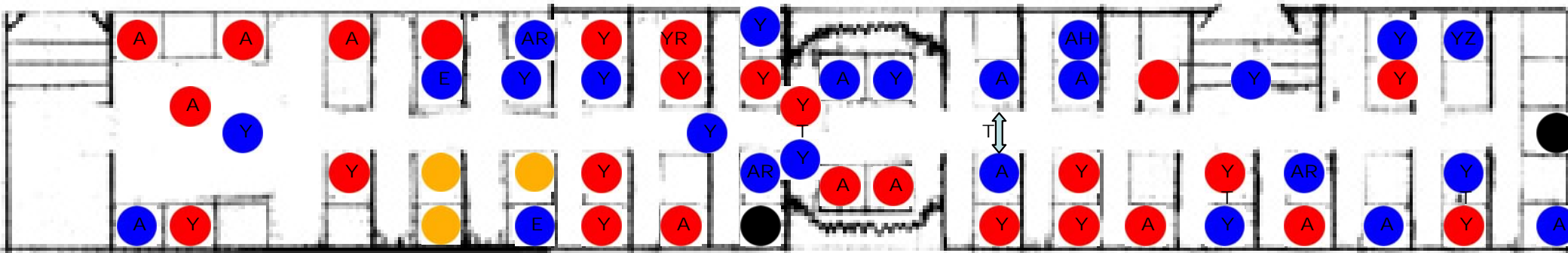
Forbes & Northumberland



- Our locations
 - Male
 - Female
 - H Listening to headphones
 - T Talking to adjacent person
 - R Reading
 - Z Sleeping
 - P Talking on Cell Phone
 - Undocumented gender
- | | |
|---|------------------|
| C | Child (Under 18) |
| Y | Young (18-29) |
| A | Adult (30-54) |
| E | "Senior" (55+) |

Age groups are estimated

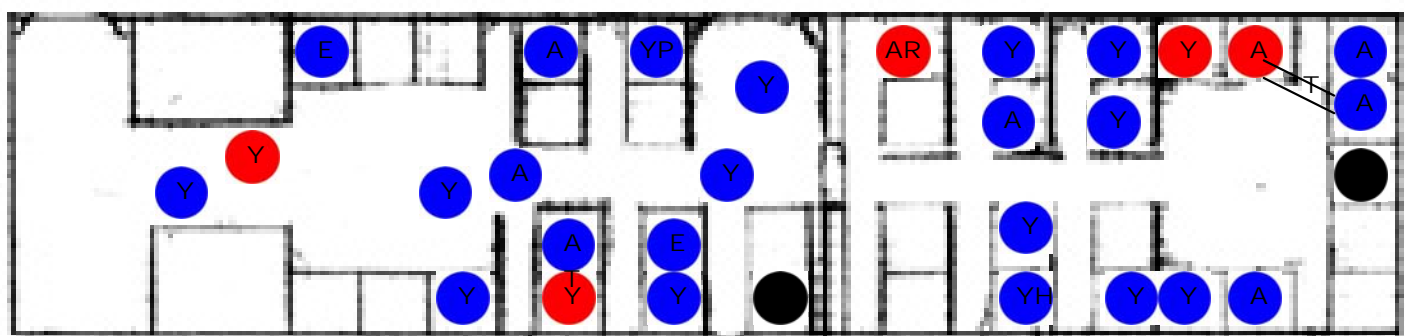
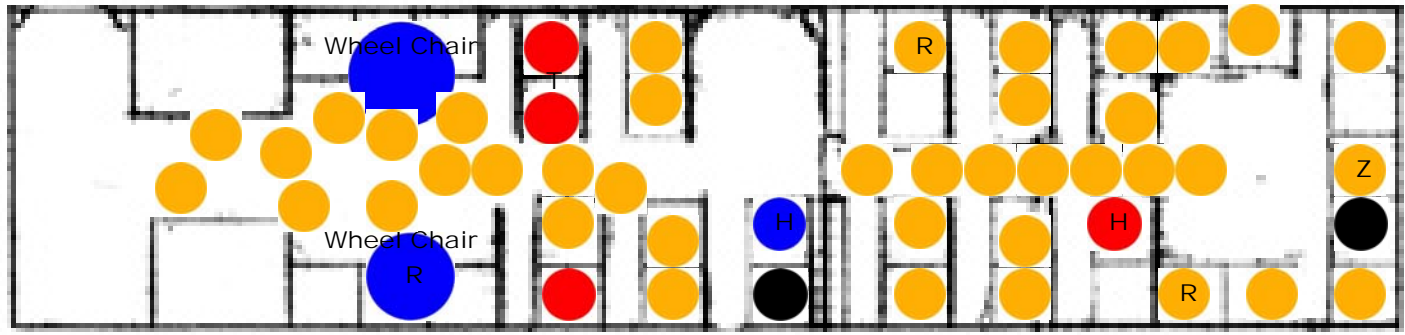
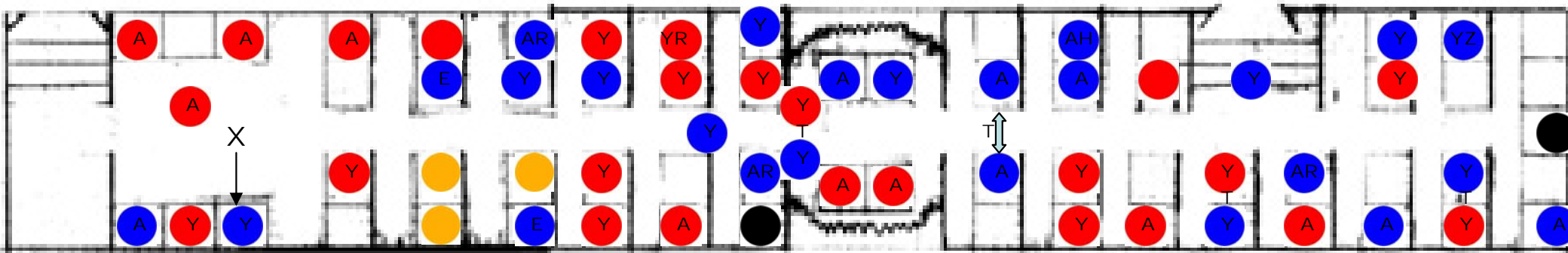
Forbes & Schenley (Golf Course)



- Our locations
 - Male
 - Female
 - H Listening to headphones
 - T Talking to adjacent person
 - R Reading
 - Z Sleeping
 - P Talking on Cell Phone
 - Undocumented gender
- | | |
|---|------------------|
| C | Child (Under 18) |
| Y | Young (18-29) |
| A | Adult (30-54) |
| E | "Senior" (55+) |

Age groups are estimated

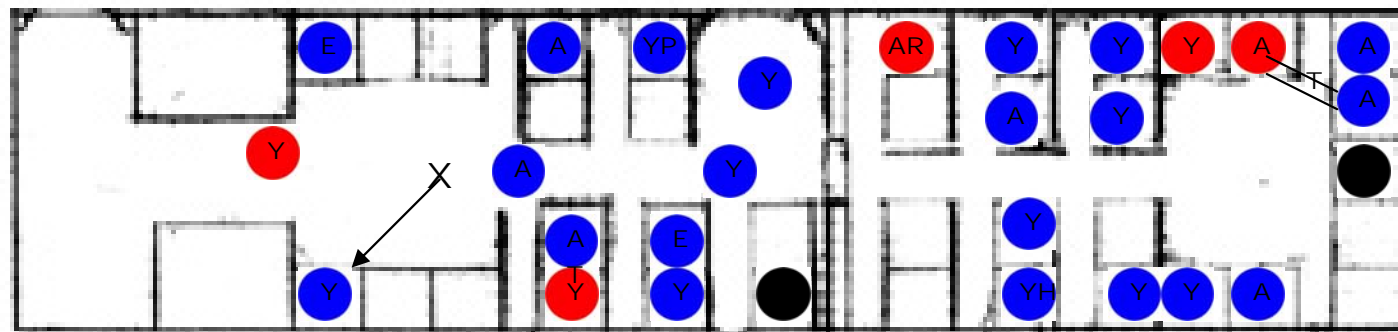
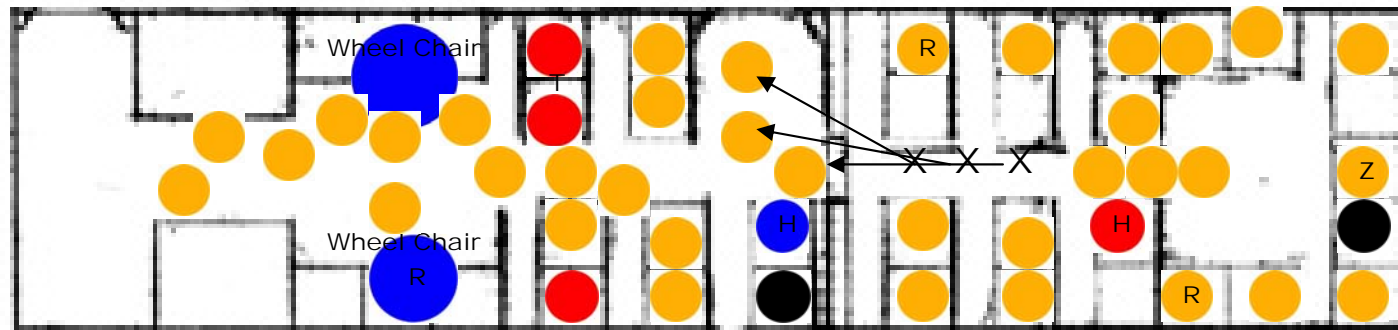
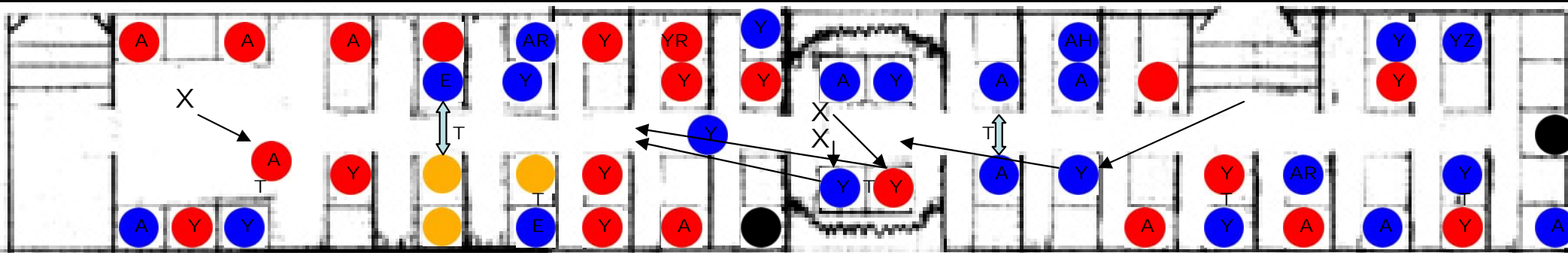
Forbes & Murdoch



- Our locations
 - Male
 - Female
 - H Listening to headphones
 - T Talking to adjacent person
 - R Reading
 - Z Sleeping
 - P Talking on Cell Phone
 - Undocumented gender
- | | |
|---|------------------|
| C | Child (Under 18) |
| Y | Young (18-29) |
| A | Adult (30-54) |
| E | "Senior" (55+) |

Age groups are estimated

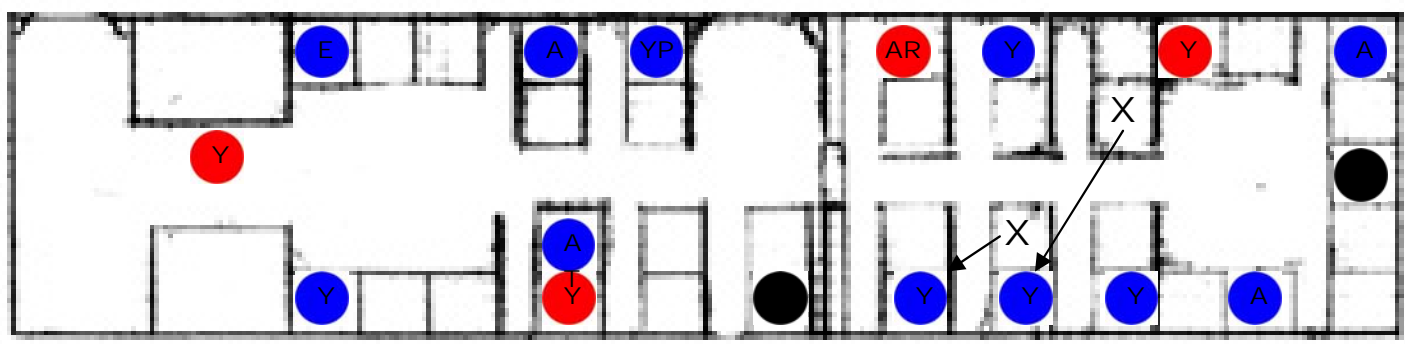
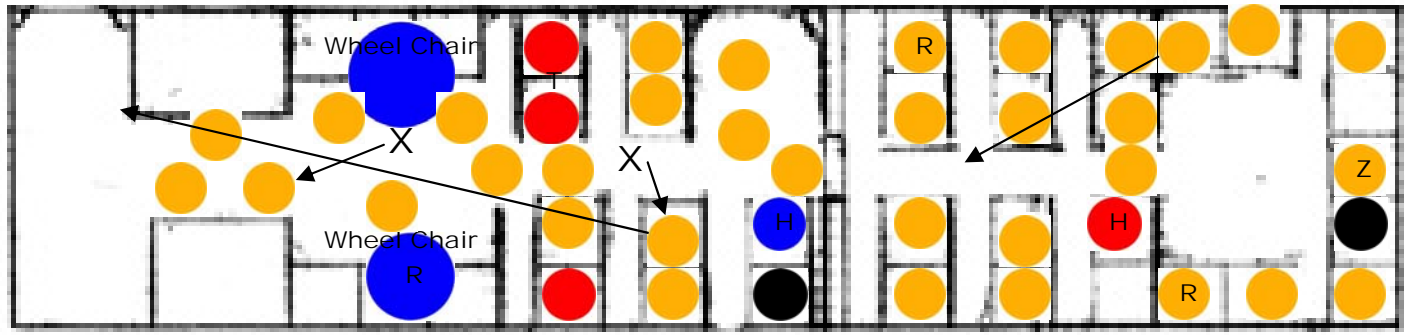
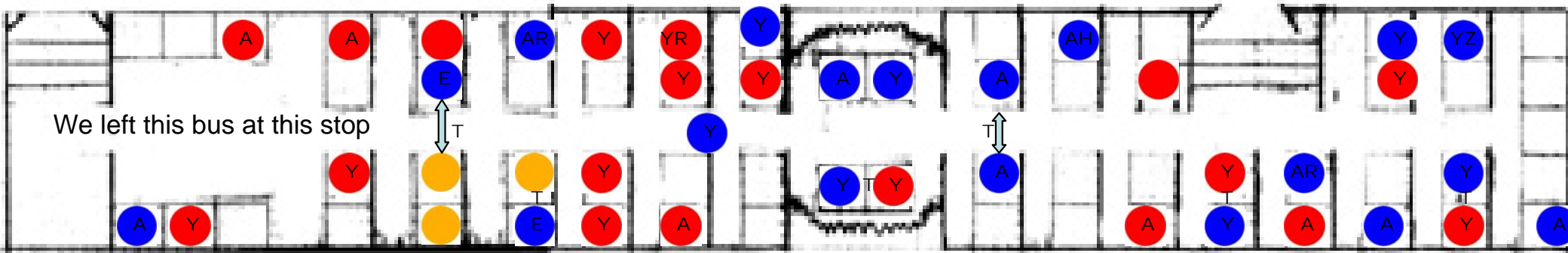
Forbes & Wightman



- Our locations
 - Male
 - Female
 - H Listening to headphones
 - T Talking to adjacent person
 - R Reading
 - Z Sleeping
 - P Talking on Cell Phone
 - Undocumented gender
- | | |
|---|------------------|
| C | Child (Under 18) |
| Y | Young (18-29) |
| A | Adult (30-54) |
| E | "Senior" (55+) |

Age groups are estimated

Forbes & Murray

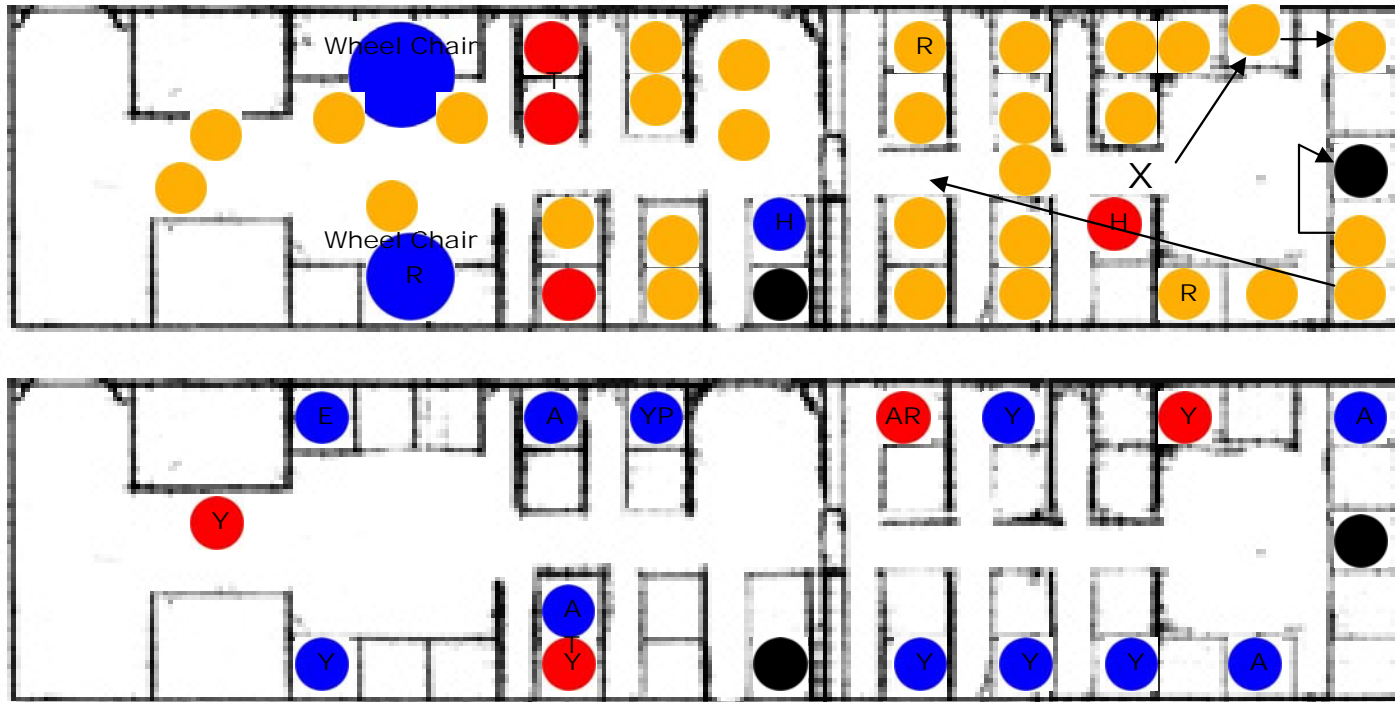


- Our locations
 - Male
 - Female
 - H Listening to headphones
 - T Talking to adjacent person
 - R Reading
 - Z Sleeping
 - P Talking on Cell Phone
 - Undocumented gender
- | | |
|---|------------------|
| C | Child (Under 18) |
| Y | Young (18-29) |
| A | Adult (30-54) |
| E | "Senior" (55+) |

Age groups are estimated

Murray & Darlington

No information available—Study finished at Forbes & Murray

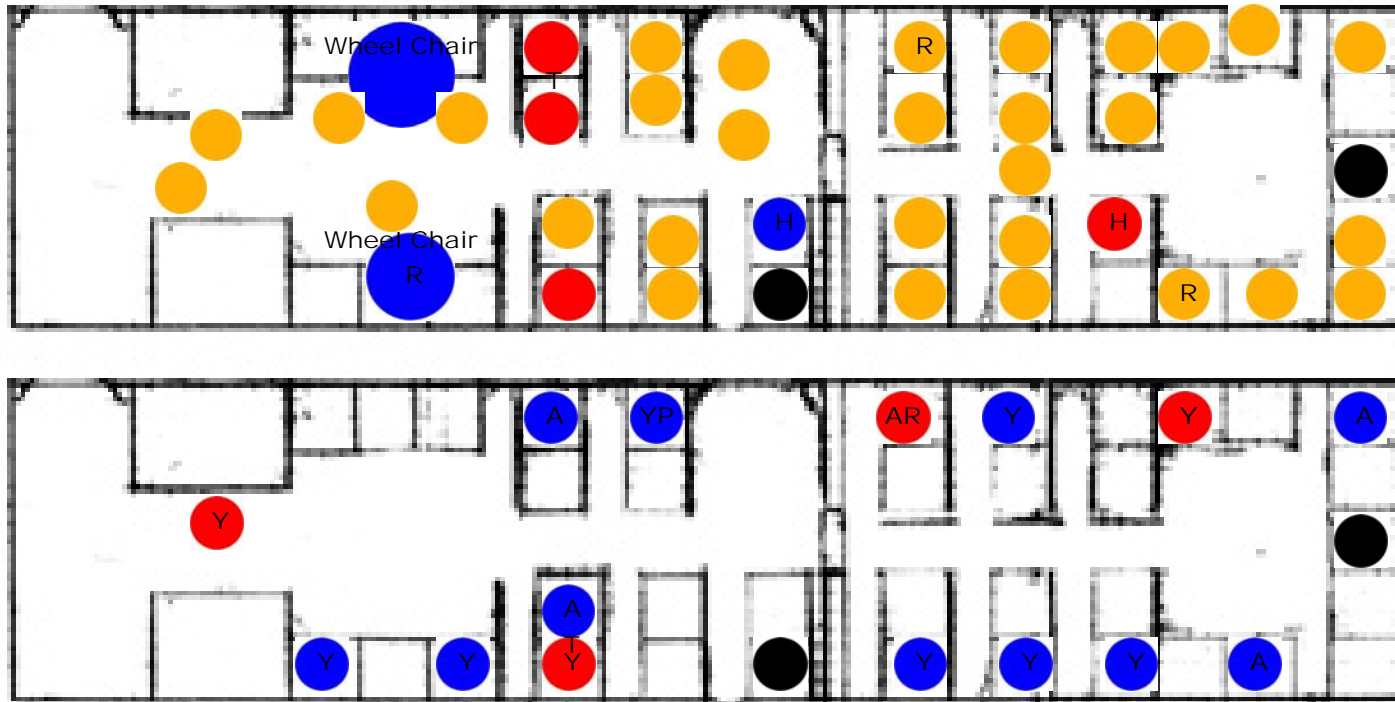


- Our locations
 - Male
 - Female
 - H Listening to headphones
 - T Talking to adjacent person
 - R Reading
 - Z Sleeping
 - P Talking on Cell Phone
 - Undocumented gender
- | | |
|---|------------------|
| C | Child (Under 18) |
| Y | Young (18-29) |
| A | Adult (30-54) |
| E | "Senior" (55+) |

Age groups are estimated

Murray & Bartlett

No information available—Study finished at Forbes & Murray

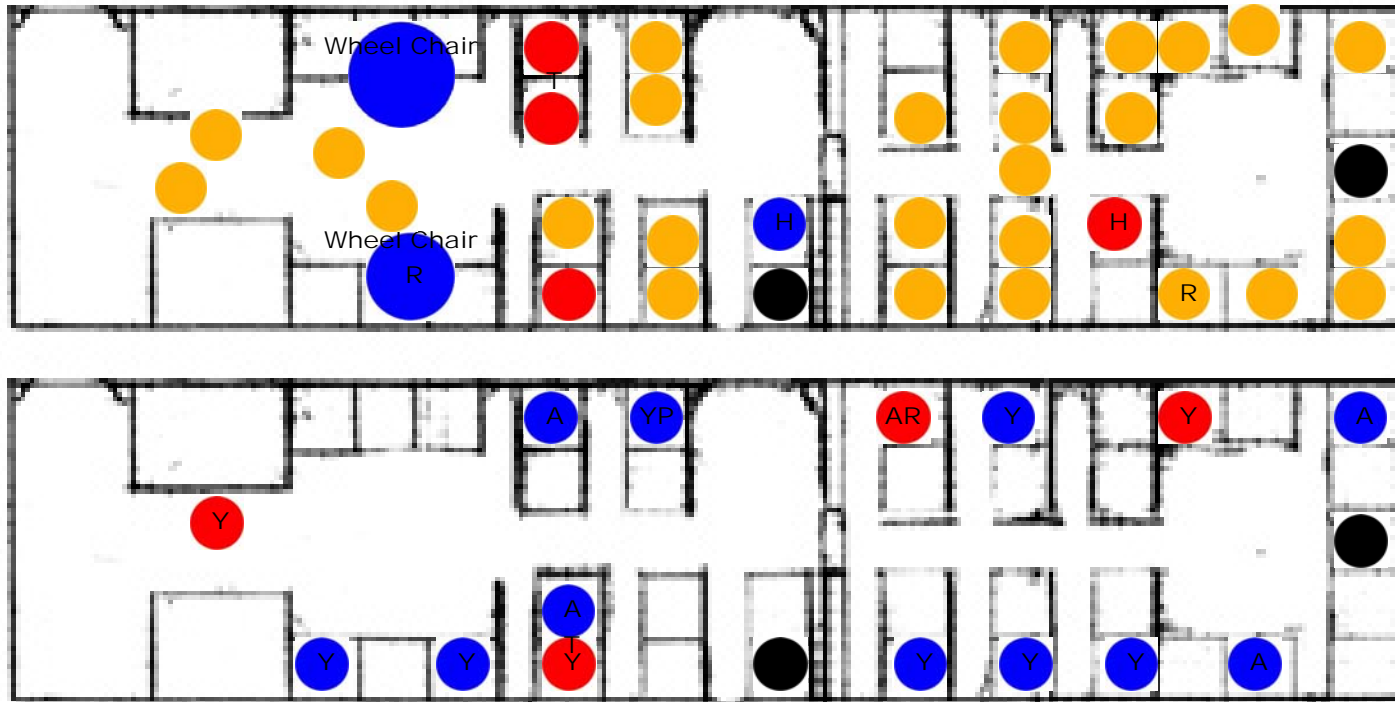


- Our locations
 - Male
 - Female
 - H Listening to headphones
 - T Talking to adjacent person
 - R Reading
 - Z Sleeping
 - P Talking on Cell Phone
 - Undocumented gender
- | | |
|---|------------------|
| C | Child (Under 18) |
| Y | Young (18-29) |
| A | Adult (30-54) |
| E | "Senior" (55+) |

Age groups are estimated

Murray & Beacon

No information available—Study finished at Forbes & Murray

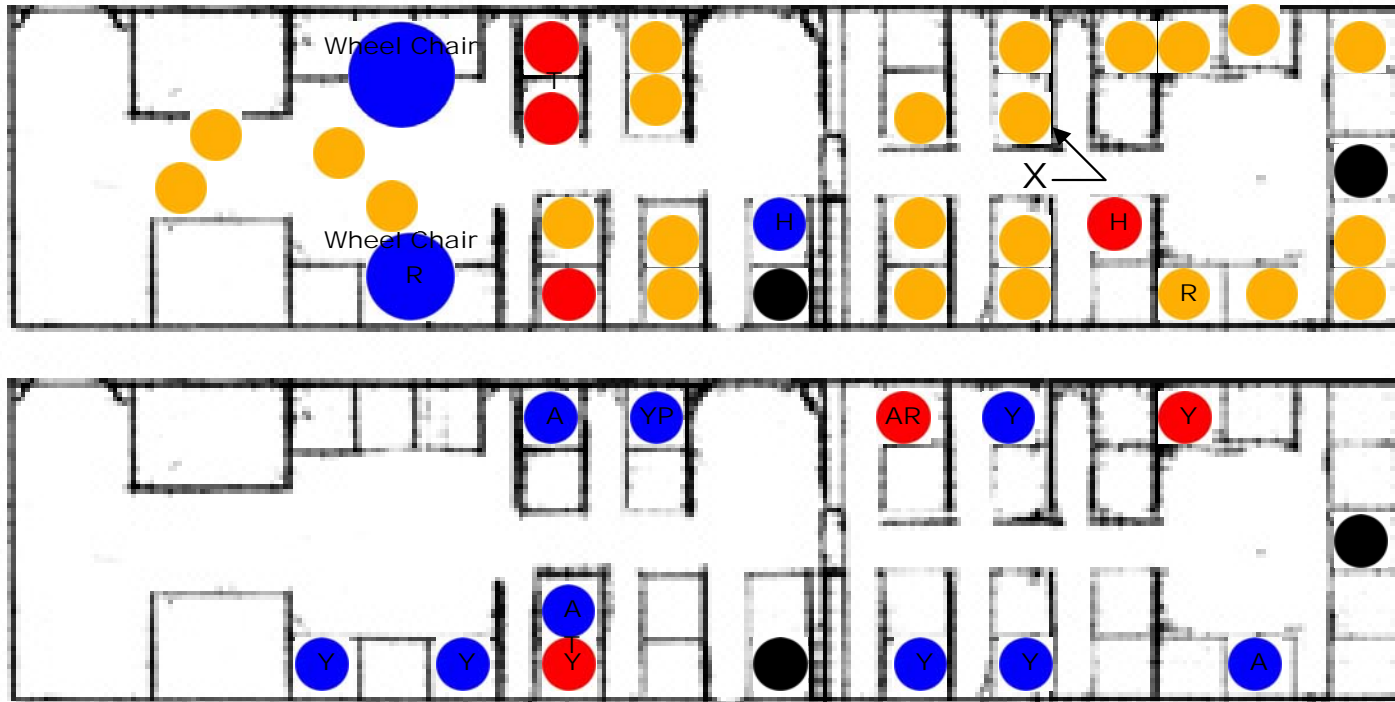


- Our locations
 - Male
 - Female
 - H Listening to headphones
 - T Talking to adjacent person
 - R Reading
 - Z Sleeping
 - P Talking on Cell Phone
 - Undocumented gender
- | | |
|---|------------------|
| C | Child (Under 18) |
| Y | Young (18-29) |
| A | Adult (30-54) |
| E | "Senior" (55+) |

Age groups are estimated

Murray & Hobart

No information available—Study finished at Forbes & Murray

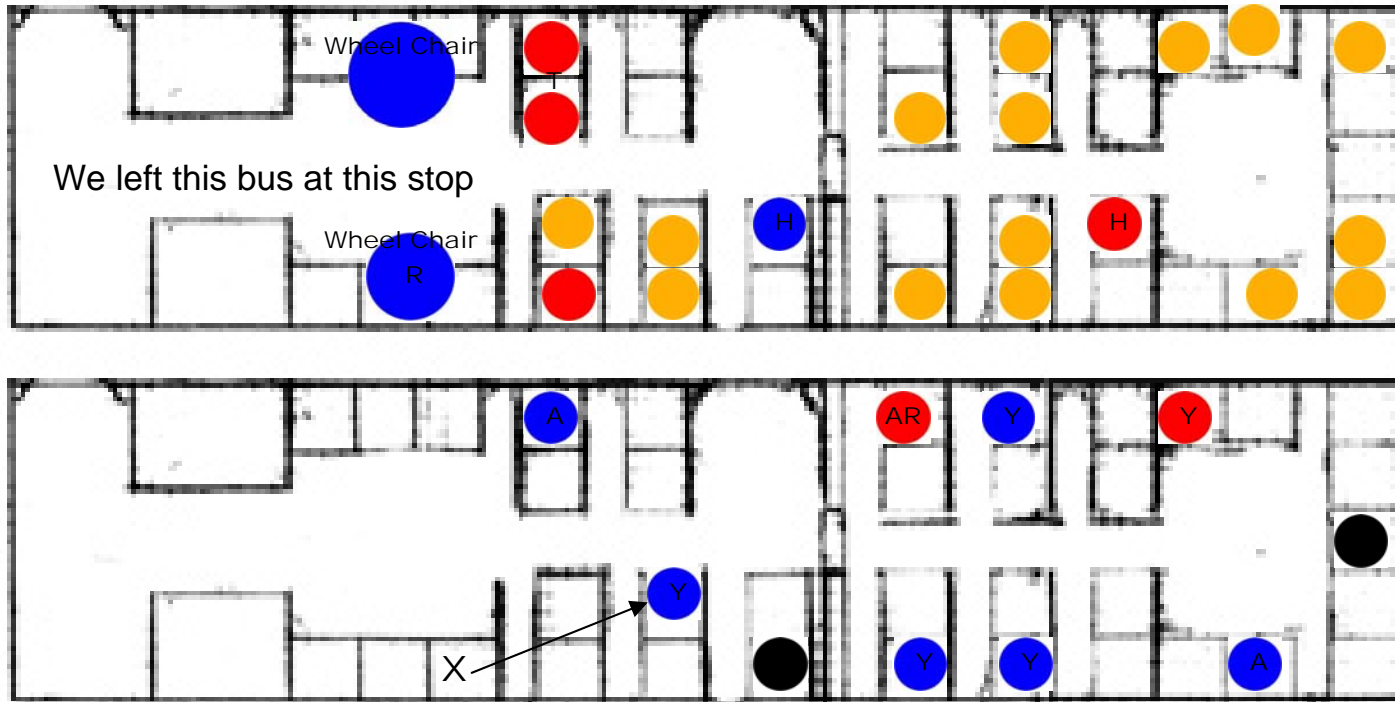


- Our locations
 - Male
 - Female
 - H Listening to headphones
 - T Talking to adjacent person
 - R Reading
 - Z Sleeping
 - P Talking on Cell Phone
 - Undocumented gender
- | | |
|---|------------------|
| C | Child (Under 18) |
| Y | Young (18-29) |
| A | Adult (30-54) |
| E | "Senior" (55+) |

Age groups are estimated

Murray & Phillips

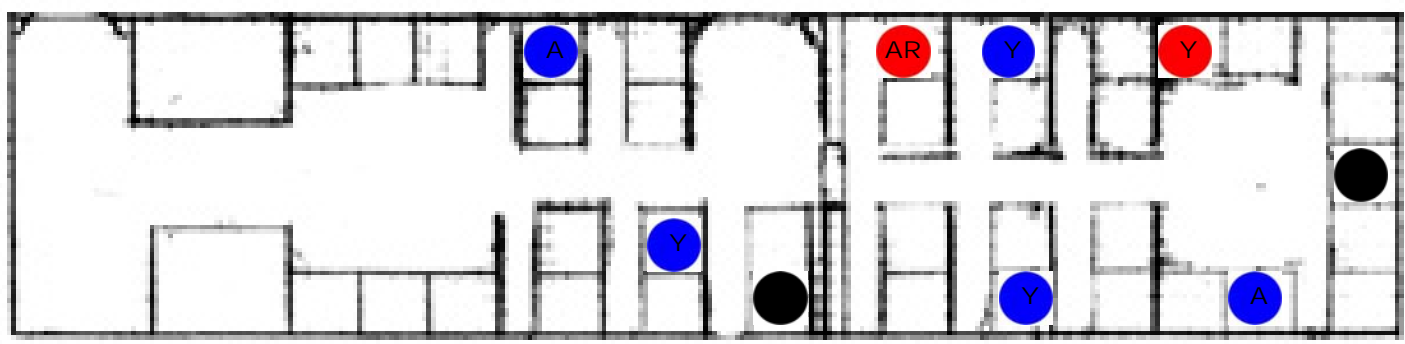
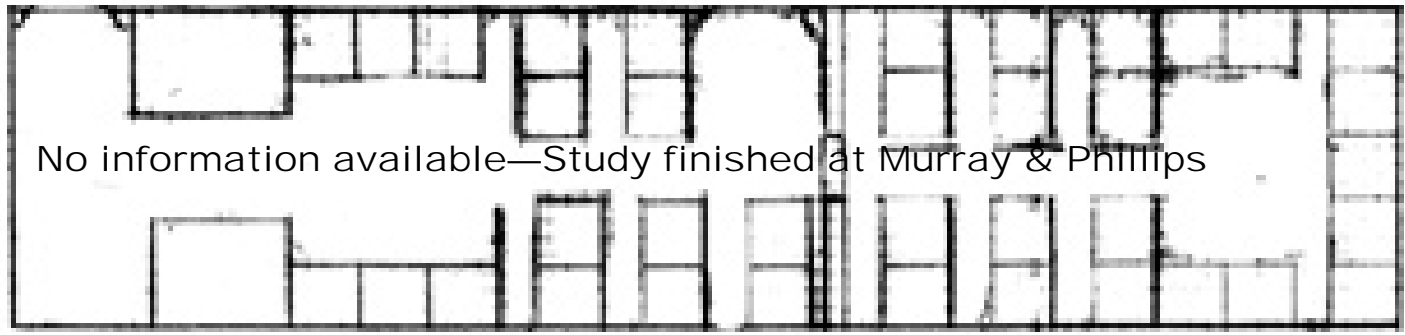
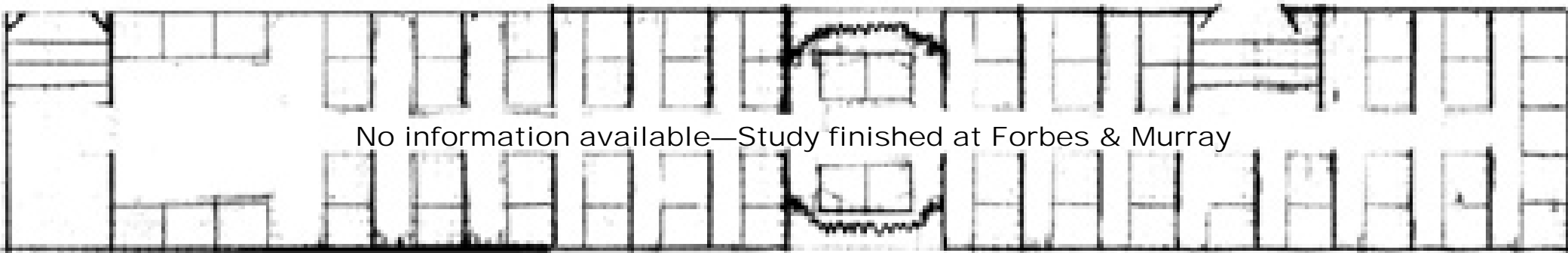
No information available—Study finished at Forbes & Murray



- Our locations
 - Male
 - Female
 - H Listening to headphones
 - T Talking to adjacent person
 - R Reading
 - Z Sleeping
 - P Talking on Cell Phone
 - Undocumented gender
- | | |
|---|------------------|
| C | Child (Under 18) |
| Y | Young (18-29) |
| A | Adult (30-54) |
| E | "Senior" (55+) |

Age groups are estimated

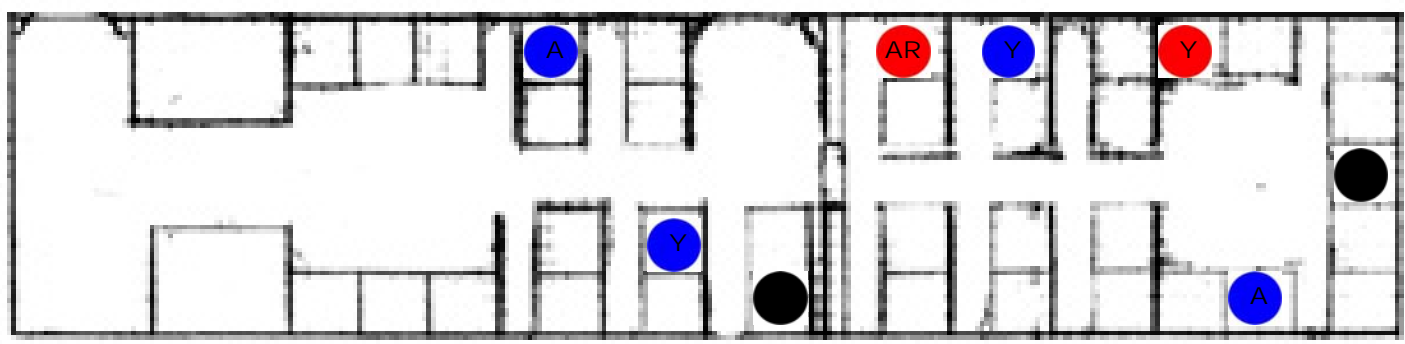
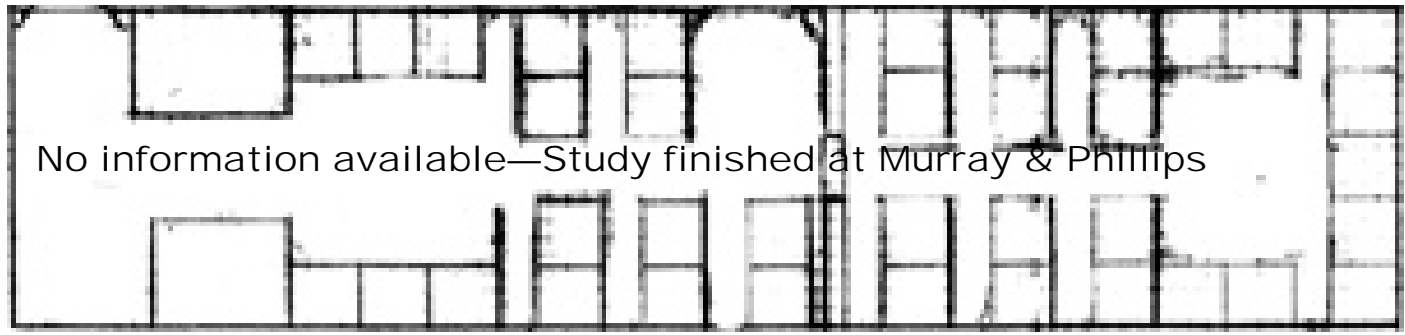
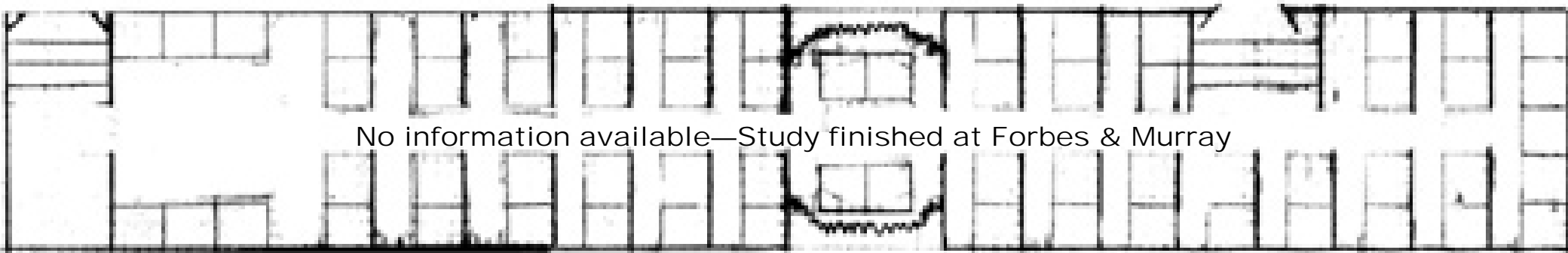
Murray & Forward



- Our locations
 - Male
 - Female
 - H Listening to headphones
 - T Talking to adjacent person
 - R Reading
 - Z Sleeping
 - P Talking on Cell Phone
 - Undocumented gender
- | | |
|---|------------------|
| C | Child (Under 18) |
| Y | Young (18-29) |
| A | Adult (30-54) |
| E | "Senior" (55+) |

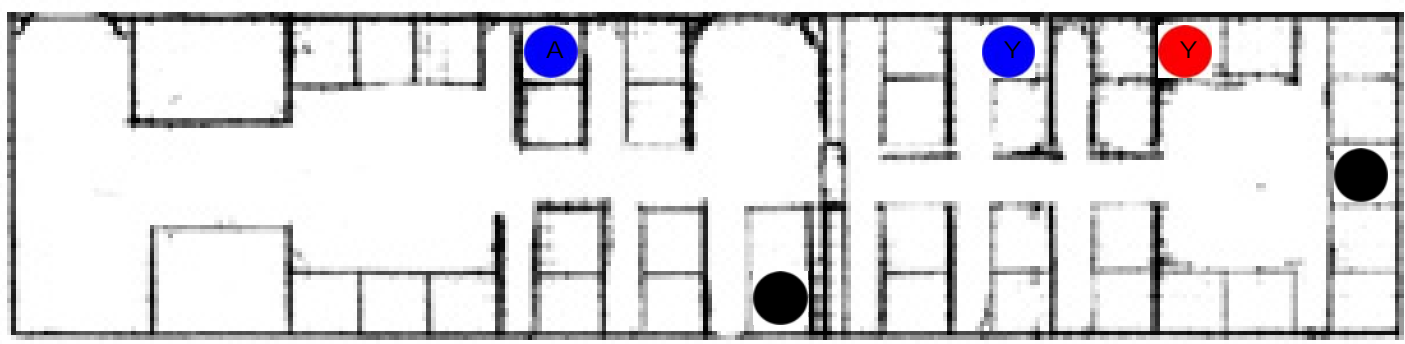
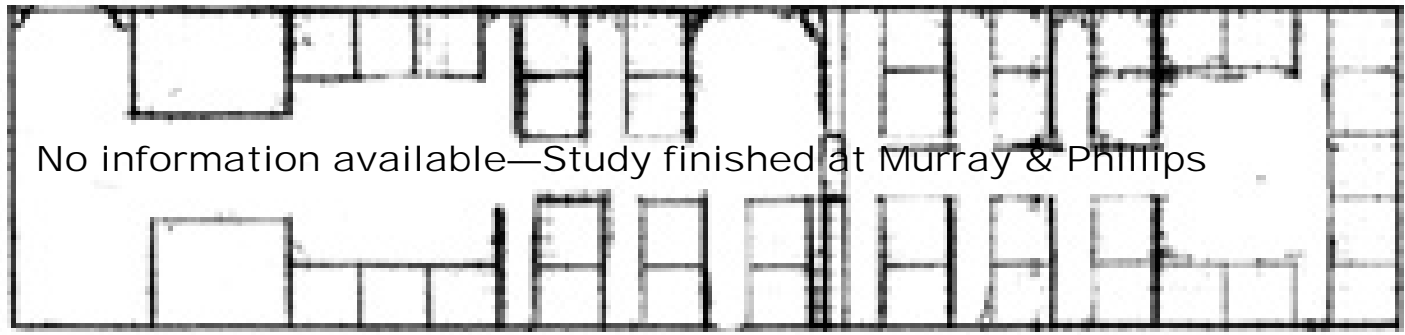
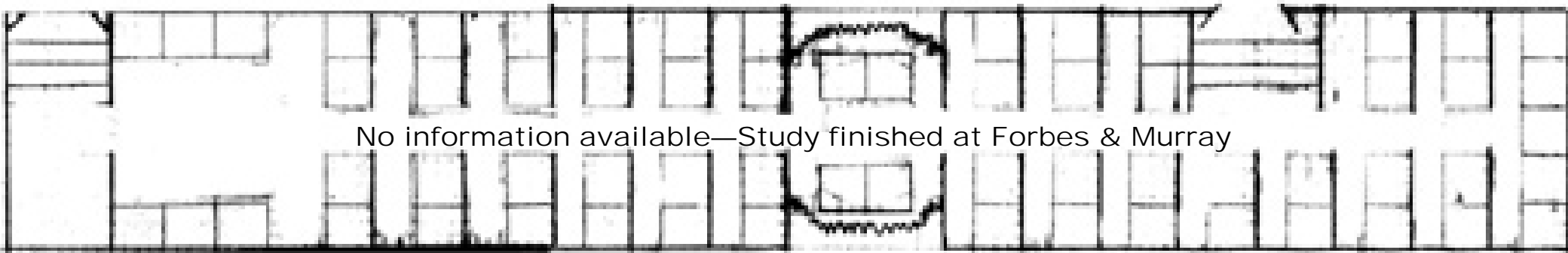
Age groups are estimated

Murray & Morrowfield Apartments



- Our locations
 - Male
 - Female
 - H Listening to headphones
 - T Talking to adjacent person
 - R Reading
 - Z Sleeping
 - P Talking on Cell Phone
 - Undocumented gender
- Age groups are estimated
- C Child (Under 18)
 - Y Young (18-29)
 - A Adult (30-54)
 - E "Senior" (55+)

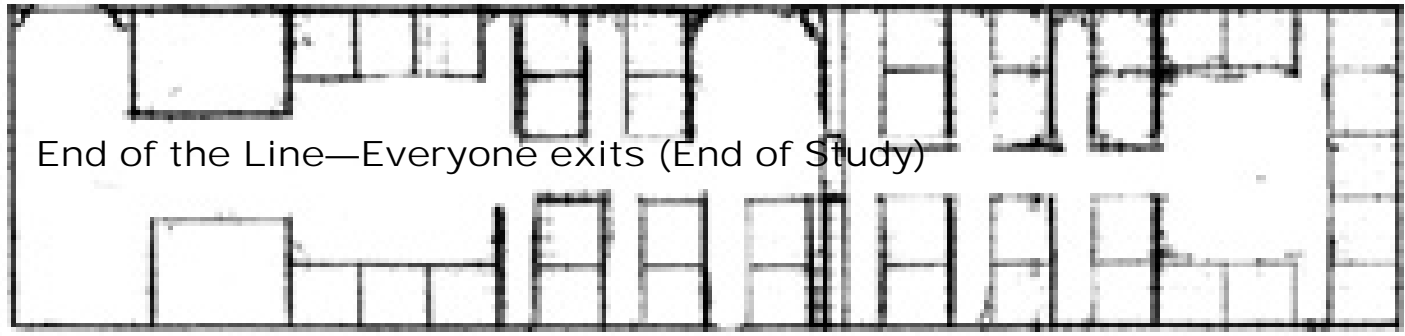
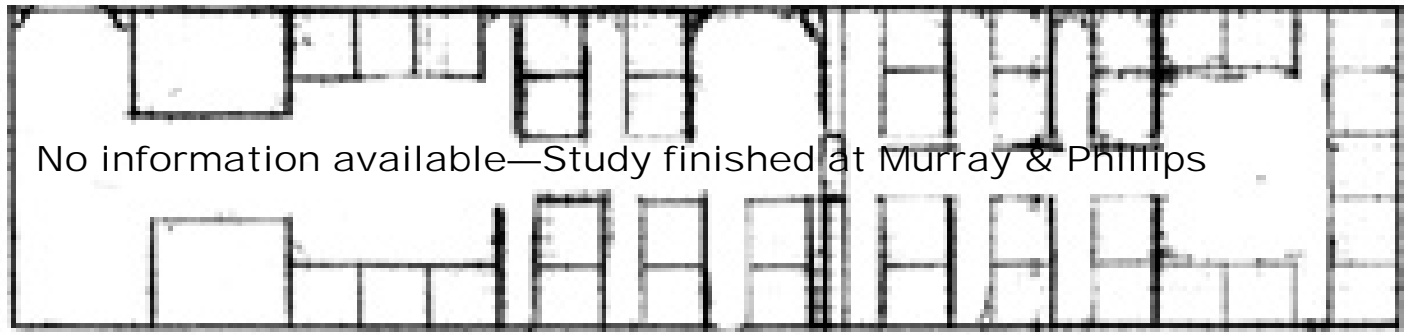
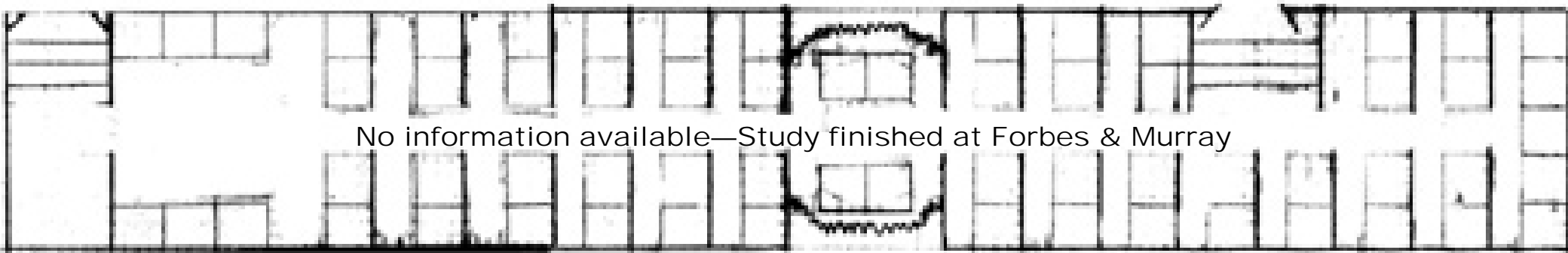
Murray & Lilac



- Our locations
 - Male
 - Female
 - H Listening to headphones
 - T Talking to adjacent person
 - R Reading
 - Z Sleeping
 - P Talking on Cell Phone
 - Undocumented gender
- | | |
|---|------------------|
| C | Child (Under 18) |
| Y | Young (18-29) |
| A | Adult (30-54) |
| E | "Senior" (55+) |

Age groups are estimated

Ann and Eighth



- Our locations
 - Male
 - Female
 - H Listening to headphones
 - T Talking to adjacent person
 - R Reading
 - Z Sleeping
 - P Talking on Cell Phone
 - Undocumented gender
- | | |
|---|------------------|
| C | Child (Under 18) |
| Y | Young (18-29) |
| A | Adult (30-54) |
| E | “Senior” (55+) |

Age groups are estimated