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Choice of Bus Seat as an Indicator of Human Sensitivity to the Environment

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Kirsten Phillips

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Abstract

Cities are a very recent feature of human evolution and have entailed significant behavioural adaptations, including the development of social pathologies. Human adaptation to an environment of increasing population density and a consequent decreasing availability of privacy and personal space was explored through natural observation and analysis of the seat choices made by 546 passengers on 26 bus journeys. As hypothesised, passengers predominantly distributed evenly between zones of the bus, actively selected seats that maximised their distance from other passengers, and that facilitated a greater sense of space. The observed behaviour reflects high sensitivity to the spatial environment and supports the need to consider possible behavioural and psychological effects of urban intensification in plans to manage urban population growth.

Many thanks to Dr Linda Jones for three years of patience.

And thank you to my flatmates who ate dinner amongst piles of paper for many months without complaint.

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Tāmaki Makaurau, known more commonly as Auckland, is the largest and still most rapidly growing city in Aotearoa New Zealand. Conservative population growth predictions expect Auckland's population to reach 1.93 million residents by 2031 and under a higher growth rate scenario it could reach a population of over two million (Statistics New Zealand, 2009). A central goal of the Auckland Regional Growth Strategy implemented in 1999 is for population growth to be contained within existing urban limits, thereby limiting urban sprawl (Statistics New Zealand, 2009). A growing population in a contained area means increasing population density.

The Proposed Auckland Unitary Plan is the practical plan for achieving the Auckland Regional Growth Strategy aim. In summary, 'the unitary plan sets out what people can and can't do with their land, shaping how Auckland and its communities can grow' (Auckland Council, 2013, p. 2). Focusing on redevelopment and intensification of existing space, the plan intends to accommodate and manage population growth by facilitating compact urban environments with the intensification of selected high density centres along public transport corridors (Harrison Grierson Consultants Limited, 2008). While consideration is given to the economic growth and functional implications of this, an exploration of psychological aspects of urban intensification appear to be neglected. Recognition of human sensitivity to the environment is important because it evidences the aptness of considering the possible behavioural and psychological impact of urban intensification on Auckland's inhabitants. This awareness may help to ensure that plans for the region will maintain or improve quality of life for Aucklanders and will contribute to an environment that fosters the psychological wellness of individuals and society.

Urban Intensification

Cities have an obvious appeal to some people for their affordances of selection, ease of access to facilities, choice of entertainment, job opportunities, heightened intensity and pace of life, to name a few factors. Many people give financial precedence to living in a populated urban area. However, the modern city is only a very recent development. It is an outcome of changing lifestyle expectations, shifting values, an economy where the people most removed from the natural environment are the most highly paid, of medical advancement and improved sanitation, population booms and faster transportation. Previously, it was simply not possible for such large numbers of people to live so close together.

For most of evolutionary history humans have lived in small, remote, family groups (Bechtel & Churchman, 2002) and the change to living in populated urban areas has entailed significant behavioural adaptation. We are able to keep pace with modern city life through manipulation of materials, the ability to learn and implement new behaviours, and to utilise new technologies. Kutner (1973) considered the ability to tolerate transient situations of extreme crowding, such as public transport or elevators, to reflect the unique propensity of humans to use cognitive and learned social behaviours to adapt to their environment. It is a necessary ability in a fast-growing urban environment. Nevertheless, adaptations produce consequences, both intended and unintended. Adapting to the city environment thus far has shaped human behaviours. These adaptations unfortunately may account for some of the development of social pathologies. For example, while Milgram (1970) suggests that the city can breed tolerance for difference, this may only be the by-product of a growing general disregard for others.

Over a century ago, Simmel (1903, cited in Milgram, 1970, p. 1462) suggested that the heightened levels of stimulation in the urban environment had shaped the adoption of behaviours that ‘conserve psychic energy’. In the past 100 years, the size, pace and business of cities has only increased. Milgram claimed information overload, or stimulus overload, was a typical experience of the urban environment that resulted in inhabitants adapting their behaviour to protect psychological wellbeing. Milgram observed the behaviour of people living in cities and noted that people in cities made deliberate attempts to reduce the information processing demands of the urban environment. This included adhering to a norm of non-involvement with strangers and actively displaying unwillingness for social contact with others.

In highly populated areas people screen out other humans. Sommer (1969) observed that an unconscious psychological adaptation to crowding is to consider other people as ‘nonpersons.’ Other people are prevented from encroaching on personal space by removal of their status as people; ‘[A] nonperson cannot invade someone’s personal space any more than a tree or chair can’ (Sommer, 1969, p. 32). It is commonplace for individuals to consciously walk past each other as if the other person does not exist. Physical distancing and social-emotional withdrawal from strangers both ‘protects and estranges the individual from [their] social environment’ (Milgram, 1970, p. 1462). This behavioural adaptation inadvertently promotes an environment for feelings of insignificance, emptiness, isolation and detachment from society.

Human responsivity to the environment is apparent in everyday behaviours and, as such, is likely taken for granted. People may only become aware of their environment when it causes them discomfort. Kahn (1999, cited in Bechtel & Churchman, 2002, pp. 561-562) argued that the ease with which humans can adapt to incremental and gradual change ‘accounts for people allowing the environment to degrade'. Changes in the environment can be gradual enough that we do not see the cumulative transformation from such an immersed perspective. In sculpting a growing city, becoming aware of discomfort in the environment may mean that changes are already negatively affecting the wellbeing of inhabitants. Therefore a warning may be needed.

All environments have selective pressures, not only on an evolutionary scale where the 'fittest' survive to reproduce, but environments are influential in determining who will flourish and who will not. Heylighen and Bernheim (2000) interpret the term 'fit' as how well a being 'fits' into a given environment. A new environment therefore creates a new operationalization of 'fit.' The authors also noted that 'survival of the fittest normally implies the demise of the unfit' (p. 355). It needs to be considered that a changing environment means changing selective pressures and therefore may create a new group, or groups of people, for whom aspects of the environment may have a negative effect on their wellbeing. Consideration of the impact of environmental changes on psychological wellbeing may be important in order to identify those most likely affected and buffer for any negative effects.

Space and the Public Transport Setting

A bus journey provides a parallel scenario to the increasing population density created by urban intensification. As predictably more passengers will board, individuals behave to compensate for the inevitably decreasing availability of physical space. Many adaptations to a densely populated environment can be seen in the public transport setting. Examples include individuals using possessions to claim more space than they physically need, the standard non-acknowledgement of others unless logistically necessary, and the somewhat instinctual decision that all individuals make about where to sit.

The public transport situation is unique in that it requires people to share a limited space that has a fixed seating layout, encourages intimate distances between strangers and requires that people remain in that space until they reach their destination (Thomas, 2009). There are real consequences in sharing a limited space, including physiological, cognitive and emotional changes. Evans and Wener (2007) measured stress levels of train passengers using a physiological index of salivary cortisol, performance on a proof reading task, and self-reported mood. The study found all three indices to be reliable indicators of stress, evidencing the physiological, cognitive and emotional impact of the spatial environment. Individuals using public transport must balance their need to maintain awareness of the environment for practical task management and personal safety, with the need to decrease awareness of nearby strangers to reduce the experience of stress.

A New Zealand study by Russell et al. (2011) observed the behaviour of passengers while seated in buses. The most commonly observed behaviour was looking ahead or out the window, and many passengers were also seen to be reading, closing their eyes as if sleeping, or listening on headphones. A later survey of over a thousand passengers undertaken by Russell found that the most commonly reported passenger activities were gazing out of the window and thinking.

Important Terms and Theoretical Issues

Space has a hidden presence in our lives. It is always around us but is something we do not generally think about until it is vastly abundant or until its presence is compromised.

Personal space conceptualises the area around an individual that they wish to preserve as their own. Personal space is described by Sommer (1969) as an ‘emotionally charged zone’ within which the presence of another person will induce stress (p. viii). Sensitivity to the presence of others increases with proximity. As such, the experience of stress increases in intensity as proximity increases. Proximity to others will be experienced less intensely by an individual requiring a smaller area of personal space than by someone with greater personal space needs. Therefore, close proximity is better tolerated when an individual requires a smaller area of personal space.

Defining features of personal space are that the area is geometrically irregular, situational, fluid in size, mobile, and the individual remains its axis. Sommer (1969) is often falsely cited as comparing personal space to a giant soap bubble surrounding a person[1] (e.g. Bechtel, 1997, p.185) but unlike a bubble, personal space is not spherical. An individual’s personal space is generally smaller to each side of them than to their front. Sommer (1969) observed this in that people can better tolerate an encroachment on personal space from the side than from in front of them. Personal space is fluid in that it will extend in the direction of anything that the individual appraises to be a potential threat (Strube & Werner, 1984, cited in Bechtel, 1997). Hediger (1950, 1955, cited in Bechtel, 1997) also observed in animals that the gross size of personal space is situational. He noted that after firing his gun he could no longer approach an animal as closely because subsequent to firing his gun the animal would flee from him when he was still at a greater distance. Evans and Wener (2007) suggested that personal space functions as a ‘boundary control mechanism’ motivating the maintenance of safe interpersonal distances (p. 92).

[1] Sommer (1959) only made reference to Von Uexkull’s (1957) analogy of people being ‘surrounded by soap-bubble worlds’ (Von Uexkull, cited in Sommer, 1959, p. 247).

Interpersonal distance is a closely related but separate construct to personal space. Interpersonal distance is simply the distance between individuals, whereas personal space is the psychological phenomenon, or mechanism, that motivates and guides the distance individuals maintain between one-another. It may be referred to as interpersonal distance, individual distance, interaction space, interpersonal space and other variations thereof. The present study uses the term interpersonal distance, considering it to be the most accurate description of the distance between individuals.

Edney, Walker, and Jordan (1976) argued that personal space helps an individual to maintain control over social situations. Another person is appraised as too close when their proximity creates an unwelcome feeling of discomfort. Hall (1966, cited in Holahan, 1982) also stated that when interpersonal distance is not right for an individual it can create feelings of discomfort and anxiety.

The feedback of discomfort produced by an invasion of personal space motivates the individual to re-establish a protective distance from the invader. Re-establishing a sufficient interpersonal distance dissipates the feeling of discomfort. The greater the perceived threat, the further the personal space boundary is from the individual and the greater the interpersonal distance needed for the feeling of discomfort to dissipate. Greater distance provides more time to react to a physical approach, and as such, distance functions to provide insulation from potential sources of threat.

Threats are not always sources of physical danger and include threats to psychological and emotional wellbeing, such as information overload, or stimulus overload. Milgram (1970) explained the concept of overload as receiving more inputs from the environment than one can manage to process. He claimed this to be a typical experience of the urban environment that resulted in inhabitants adapting their behaviour to protect psychological wellbeing. Humans have increasing sensitivity to stimulus at closer proximity so attempt to regulate the availability of stimulus by controlling proximity. Hall (1966, cited in Holahan, 1982) devised four concentric zones around individuals based on human sensory capacities. Hall quantified that information is shared between individuals through visual and oral cues at a distance of 12 to 25 feet; this information is more detailed at a distance of 4 to 12 feet; also includes olfactory information from 18 inches to 4 feet; and additionally includes temperature at a range of 0 to 18 inches. The distance maintained between individuals in interactions affects what and how much information is exchanged. Maintaining greater interpersonal distance affords less unwanted social exchange of information. Information or stimulus overload can therefore also be moderated by interpersonal distance.

Population density refers to the number of people per unit of space in a given area and can be relatively easily measured. Population density is related to personal space and interpersonal distance in that a more densely populated zone facilitates greater proximity to others. As the number of people in a confined space increases, the average area of space available to each individual decreases. Evans and Wener (2007) note the implication that the greater the density of people, the greater the chance of unwanted physical or social contact with others.

Privacy is an abstract construct describing the experience of sufficient limitations on the exchange of information with others. Individuals assess how much information exchange or privacy they desire in a situation and attempt to maintain that level. The level of privacy ultimately experienced is affected by multiple factors such as ‘[interpersonal] distance, eye contact, body orientation, and conversation intimacy’ (Hall, 1966, cited in Greenberg & Firestone, 1977, p. 637).

Crowding commonly connotes a large number of people for a given area, however the experience of crowding is linked more directly to proximity than to population density. Evans and Wener (2007) found that the experience of crowding in a train carriage was more closely related to the proximity of the passengers nearest the individual than it was to the overall population density of the carriage. It was also found to be significantly correlated with the experience of stress. The experience of crowding being a function of proximity rather than population density indicates the significance of interpersonal distancing in our appraisal of the environment.

The stimulus overload model and the privacy regulation model are two distinct models of crowding. The stimulus overload model of crowding holds that feeling crowded is experienced when the amount of social stimulus received is greater than the level that is desired (Evans & Wener, 2007). Altman's (1975, cited in Greenberg & Firestone, 1977) privacy regulation model understands the experience of crowding to result from privacy needs being unmet for the given situation. Greenberg and Firestone (1977) pointed out that this is different to the stimulus overload model because the mere presence of others in situations that would otherwise be considered private can induce feelings of crowding.

Territory is the reasonably fixed geographic area that is claimed, often visually marked out, and defended by its occupant. From an evolutionary perspective, territorial behaviour may be an adaptive response to competition for limited resources. Those with the ability to defend sufficient territory will then have the best chance of survival. Similarly, control over an area may secure access to privacy in a situation where the availability of privacy is limited. Animals use behaviours such as scratching the bark of a tree, secreting odours, or urinating at the boundary to claim and defend an area in their absence (Bechtel, 1997). Although none are common practice in human populations, people do equally use other forms of marking. Individuals mark their territory with fences, doors and locks, or markers may be more abstract such as a ‘reserved’ parking sign or a legal title to land.

Past Studies of Human Sensitivity to the Spatial Environment

The 1960s and 1970s was a period that saw immense interest in what was termed ‘proper ecological balance’ and the effect of increased population density on humans (Kutner, 1973, p. 31). Despite further increasing human populations and changing environments, little work has been published on the topic since and as such, much of the literature comes from that period.

The study of reactivity to the spatial environment began with the observation of the flight distance of animals. Flight distance is the proximity to an animal that causes the animal to flee. Sommer (1959) noticed that flight distance had been measured for hundreds of species but never measured in humans. As was observed with animals, humans will generally increase interpersonal distance in response to an intrusion on personal space. Although an abstract concept, personal space can conceivably be measured through interpersonal distancing. Experimenters, therefore, sought to measure the physical boundaries of human personal space by establishing the interpersonal distance at which the presence of another person will elicit behavioural attempts to mitigate the discomfort. For example, Sommer (1969) invaded the personal space of psychiatric inpatients, moving closer until his proximity ultimately caused the unwilling participants of his study to flee. Sommer had believed the psychiatric hospital to be a ‘feasible and appropriate’ setting for experiments in personal space invasion as he believed it to be somewhat exempt from the behavioural constraints imposed by society (1969, p. 32). However, studies have found personal space and interpersonal distancing to be influenced by a complex matrix of individual, interpersonal, and environmental factors. These include individuals' physical orientation and opportunity for eye contact, cultural and social norms, social status, gender, sense of control, perceptions of threat, stimulus intensity, availability of environmental cues, and demands on attention.

Researchers have sought to quantify personal space through interpersonal distance using a variety of measures and units of measurement. For example, Kaya and Erkip (1999) measured interpersonal distance using 30cm floor tiles. Cavan (1966, cited in Sommer, 1969) measured interpersonal distance by the number of barstools between people. Hall (1966, cited in Holahan, 1982) measured distances by levels of intimacy according to human sensory capacities. Dosey and Meisels (1969) measured image placement. Sommer (1959) quantified interpersonal distances using relative seat positions around tables.

Past studies have highlighted the importance of study design, method and construct validity in the research design and interpretation of results. Studies with poor construct validity have demonstrated the necessity of ensuring that the behaviour measured is a valid representation of the intended construct. For example, Dosey and Meisels (1969) studied the effect of stress on personal space using three methods of measurement. The researchers had participants draw a figure of themselves next to another figure, observed where participants chose to sit at a table relative to the researcher's seat, and used the stop-distance method where participants were asked to walk up to a peer and stop in front of them. The findings revealed little correlation between participant scores on the three measures of personal space (stop-distance, drawing and seat choice).

The type of study undertaken also places limits on the interpretation of results. In an exploratory observational study, Sommer (1959) observed the relationship between the seat position of hospital staff members at a cafeteria table and the frequency with which they interacted with individuals at other seat positions. The study found that a greater proportion of the verbal interactions than would occur by chance took place between individuals sitting corner to corner (at right angles to one another) at the table. A major limitation to interpretation of these findings was that, in being observational only, the results were non-directional. It could not be determined whether the interaction between individuals sitting corner to corner resulted from the seating positions or if the seating positions were chosen with intent to interact. To gain further understanding of how these variables interacted required Sommer to conduct another study and used an experimental design. Findings are discussed later in this paper.

Variables Affecting Personal Space Needs

Many individual, interpersonal and environmental factors affect the size and shape of an individual's personal space and what that individual therefore considers a comfortable interpersonal distance.

Angle of orientation and visual proximity. A problem with measuring interpersonal distance by relative seat position around a table is the confounding effect of people being at different angles of orientation to one another. For example, Dosey and Meisels (1969) used the seat around the corner of the table from the experimenter as their measure of 'near' distance and the seat directly across the four foot deep table as the 'far' distance from the experimenter (p. 94). Finding no effect of the experimental condition on participants' choice of near or far seats, Dosey and Meisels reflected that the covariance of different opportunities for eye contact in directly facing versus being perpendicular to the experimenter may have masked any trend in preference for interpersonal distance.

Sommer (1959) asked pairs of hospital staff and pairs of nursing students and then groups of three to take a seat at a cafeteria table in order to participate in a discussion task. The experiment was not concerned with the discussion task itself but with how each pair or group of three positioned themselves around a table relative to one another. An important element of the design was that the participants usually chose their seat ‘without conscious decision’ (Sommer, 1959, p. 253). Sommer found that in selecting seat positions around a table with the purpose of having a discussion, the pairs overwhelmingly chose to sit corner to corner. The finding was statistically significant and occurred regardless of table dimensions. Out of the eleven groups of three individuals, nine groups chose the chair positions around the end of the table that also maximised corner to corner seating. As this result was unlikely due to chance, the results suggested that people prefer to sit at right angles to one another when conversing at a table.

Sommer’s (1959) study of seating position suggested that visual proximity as well as spatial proximity factored into the spatial arrangements of interpersonal interactions. Individuals seated closer to one another interacted more frequently than individuals seated further apart with the one exception being individuals seated side by side. Individuals sitting directly side by side are at greater proximity than the individuals seated corner to corner but have limited visual proximity. The angle of orientation between individuals moderates the extent to which visual information can be, and is, exchanged. There is greater opportunity for visual communication between people sitting corner to corner than between people sitting side to side. There was also greater interaction between people sitting corner to corner than between people sitting side to side.

Changing from a perpendicular orientation to a face-to-face orientation is similar in effect to increasing proximity between individuals in that it produces greater information exchange, greater physiological arousal, perceptions of increased proximity, and a heightened experience of stress (Kutner 1973; McBride, King & James, 1965). Kutner (1973) claimed that the exchange of visual information is the most difficult interpersonal interaction to control and likened visual exposure to an invasion of privacy. He also noted that the closer a person or object is to an individual, the more of their visual field they fill, in turn making it more difficult not to look at them.

To explore the relationship between visual exposure, stress and distance perception, Kutner (1973) had pairs of participants sit in chairs facing either towards or away from each other while they independently undertook an audio task. He had conceived that an audio task would deny participants a 'socially approved place' to look and so participants sitting face to face would be visually exposed to one another (p. 37). Kutner found that on average, participants seated facing each other underestimated interpersonal distances and reported greater stress compared to the participants sitting back to back. This experience of greater stress when facing another individual supported previous research by McBride, King and James (1965) who had found greater physiological changes in seated individuals when they were approached from the front as compared to when they were approached from either side or behind.

Previous studies have demonstrated that people generally have a greater area of personal space in front of than behind them (e.g. Hayduk, 1978). Kaya and Erkíp (1999) observed the proximity of queuing individuals to a person using an indoor

ATM and administered a questionnaire subsequent to their using the machine. If the dimensions of personal space were similar for each of the individuals observed by Kaya and Erkíp, and if all queued facing forward toward the ATM, then each person standing in the queue could be expected to maintain a greater distance in front of their body than the distance the next person forward in the queue required behind them. Accordingly, this means that interpersonal distances in a queue should not be experienced as crowded.

Cultural and social norms. Personal space requirements differ between cultures and within cultures, however most people will develop their personal space needs in line with the norm for their culture. People use ‘culturally accepted norms of interpersonal distance’ to regulate privacy (Evans & Wener, 2007, p. 90). Regulation of distance facilitates regulation of both stimulus intensity and social exchange of information. Cultural and social norms of interpersonal distancing might be most evident to an individual when they are violated.

Behavioural attempts of humans to mitigate discomfort are guided and constrained by cultural and social norms. Greenberg and Firestone (1977) studied the effect of personal space invasion on the behaviour of individuals in an interview situation where the interviewer sat close enough to the participant for their knees to touch. In one condition, the participant’s chair was positioned in the very corner of the room so the participant was physically unable to increase their distance from the interviewer. In the second condition, the participant’s chair was positioned nearer the centre of the room meaning that they were physically able to increase their distance from the interviewer. However, only two of the 64 participants in this condition actually did move their chair. The other participants did not regulate interpersonal distance because their behaviour was restricted by rules of social politeness. The researchers concluded that even when participants were physically able to move their chairs away from an uncomfortably close interviewer, they did not feel socially able to do so.

Social status. Rosenfeld, Giacalone and Kennedy (1987) explored how a person's social status moderated the likelihood of others intruding into their personal space. The researchers found that an individual's higher status decreased the likelihood of others intruding into their personal space. The researchers expanded on previous work by Barfoot, Hoople, and McClay (1972) and observed the proportion of people walking through a university administration building who stopped to drink from a water fountain in each of three conditions. The high status condition was operationalised by a man wearing a suit and tie standing beside the fountain and reading a newspaper. The same man repeated this in the low status condition but instead wearing jeans and a t-shirt. In each of these conditions, drinking from the fountain entailed intruding into the personal space of the man standing beside the fountain. Nobody stood by the fountain in the control condition. Results of the study found that significantly fewer people stopped and drank from a water fountain in the high status condition than in the control condition. Fewer individuals drank from the fountain in the low status condition than in the control condition but it was not statistically significant. Although an effect was observed, being that only between 2.1% and 5.5% of individuals stopped to drink from the fountain across the three conditions, the small effect size may have lead to the result being non-significant.

The study by Greenberg and Firestone (1977) of the uncomfortably close interviewer therefore presents a paradox to this study of status. While in Rosenfeld, Giacalone and Kennedy (1987) people were less inclined to intrude on the personal space of someone with higher status, in Greenberg and Firestone (1977) a person with lower status was not inclined to moderate uncomfortable proximity if the interpersonal distance was being determined by a person of higher status. This might provide evidence that interpersonal distances are set by those of higher status and adhered to by those of lower social status.

Gender. In his study of seat position choices, Sommer (1959) had also been interested to see if gender affected what chair participants chose when asked to talk with somebody who was already seated. Rosenfeld, Giacalone and Kennedy (1987) claimed that while it is a well-established norm for individuals to avoid invading the personal space of others, the extent of avoidance is situational. The study by Sommer (1959) found that gender affected the likelihood of sitting alongside the other person. Female participants sat in closer proximity to the already seated person when that person was also a female, compared to when the already seated person was a male. Female participants had also generally sat down closer to males than the male participants had sat down to somebody of either gender. Female participants sat alongside the female confederates far more frequently than they did alongside the male confederates. Male participants sat alongside the female confederates less frequently than the female participants had done. No male participants chose to sit alongside a male confederate. This evidences gender affecting interpersonal distance and angle of orientation.

Perceptions of control. Edney, Walker, and Jordan (1976) measured the area of beach around individuals that those individuals regarded as, or intended it to be, their territory. The researchers found that the area of beach claimed was influenced by the proximity of other groups, the individual's locus of control and by their sense of control of the environment at the time. When the average measure of interpersonal distance from the closest two groups of strangers was greater than seven foot there was no significant difference between the sizes of individuals' territories based on their situational appraisals of control over the environment. However, it was found that at interpersonal distances less than seven foot, individuals who felt lower in control claimed a greater territory compared to individuals who felt higher in control. A gender effect was also observed as males in the study had significantly higher perceptions of control over a situation as compared to females.

Perceived threat. Gérin-Lajoie, Richards and McFayden (2005) suggested that in conditions of high information processing demands, participants maintained a greater distance from a human-shaped object to compensate for directing less attention to the object. Maintaining a greater distance provided the individual with a longer buffer of time to detect if the object posed a threat and to respond accordingly. People similarly retain a greater distance from signs of anger in others. Participants in a study by Park, Ku, Kim, et al. (2009) interacted with a 'virtual person' from a greater distance when the virtual person showed angry affect than when it showed either neutral or happy affect. There was no significant difference between neutral affect and happy affect. This suggests that the greater distance from the virtual person was in response to perceived threat.

The study by Edney, Walker, and Jordan (1976) on the relationship between an individual's sense of control over their environment and the amount of space claimed at a beach showed that the size of their territory increased in response to perceived threat and psychological stress in the same way that an individual's personal space expands in response to feeling threatened. This is consistent with Dosey and Meisels' (1969) hypothesis that the psychological stress resulting from peer assessment of attractiveness would motivate individuals to maintain greater interpersonal distances.

Personal space needs are also seen to expand with the added threat of completing a banking transaction in public, as seen in Kaya and Erkíp (1999). In observing the proximity of queuing individuals to a person using an indoor ATM, Kaya and Erkíp (1999) found that the interpersonal distance maintained between the front of the queue and the ATM user was experienced by the ATM user as being crowded but not experienced as crowded by the person when at the front of the queue. However, this can be explained in that an individual's personal space is situational. Using an ATM is a situation that entails an element of risk by the nature of the task, creates a desire for greater privacy and consequently the desire for greater a interpersonal distance. Using an ATM in public communicates that the user might be accessing cash, placing that individual at greater (if not still minimal) risk of theft. In addition to maintaining privacy while entering bank account access codes and monitoring the environment for the threat of theft, the ATM user is undertaking a banking task that itself requires attention. In comparison, the individuals waiting in the queue can afford more attention to monitoring their environment therefore requiring less space than the person using the ATM.

As increased psychological stress is correlated with increased personal space needs, it is interesting that the personal space of prisoners with a history of violence was found to be four times greater in area than that of non-violent prisoners (Kinzel, 1970, cited in Holahan, 1982). Perhaps heightened psychological stress precipitates violence. This greater personal space requirement might additionally contribute to others' easy violation of a violent offender's personal space. Perhaps living in an environment of violence precipitates heightened psychological stress in individuals. Perhaps it is this chain effect that perpetuates an intergenerational cycle.

Stimulus intensity. All behaviour occurs within an environment. Nesbitt and Steven (1974) concluded that individuals regulate interpersonal distances according to the intensity of stimulus. Their experiment measured interpersonal distances in a queue in both high and low visual stimulus intensity and high and low olfactory stimulus intensity conditions. The high visual stimulus condition was operationalised by the model wearing brightly coloured clothes and the low visual stimulus condition by the model wearing conservative clothing. Nesbitt and Steven found that people standing in a queue immediately behind the model, kept a greater interpersonal distance on average when the model wore brightly coloured clothes compared to conservative clothing. However, Nesbitt and Steven recognised a potential validity issue in the operationalisation of high stimulus. High intensity stimulus clothing for the female model was a long, shiny, gold dress, and the clothing worn by the male model was a red shirt with yellow polka dots. The researchers reflected that these clothes may be unlikeable and their condition of high stimulus intensity may have instead acted as a condition for dislike. Nesbitt and Steven repeated the experiment with a high olfactory stimulus condition operationalised by the model wearing a ‘likeable’ perfume or aftershave (p. 110). The experiment produced the same results with the perfume as it had with the bright clothing, supporting the hypothesis that people maintain a greater distance from higher stimulus.

Availability of environmental cues. Lloyd, Coates, Knopp, Oram and Rowbotham (2009) modified the stop-distance method to study the effect of auditory stimulus on personal space boundaries. The researchers had participants approach and stop in front of a confederate under three different auditory conditions. The conditions determined the availability of external auditory cues and the degree of auditory stimulation. Their findings showed that compared to in normal external auditory conditions, participants stopped at a significantly greater distance from the confederate when wearing earplugs or listening to music through personal-stereos. This was interpreted to suggest that participants maintained the greater interpersonal distance as a safety buffer to compensate for the lack of external auditory cues that would normally inform them about their environment. Maintenance of greater interpersonal distance reflected the greater personal space needs of individuals under those auditory conditions.

Information processing demands. Gérin-Lajoie, Richards and McFayden (2005) tested the effect of information processing demands on personal space. The researchers found that personal space was involved in regulation of distances for self protection with greater distances maintained when information processing demands in the environment were greater. Gérin-Lajoie and colleagues had participants walk past a human-shaped obstacle, manipulated auditory and visiospatial processing demands in the environment and measured the distances participants maintained from the obstacle. Personal space protects an individual during walking as the space provides a buffer of time to detect any hazards, plan, and change path trajectory to avoid them (Gérin-Lajoie et al., 2005). The researchers hypothesised that when competition for an individual's attention increased, the individual would experience greater personal space needs and accordingly would alter their trajectory path to maintain a greater distance from an obstacle when walking past it. The findings of the study supported this hypothesis.

In a study by Park, Ku, Kim, et al. (2009), participants diagnosed with schizophrenia were found to maintain greater interpersonal distances than the control participants when interacting with a virtual person. As impaired sensory gating is a problem in schizophrenia, information overload theory may provide relevant insight into information processing difficulties characteristic of schizophrenia. A greater interpersonal distance provides a less detailed visual image. Park et al. suggested that a propensity for maintaining greater interpersonal distances may be an adaptation to prevent overstimulation and distractibility through decreasing the amount of visual information gained. Similarly, in Sommer's (1959) study of the seat position chosen by individuals under the pretence of discussing a topic, none of the males without a schizophrenia diagnosis sat alongside the male confederate whereas the male patients with schizophrenia predominantly sat alongside the male confederate. Sitting beside another person allows less opportunity for visual exchange of information so becomes a technique for sensory gating.

Adaptive Behaviours

When flight behaviour is restricted physically or socially, people are observed to engage in an array of behavioural adaptations that attempt to increase personal space or to increase their sense of space. Milgram (1970) suggested that increasing one's sense of space served the adaptive function of preserving 'emotional and social privacy' in an environment where attaining physical privacy is more difficult (p. 1463).

Offensive and withdrawal behaviours. These responses can be described as offensive or withdrawal behaviours. Kaya and Erkíp (1999) reported that some ATM users gained privacy by shielding the ATM screen. Others responded to a threat to their privacy by turning to look at the person queued behind them, with some ATM users also responding verbally to that person's proximity. Turning to face the person and responding verbally can both be described as offensive, challenging behaviours. The change in angle of orientation when turning to look at the person queued behind may be sufficiently effective for them to increase interpersonal distance. A face-to-face orientation acutely heightens the person's visual exposure and in turn creates a heightened sense of proximity that may then become experienced as uncomfortably close. Gaining privacy by shielding the ATM screen from a perceived threat is an example of withdrawal behaviour.

Kutner (1973) cited previous research by Felipe and Sommer (1966) who had observed that individuals reacted to an encroachment on personal space by turning their head away. Greenberg and Firestone (1977) noted that intrusion on personal space resulted in postural withdrawal. The researchers reported that when an interviewer deliberately sat so that his knee touched the participant's leg, almost all participants adjusted their posture to avoid physical contact.

Withdrawal responses to insufficient personal space or privacy may also be to withdraw socially, psychologically or verbally. Withdrawal behaviours are those such as decreasing verbal self disclosure and decreasing visual exposure or the amount of eye contact made. Greenberg and Firestone (1977) studied the effect that intrusions on privacy and personal space had on participants' behaviour in an interview situation. The study found that intrusion on privacy resulted in verbal withdrawal. Participants disclosed less about themselves in the reduced privacy interview condition where two confederates acting as non-participant observers were also present during the interview. In the same study, intrusion on personal space resulted in visual withdrawal by participants. The participants whose personal space was severely intruded upon by the interviewer used less eye contact than participants whose personal space was not encroached on.

Collective management of the spatial environment. Space can be collectively managed through the regulation of equal distribution. Findings of Edney, Walker, and Jordan

(1976) showed support for people selecting positions on a public beach so as to maximise interpersonal distances between strangers. The researchers measured the distance from 60 lone individuals to the nearest two groups of people settled on the beach and found that these nearest two interpersonal distances were strongly positively correlated at $r = .86$ ($p < .001$). Highly correlated measurements suggest that the individuals had positioned themselves to maximise all interpersonal distances. While this promotes retention of enough public territory to meet the individuals' own personal space needs it also collectively creates a situation of best meeting everybody's personal space needs.

Social behaviour may be collectively regularised in situations that threaten the size of an individual's space. Sommer (1969) observed that commuters on crowded public transport lowered their eyes and became physically still in order to minimise 'unwanted social intercourse' (pp. 28-29). He claimed that the scenario of two people making eye contact on a bus or a train and forming a connection was largely unrealistic and a fiction of Hollywood. Kutner (1973) considered having eye contact met by a stranger to amount to an invasion of privacy. He claimed that being caught looking or staring implies curiosity or some other motive, even if looking was unintentional. The individual who finds another person looking at them may feel that their privacy has been intruded on, meanwhile the individual whom was caught looking may feel that they have been exposed. If an individual wanted to minimise their sharing of visual information and avoid unintentional visual engagement or violation of the privacy of others, they might choose to face away from others, obscure their eyes (such as with sunglasses, a cap, a hood or a fringe), or to engage visually with something else that is socially approved and less exposing, such as looking out the window.

Another example of collective management is that space may be collectively observed as a person's territory even when it is marked only by that person's habitual presence. Sommer (1969) observed that routinely occupying a public space, such as a particular chair at a regular meeting or a particular seat on a daily commute, can create 'a form of tenure' where even in their absence other people will still treat the space as being occupied (p. 52).

Use of material items. A collective strategy used in managing the spatial environment is a culturally shared recognition of a claim to public territory through use of material items. People often make territorial claims to public areas and can successfully defend an area for some time using only everyday material items as markers such as a jacket over the back of a chair. Sommer and colleagues found that when there was low demand for seats in a library, pretty much any object could effectively defend a seat as being occupied territory, as long as the marker was not perceived as just rubbish (n.d., cited in Sommer, 1969).

It is common to see people on public transport using personal-stereos. Through a qualitative study, Bull (2000) found that personal-stereos are being used by individuals to reduce awareness of environmental stimulus in situations that require strangers to co-exist in each other's personal space, situations where the individual may feel threatened by the environment and situations where the individual may otherwise experience stress from sensory overload/overstimulation. Bull suggested that personal-stereos can increase an individual's sense of space by creating a virtual sound space that is private to that individual. The use of personal-stereos may therefore be a material adaptation allowing passengers to decrease their personal space needs by increasing their sense of space.

Another material adaptation for negotiating a densely populated environment is the use of physical barriers. Passengers have been observed to utilise physical barriers to manage the space around them. Fried and DeFazio (1974) found that passengers aided their maintenance of interpersonal distance using the physical structures in the train carriage as territorial boundaries. On the train carriages studied, the seats with structural boundaries were the two-passenger seats and the seats at each end of the long benches. These seats best separated individuals from other passengers, at least on one side, and they were the seats first selected by passengers. In their study of passenger seat occupancy in train carriages, Evans and Wener (2007) noted that passengers would sit at either end of an empty row of three seats but would not sit in the middle seat. They suggested that this is because an empty seat on either side of the individual doubles the likelihood of a stranger sitting right beside them. Evans and Wener also suggested that passengers avoid sitting in the middle seat of three seats because sitting between two strangers reduces the effectiveness of postural readjustment as a behavioural adaptation to invasion of personal space. Postural readjustment can involve changing body position to angle away from another individual and thus reduce visual exposure. However, this tactic is not effective when there are people seated to both sides.

Key Study

The present study replicates in part a study by Rivano-Fischer (1988) titled ‘Micro territorial behaviour in public transport vehicles’. The study aimed to observe the formation of separate territories within a bus and to explore how effective commonly used behavioural strategies are in maintaining a territory. As part of the study, Rivano-Fischer conducted a natural observation study of the seats selected by bus passengers. In the university town of Lund, Sweden, Rivano-Fischer randomly selected journeys along one bus route between 10am and 3pm. The time parameters were chosen to avoid peak work commuting hours during which Rivano-Fischer suggested habitual patterns of seating may manifest. Data was collected by an observer who sat in the rear corner of the bus who used a seating plan to record which seats were occupied after every stop made. Observations spanned the first 15 bus stops on the route. Only one layout of bus was used so that seating could be compared between journeys. Seating capacity was forty passengers. Bus journeys on which passenger numbers exceeded the seating capacity were excluded from the study. Seventeen journeys were included in the final analysis.

The model of bus used by Rivano-Fischer had a central exit door approximately half way down the bus and the opposite side of the aisle to the door was an area void of seating. The section of the bus forward of the central door was referred to as the *front zone* and the area rear of the central door was referred to as the *rear zone* of the bus. Within each of these areas Rivano-Fischer made a distinction between 'relevant' and 'non-relevant' seats. Twenty-eight paired seats were referred to as 'relevant' seats, six pairs of which were located in the front zone of the bus and eight pairs of which were located in the rear zone. All other seats were considered 'non-relevant.' These were the driver's seat, the row of five seats at the very rear of the bus (one of which was occupied by the observer) and the seven foremost passenger seats. These seven seats were arranged as a row of three seats and a row of four seats that were across the aisle from each other and oriented to face into the aisle.

Rivano-Fischer claimed that together the central exit door and the area void of seating across from the door demarcated a boundary between two geographically separate sub-territories; a front zone and a rear zone of the bus. Rivano-Fischer hypothesised that the two sub-territories would result in differential preferences for seating within each territory. It was expected that the rear zone would be preferred at low passenger density with the rationale that passengers would claim an area that allowed them privacy and aided their retention of the space. An assumption made is that the rear zone of the bus better facilitates this.

Using the data from the seventeen journeys, Rivano-Fischer calculated mean passenger densities for the 12 ‘relevant’ seats in the front zone and 16 ‘relevant’ seats in the rear zone of the bus at bus stops #3, #6, #9 and bus stop #12. The results showed greater mean passenger density in the rear zone as compared to the front zone of the bus at bus stop #3, but greater mean passenger density in the front zone as compared to the rear zone of the bus at bus stops #6, #9 and #12. Mann-Whitney U tests found the differences to be statistically significant.

Rivano-Fischer interpreted greater passenger density as indicating a preference for that zone. The results were therefore interpreted as showing a preference for the rear zone of the bus at bus stop #3 and then switching to the front zone being preferred at bus stops #6, #9, and #12. Rivano-Fischer suggested that the front zone of the bus may have been the preferred zone at high passenger density as sitting down removed the individual as quickly as possible from the ‘glances and looks’ of already seated passengers (p. 13). This switch in zone preference was considered by Rivano-Fischer to show support for the front and rear zones being separate sub-territories in that model of bus.

The second hypothesis made by Rivano-Fischer was that when the choice is available, passengers will choose to sit at window seats over aisle seats. Rivano-Fischer gave the rationale that passengers aim to ‘put as much interpersonal distance as possible between each other’ and window seats allow a greater distance from other passengers. Another rationale given was that window seats better allow passengers to avoid social engagement.

Results of the study were interpreted as showing support for these claims. Rivano-Fischer found that across the 17 bus journeys, seats were occupied at bus stop #6 at a ratio of 2.3 window seats for every aisle seat occupied. At bus stop #12, seats were occupied at a ratio of 1.6 window seats for every aisle seat occupied. Rivano-Fischer also noticed a degree of consistency between journeys in the ratios of window to aisle seats occupied.

Critique of Key Study

In dissecting Rivano-Fischer's observational study of human sensitivity to their spatial environment, some reasoning to elements of the chosen procedure and analysis remain perplexing. This includes Rivano-Fischer's operationalisation of sub-territories, the interpretation of changes in passenger density as defining discrete sub-territories, and the possible creation of construct validity issues in selective inclusion of seating as relevant versus non-relevant given the effect inclusion or exclusion of seats has on zone density calculation. The risk is that reporting selective observations of passenger behaviour within arbitrary sub-territories may culminate in a misrepresentation of the sensitivity and behavioural responsivity of humans to their environment.

Identifying the study's procedure required investigation. The total number of passengers observed by Rivano-Fischer over the 17 journeys was not given but the mean number of passengers for bus stops #3, #6, #9 and #12 could be derived from their Table 1 which presented 'total passenger density' (p. 9). Mean passenger density increased sequentially over these four bus stops with population means of one passenger at bus-stop #3 and 23 passengers at bus stop #12 using Swedish rounding[2]. Rivano-Fischer also reported that observations were taken at the first fifteen bus stops. A table showed passenger density at bus stop #3 to be zero for five of the 17 journeys. This enabled it to be inferred that bus stops #1 to #15 were the first possible bus stops on the bus route and not the first 15 stops that the bus stopped at on each journey. Also, as mean passenger density at bus stop #1 was graphically depicted as greater than zero it could also be inferred that data pertaining to each bus stop was recorded after any new passengers were seated and not upon the bus pulling in to a stop.

Using a 10am to 3pm timeframe for observations was a good decision by Rivano-Fischer to avoid circumstances that may elicit habitual behaviour. Rivano-Fischer did not report what days of the week or over how many days the data was collected but the concern expressed about habitual patterns of seating being enacted during work commuting hours suggests that observations may have taken place on weekdays. The 10am to 3pm timeframe was therefore used to avoid mass commuting travel times in which seating arrangements may have been regularised by routine. Sommer (1969) had reported how habitual use of a public area can create a form of ownership over a space where, even in their absence, the space is respected by others as being occupied. The off-peak timeframe also reduced the likelihood of passenger numbers exceeding seating capacity.

Rivano-Fischer's random selection of bus journeys may have been an unnecessary or even detrimental design factor. The waiting between randomly selected journeys would have likely made it a time consuming exercise and thus contributed to limiting the study's sample size to 17 journeys. By restricting observations to the 10am to 3pm timeframe, measures were already in place to avoid systematic bias in

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[2] Swedish rounding seemed appropriate as each passenger observed was a whole person and, given the setting, was likely to be Swedish.

passenger seat selection. As journeys between 10am and 3pm were less likely to be routinely and exclusively utilised by the same groups of passengers, it was expected that the position of occupied and available bus seats would differ from one journey to the next. Seat selection would then already be an outcome of primarily spontaneous decision making by each passenger in response to their immediate environment upon boarding. For this reason it seems more important that a large enough data sample be collected than it does to randomly select journeys travelling the same bus route.

Strangely, Rivano-Fischer based two of the study's hypotheses on incongruent theories. One hypothesis was that passengers will act to establish sub-territories (front zone and rear zone) that differ by population density. Another hypothesis was that passengers will select window seats over aisle seats in order to maximise interpersonal distances. These are incompatible in that establishing areas of different passenger densities would not maximise interpersonal distances between all individuals. Areas of different passenger densities could allow for greater interpersonal distances in the least densely populated sub-territory, however, individuals in the most densely populated sub-territory would on average be in closer proximity to one another than they would if all people were equally distributed across sub-territories.

In testing the first hypothesis that separate sub-territories would be evidenced by different passenger densities, Rivano-Fischer (1988) delineated two geographical sub-territories. The sub-territories were perceived as being separated by the area devoid of seating that spanned the width of the bus at the rear exit door. The prediction was non-directional as to how the passenger density in the front zone of the bus would differ to passenger density in the rear zone of the bus. Rivano-Fischer considered that there may be more than the two sub-territories in the bus and it is not explained why the rear exit door was specifically chosen as the defining boundary. Another prominent partition that could have been considered is the central aisle of the bus. The central aisle is also an area devoid of seating that could be considered to divide all seats on the bus into left and right sub-territories with the one exception of the middle seat at the very rear of the bus.

Rivano-Fischer (1988) calculated mean passenger densities for each bus stop with all passengers and seats, however, in comparing passenger density between the front and rear zones of the bus, the study treated only the regular, forward-facing, paired seats as being ‘relevant.’ This decision is unusual as Rivano-Fischer had justified including all passengers in calculating mean passenger densities because ‘the total number of passengers and their seating preferences are important factors affecting the choice of new passengers boarding the bus at that stop’ (1988, p. 6).

Seating in the front and rear zones differed in that there were twelve ‘relevant’ seats in the front zone and sixteen ‘relevant’ seats in the rear zone of the bus. Seven of the seats in the front half and five of the seats in the rear half of the bus, including that of the observer, were disregarded from calculations as ‘non-relevant.’ This is a large proportion of seats to ignore and meant that comparisons of passenger densities between front and rear zones of the bus excluded over a third of the seats in the front zone and nearly one quarter of seats in the rear zone of the bus. Among the seats excluded were seven side-facing seats in the front zone of the bus. The side-facing seats were unique as the only seats in Rivano-Fischer’s study where passengers may end up seated face to face (across the aisle) with a stranger. Side-facing seats also involve travelling sideways which is not a natural direction for humans to travel in. If for these or other reasons fewer passengers chose to sit in the side-facing seats compared to other seats it would mean that actual passenger density in the front of the bus would be less than that reported. Including those side-facing seats in comparing front and rear zone passenger densities could then potentially have changed the statistical significance of Rivano-Fischer's findings for bus stops #6, #9 and #12.

Rivano-Fischer used the Mann-Whitney U test of statistical significance. The Mann-Whitney U test requires independence of cases. This is not possible when the same observer appears in the data on all journeys in pre-selected seats. Rivano-Fischer met the requirement for independence of cases as the observer was not included in analysis. However, excluding the observer entails its own consequences. While the observer did not feature in the data, their presence would still have been a feature of the bus environment in which passengers made decisions on where to sit. Without acknowledging the observer's presence in the data, any influence they may have had on passengers' seat selection would remain unexplained variance.

All behaviour occurs in context so in a study of spatial relationships between people in an environment it is important to achieve an accurate representation of those elements of the environment. The bus environment in which passenger behaviour was measured had included all seats on the bus and all occupants of those seats. As the environment would have influenced the behaviour that was measured, the behaviour is best interpreted within the context of that same spatial and interpersonal environment, as was experienced by the passengers. However, Rivano-Fischer selectively included and excluded elements of the environment and interpreted the data within that altered environment.

The distinction Rivano-Fischer made between 'relevant' and 'non-relevant' seats was not, as the labels seem to imply, to do with the relevance of those seats to the bus environment and phenomenon of interest. Instead, the labels simply coded decisions made by Rivano-Fischer about what seats to include or exclude from the analysis. This selectivity may have been to simplify the task of data collection or the data analysis but the decision was made at a cost to the study's validity. As passenger density is a statistic of the number of occupied seats divided by the total number of seats in a given area, it is illogical to claim that particular seats within the area are not relevant to passenger density.

Passenger density of the 'relevant' seats in a zone would only be representative of all seats in that zone if passenger density in the 'non-relevant' seats was homogenous with the rest of the seating. Rivano-Fischer's study used only one model of bus in the analysis. This may have been because only one model of bus serviced the route. Alternatively, it may have been to control for an anticipated effect of different seating layouts on passengers' seat choices. If the latter were so, this would imply that Rivano-Fischer did not expect passenger densities in 'relevant' and 'non-relevant' seats to be homogenous. If seating layout differently affected seat selection then seat occupancy could be expected to differ between 'relevant' and 'non-relevant' seats. Therefore, findings based solely on passenger density of the 'relevant' seats would not be expected to represent the total passenger density of each zone or accurately reflect the seating behaviour and patterns of spacing observed.

Rivano-Fischer's second hypothesis stated that window seats are preferentially selected over aisle seats when the choice is available, the rationale being that window seats maximise interpersonal distances between passengers (p. 9). This requires that window seats do in fact facilitate greater distance from other passengers. From a window seat the sum of the distances to all other passengers may be greater than from an aisle seat, but only on the assumption that not all other passengers are seated against that same window. On the other hand, if an individual chose a window seat where the nearest passengers were at the same window one row in front and one row behind, the physical distance from either would be less than if the individual were to sit in the aisle seat one row in front or one row behind. The aisle seat, however, would entail greater visual proximity.

Rivano-Fischer tested the hypothesis that window seats are preferentially selected over aisle seats by comparing the number of passengers seated at a window with the number of passengers seated in the aisle at bus stops #6 and #12. Using only the paired seats, half of the seats observed would be by the window and the other half would be aisle seats. An all-in comparison of the number of passengers in window seats with the number in aisle seats is only an accurate measure of seat preference under the assumption that the random chance of each passenger sitting at the window or aisle is 50/50. However, passengers enter a bus and select seats one at a time. Each passenger changes the availability of seats for subsequent passengers and therefore changes the odds of their sitting at a window or aisle seat at random. This would indicate the need for a stepwise analysis. The random chance of sitting at the window is 50% for the first passenger but then only 50% for the next passenger on the condition that both the seat chosen by the first passenger and the seat adjacent to that one are no longer included. Rivano-Fischer's 'all-in' analysis of window seats being preferentially selected over aisle seats is dependent on new passengers considering paired seats to both be unavailable when only one of the pair is occupied by a passenger. Therefore, in order to measure seat preference for window or aisle seats, Rivano-Fischer needed to have first established that seating behaviour meets this assumption in that passengers will not consider sitting beside a stranger when alternative seating is available.

The Present Study

The present study aims to explore human sensitivity to the spatial environment through observation and analysis of the seat choices made by bus passengers. Exploring everyday human behaviour in an environment of increasing population density and consequent decreasing availability of privacy and personal space could contribute to understanding, and even shaping, the possible effects of urban intensification on human behaviour and wellbeing.

It is predicted that human sensitivity to the presence of others in the spatial environment will be reflected in the seat choices made by bus passengers. It is expected that analysis of seat occupancy will demonstrate that seats are actively chosen by passengers to maximise their distance from other passengers and maximise their sense of space. If bus passengers do select their seats to maximise interpersonal distances then it can be expected that:

Hypothesis 1. Passenger density in the front zone of the bus will be the same as passenger density in the rear zone of the bus and passenger density on the left side of the bus will be the same as passenger density on the right side of the bus.

If bus passengers do select their seats to maximise sense of space then it can be expected that:

Hypothesis 2. Passenger density at window seats will be greater than passenger density at aisle seats.

If equal distribution between zones is observed in hypothesis one and is not an outcome of random distribution it can be expected that:

Hypothesis 3. When the option is available, passengers will select one of an unoccupied pair of seats rather than sit beside a stranger.

Method

Participants

Observations of 546 passengers were made on 26 bus journeys over five weekdays. All passengers boarded at one of the first 15 stops on bus route 274 heading into the city centre from the Auckland suburb of Three Kings.

Materials

A floor plan of seating on a generic bus was developed for recording passenger observations of where passengers sit. The template was able to be altered to represent the seat configurations of different bus models. At the start of each journey the observer altered the charts by crossing out seats not present on that bus and drawing an arrow to indicate a seat's direction if not toward the front of the bus. A template sheet of charts used in collecting the data is included as Appendix A.

The majority of bus seats were configured in pairs on each side of a central aisle and oriented towards the front of the bus. As such, these are referred to as *regular* seats. Seats in different configurations or at different orientations are referred to as *irregular* seats. Paired seats were either two clearly demarcated adjacent seats or were benches with seating capacity intended for two adults. Neither seats nor benches had armrests. Passengers on all bus models boarded through the front door by the driver and could exit through either the same door or a second door approximately half way down the bus. The floor level rear of the second door was elevated above the front section and separated by approximately two steps. Except for the pair of seats either side of the steps which were only partially raised, seats in the rear section were level to one another.

Figure 1 shows the three different seating layouts encountered over the 26 bus journeys. The three diagrams were used to chart the data. The partially raised seats at

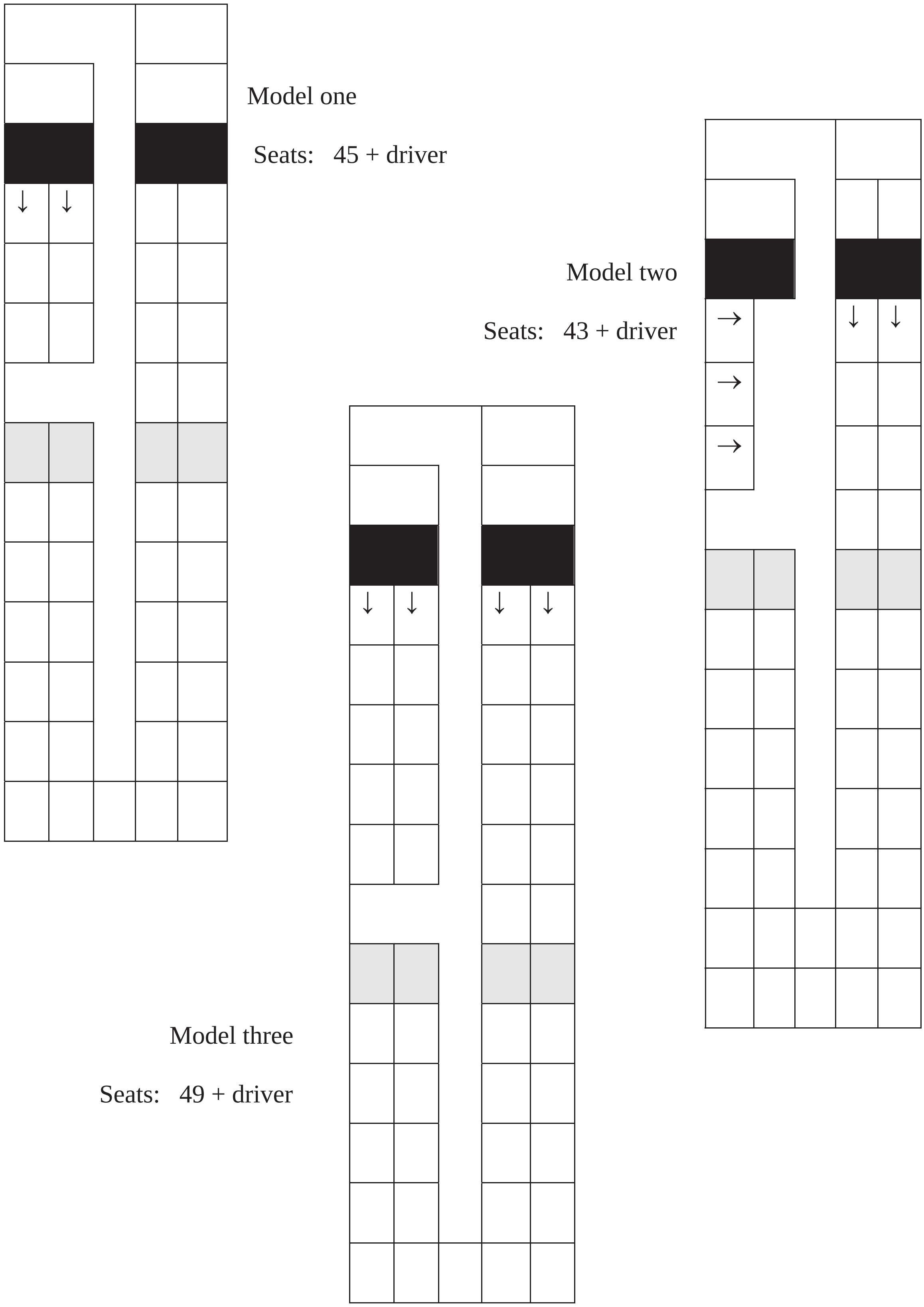

Figure 1. The three bus seating layouts encountered over all journeys.

the front of the rear section were shaded grey on the diagrams as a point of reference to aid the observer. The aisle steps are located between the seats shaded grey, platforms housing the bus' front wheels are shaded black, and arrows represent the orientation of seats facing directions other than the front of the bus. Over the 26 journeys observed, 12 journeys took place on bus model one, 11 journeys took place on bus model two, and 3 journeys took place on bus model three.

Bus model one had seating capacity for a driver plus 45 passengers, 36 of which were in regular, forward-facing pairs. The irregular seats consisted of the rear row of five and the foremost two passenger seats that accommodated single passengers only. The platforms behind those single seats provided some distance between the next row of passenger seats, of which one pair was rear-facing and therefore irregular, while passenger seats included the rear row of five, one single seat at the front, a pair of rear-facing seats, and a row of three side-facing seats rear of the platform housing the bus' front left wheel. Bus model three had seating capacity for a driver plus 49 passengers, 38 of which were in regular, forward-facing pairs. The irregular seats included the rear row of five, the foremost two passenger seats accommodated single passengers only, and rear of each single seat was a pair of rear-facing seats.

Procedure

Two pilot runs were conducted in order to develop the generic seating chart, to visually identify the first 15 bus stops along the journey, and to establish the best seat position for the observer. Passenger seating behaviour was collected by one observer during August and September of 2012 by method of natural observation. The observations took place on bus journeys between the hours of 10am and 3pm over five weekdays. The observer boarded the next bus departing from Three Kings travelling route 274 and returned to repeat this journey as many times as possible within the specified timeframe. The 15 bus stops included in the study were all possible stops along Mt Eden Road from the start point of the route at Three Kings (bus stop #8533) to the bus stop for the Mt Eden train station (bus stop #8503).

The best observation position for the requirements of the study was determined to be the seat in the second row of the rear zone of the bus, beside the left window. This seat was at the front of the highest tier of seats and had been identified in pilot journeys as the best position to view the bus stops, observe passengers as they entered through the front door of the bus, and view occupancy of all seats. The observer aimed to be the first passenger on board and to sit at this seat. If this primary observation position was unavailable upon boarding the bus, the observer sat in one of two alternative seats dependent on the position of any other passengers. This was necessary on six of the 26 journeys. Alternative seats were the window seat across the aisle from the preferred observation seat or if that was also occupied, the seat one row behind the preferred seat and on the aisle. These alternative positions were chosen based on their enabling observation of the rest of the bus and the bus stops.

Bus stops were labelled #1 through to #15 according to their order on the bus route, bus journeys were chronologically assigned a letter of the alphabet, and passengers on each journey were identified numerically by their order of boarding. For each stop made on a journey the observer noted the location of the bus stop, the order that passengers boarded, the seats they selected, the seats absented by passengers exiting the bus, and any other changes in seat occupancy. Observations were recorded using a new figure for every stop made. Charted data for the 26 bus journeys is presented as Appendix B.

All 1160 seats able to be occupied by passengers were included in the study. Newly selected seats were coded on the seating chart by recording the passenger’s identification number in the box corresponding to the seat they selected. The numeral formatted in bold font at bus stop #1 for each journey marks the seat occupied by the observer. Seats that remained occupied by the same passenger were marked as ‘0’ for ‘occupied’ at subsequent stops. Seats from which a passenger had newly absented to exit the bus were marked ‘x’ for ‘exit.’ Any seat absented in shifting to another seat was marked ‘c’ for ‘change’ and the passenger’s identification number was recorded in their newly selected seat position. Shifting seats was considered to occur at a bus stop in anticipation of new passengers boarding. Exceptions were annotated, such as when shifting seats occurred after new passengers had already boarded and taken a seat. The relationship between passengers whom appeared to be travelling together was charted for their bus stop of boarding by removal of the boundary that divided their seats. Any other items of significant size were described on the seating chart, for example, ‘pram’ and ‘dog.’

Passengers were not made aware of observations. The study was peer reviewed and recorded on the Massey University Human Ethics Committee’s Low Risk Database. Acknowledgement of the Low Risk Notification can be seen in the letter dated 09 August, included as Appendix C.

Results

Hypothesis 1

Passenger density was calculated by the number of bus passengers occupying seats divided by the number of passenger seats in the bus. Table 1 presents descriptive statistics of the number of passengers and passenger densities across the 26 bus

Table 1

Descriptive Statistics for the Number of Passengers and Passenger Densities Over All Journeys by Bus Stop

	Passengers N				Passenger Density		
	Total	Mean	Median	SD	Mean	Median	SD
Bus stop #3	167	6.42	5.50	3.28	0.14	0.13	0.07
Bus stop #6	229	8.81	8.00	4.83	0.20	0.18	0.11
Bus stop #9	315	12.12	10.50	6.90	0.27	0.24	0.16
Bus stop #12	445	17.12	15.50	9.04	0.39	0.36	0.21

journeys at bus stops #3, #6, #9, and #12. Figure 2 compares mean passenger density of the front zone with the rear zone of the bus for bus stops #3, #6, #9 and #12 across all bus journeys. The graph shows slightly greater passenger densities in the front zone compared to the rear zone of the bus at all four stops. This difference in passenger density between front and rear zones appears to increase at successive bus stops. At bus stop #3 the mean passenger densities of the front zone and rear zone were 0.15 and 0.14, respectively. At bus stop #6, the mean passenger densities of 0.20 and 0.19, respectively. At bus stop #9 the mean passenger densities of the front zone and rear zone were 0.29 and 0.26, respectively. At bus stop #12 the mean passenger densities of the front zone and rear zone were 0.44 and 0.35, respectively.

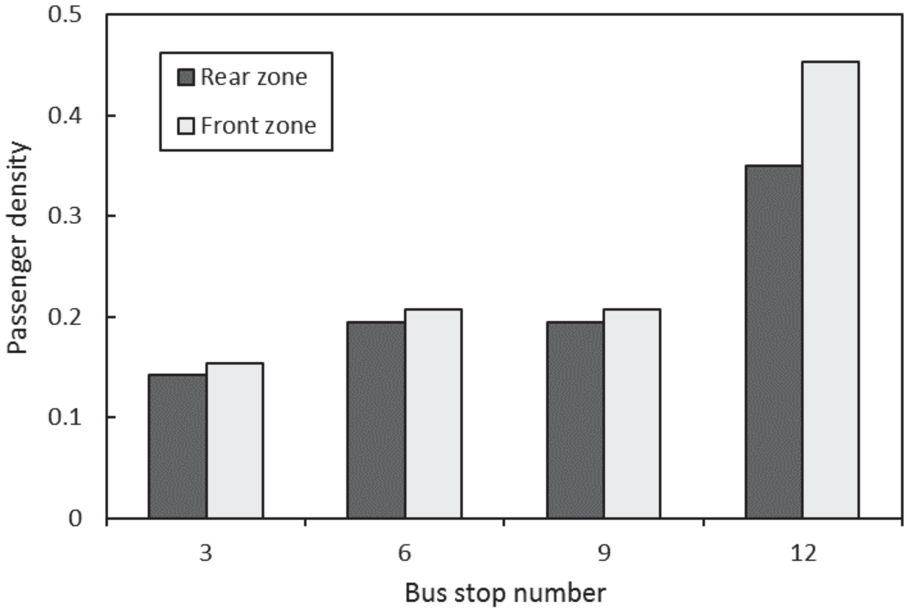

Figure 2. Mean passenger densities across all journeys, in front versus rear zones at four bus stops.

Over all journeys, 519 seats were available to passengers in the left zone of the bus and 615 seats were available in the right zone. Figure 3 compares mean passenger density of the left zone with the right zone of the bus for bus stops #3, #6, #9 and #12, across all bus journeys. The graph depicts slightly greater mean passenger densities in the left zone of the bus compared to the right zone of the bus for all four stops with bus stop #12 showing the least difference in mean passenger density between left and right zones. At bus stop #3 the mean passenger densities of the left zone and right zone were 0.16 and 0.14, respectively. At bus stop #6, mean passenger densities of the left zone and right zone were 0.21 and 0.20, respectively. At bus stop #9 the mean passenger densities of the left zone and right zone were 0.29 and 0.27, respectively. At bus stop #12, mean passenger densities were 0.39 for both zones.

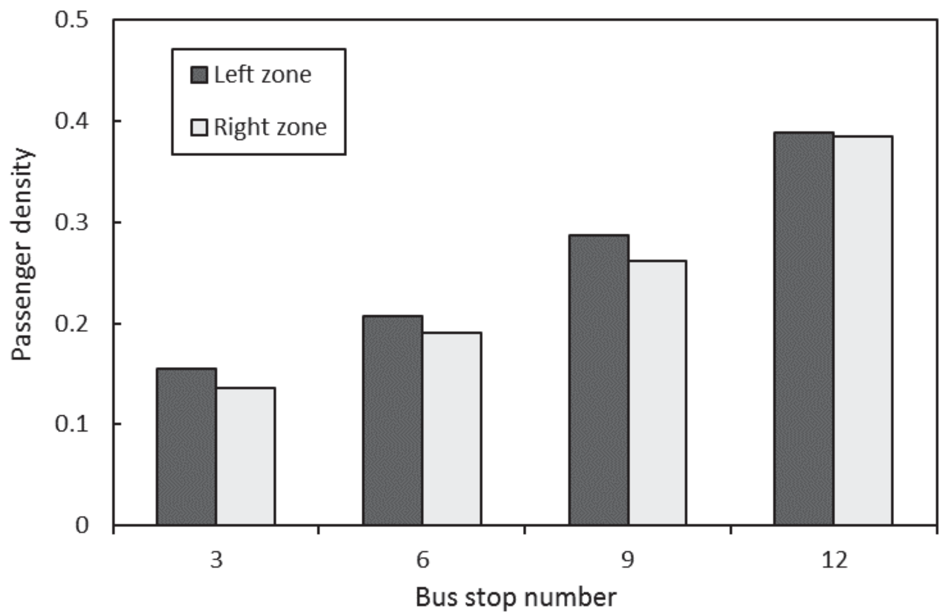

Figure 3. Mean passenger densities across all journeys, in left versus right zones at four bus stops.

Two-tailed Z-score tests were performed to test if mean passenger densities across all 26 journeys were significantly different between the front and rear zones and between the left and right zones of the bus at each of the four bus stops. Findings presented in Table 2 showed a greater mean passenger density in the front zone as compared to the rear zone of the bus at bus stops #3, #6, #9 and #12, however, these results were statistically significant only for bus stop #12 ($p < 0.01$).

Table 2

Comparison of Mean Passenger Densities between Front and Rear Zones of the Bus at Four Bus Stops

	Front Zone			Rear Zone				
	Passengers	Seats	Density	Passengers	Seats	Density	*Z*	*p*
Bus stop #3	62	418	0.15	105	742	0.14	0.317	.749
Bus stop #6	85	418	0.20	144	742	0.19	0.381	.704
Bus stop #9	120	418	0.29	195	742	0.26	0.893	.373
Bus stop #12	185	418	0.44	260	742	0.35	3.100	.002

Findings presented in Table 3 also showed greater passenger density in the left zone as compared to the right zone of the bus at all four of the bus stops tested, however, none of the differences were statistically significant at $p < 0.05$. In light of these results, the null hypothesis that there is no significant difference in passenger density between zones can be rejected for front versus rear zones at bus stop #12 only. The number of passengers boarding on a single journey differed within the wide range of 6 to 48 passengers. Data for the bus journeys was analysed to test if the number of journeys on which passenger density was higher in one zone of the bus was significantly different to the number of journeys on which passenger density was higher in the opposite zone. Zones having the greatest passenger density (front versus rear and left versus right) were identified for each of the 26 observed journeys at bus stops #3, #6, #9 and #12.

Table 3

Comparison of Mean Passenger Densities between Left and Right Zones of the Bus at Four Bus Stops

	Left Zone			Right Zone				
	Passengers	Seats	Density	Passengers	Seats	Density	*Z*	*p*
Bus stop #3	82	519	0.16	85	615	0.14	0.937	.347
Bus stop #6	109	519	0.21	120	615	0.20	0.623	.535
Bus stop #9	150	519	0.29	164	615	0.27	0.838	.401
Bus stop #12	201	519	0.39	239	615	0.39	0.046	.960

Two-tailed Z-score tests of statistical significance were performed to compare the frequencies with which zones had the greatest passenger densities and to determine if any difference between zones was statistically significant. Table 4 compares the number of journeys on which passenger density was greater in the front zone of the bus to the number of journeys on which passenger density was greater in the rear zone of the bus at each of the selected four bus stops. Findings showed a statistically significant difference in the number of journeys on which passenger density was greater in the front zone of the bus compared to the number of journeys on which passenger density was greater in the rear zone of the bus at bus stop #12 only ($p < 0.05$).

Table 4

Frequency of Journeys Having Greater Passenger Density in Front or Rear Zones of the Bus at Four Bus Stops

	Front	Rear	N	*p*
Bus stop #3	12	13	26	0.779
Bus stop #6	12	14	26	0.583
Bus stop #9	13	11	26	0.576
Bus stop #12	19	6	26	0.001

Table 5 compares the number of journeys on which passenger density was greater in the left zone of the bus to the number of journeys on which passenger density was greater in the right zone of the bus at each of the four bus stops. Findings showed no significant difference in the number of journeys on which passenger density was greater in the left zone of the bus compared to the number of journeys on which passenger density was greater in the right zone of the bus at any of the four bus stops. The hypothesis of no significant difference in passenger density between zones can therefore be rejected for front versus rear zones at bus stop #12 only.

Table 5

Frequency of Journeys Having Greater Passenger Density in Left or Right Zones of the Bus at Four Bus Stops

	Left	Right	N	*p*
Bus stop #3	12	11	26	0.779
Bus stop #6	13	12	26	0.779
Bus stop #9	16	9	26	0.052
Bus stop #12	11	14	26	0.407

Passenger density for a zone of the bus was calculated by the number of passengers occupying seats in that zone of the bus divided by the number of passenger seats in that zone. Figure 4 presents mean passenger densities over all bus journeys at each bus stop. Total passenger density is shown for the bus as a whole and for each quadrant. The quadrants are defined by the same boundaries used to categorise seating into front and rear zones and into left and right zones of the bus. Visual inspection of the graph shows the mean passenger density of each quadrant to progressively increase along the journey, with the front left and front right quadrants increasing in passenger density at a higher rate than the rear left and rear right quadrants. This trend becomes evident for the front left quadrant at bus stop #4 and later for the front right quadrant at bus stop #8, at which point passenger densities for all zones are approximately between 0.20 and 0.25 respectively. The rear right quadrant has the lowest mean passenger density of all quadrants at all 15 bus stops.

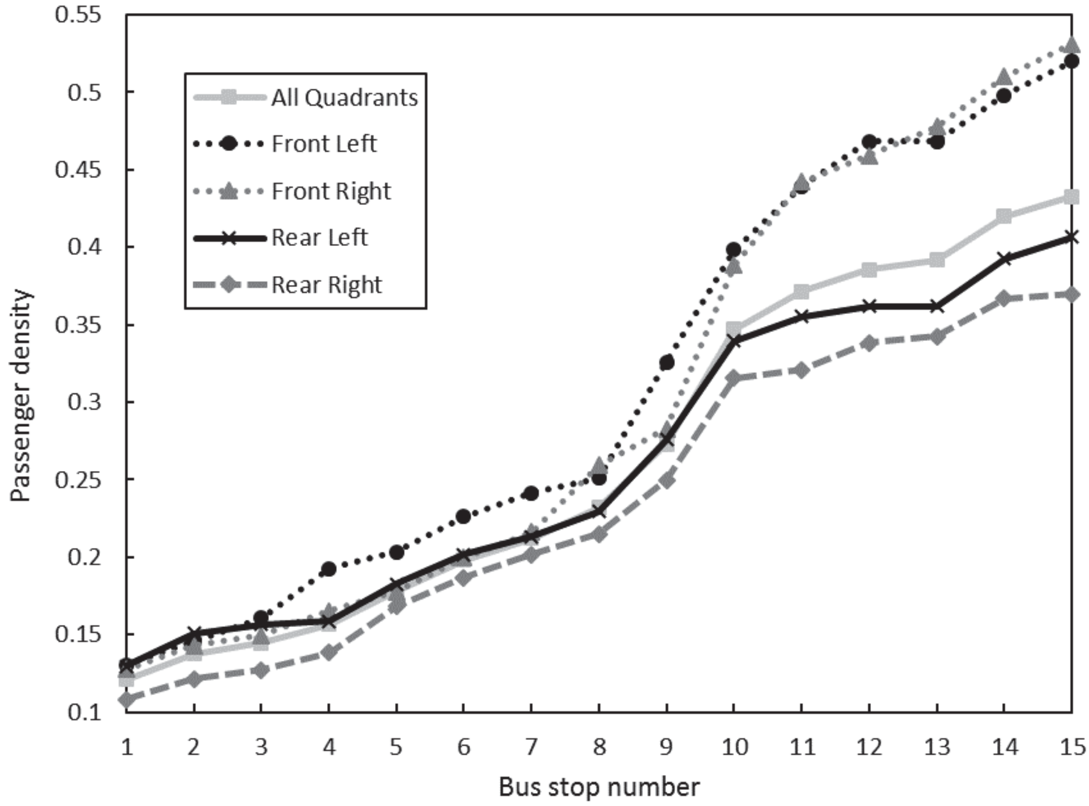

Figure 4. Mean seat occupancy across all journeys by quadrant.

Figure 5 presents mean passenger densities of each quadrant relative to total passenger density at each bus stop. The front left quadrant can be seen to increase in mean relative passenger density over the journey as the rear left and rear right quadrants decrease in mean relative passenger density over the journey. The mean relative passenger density of the front right quadrant can be seen to decrease slightly until bus stop #8 at which point there is a pronounced change and a trend of increasing mean relative passenger density can be observed. Of the four quadrants, the rear right quadrant has the lowest mean passenger density relative to overall passenger density for all 15 bus stops.

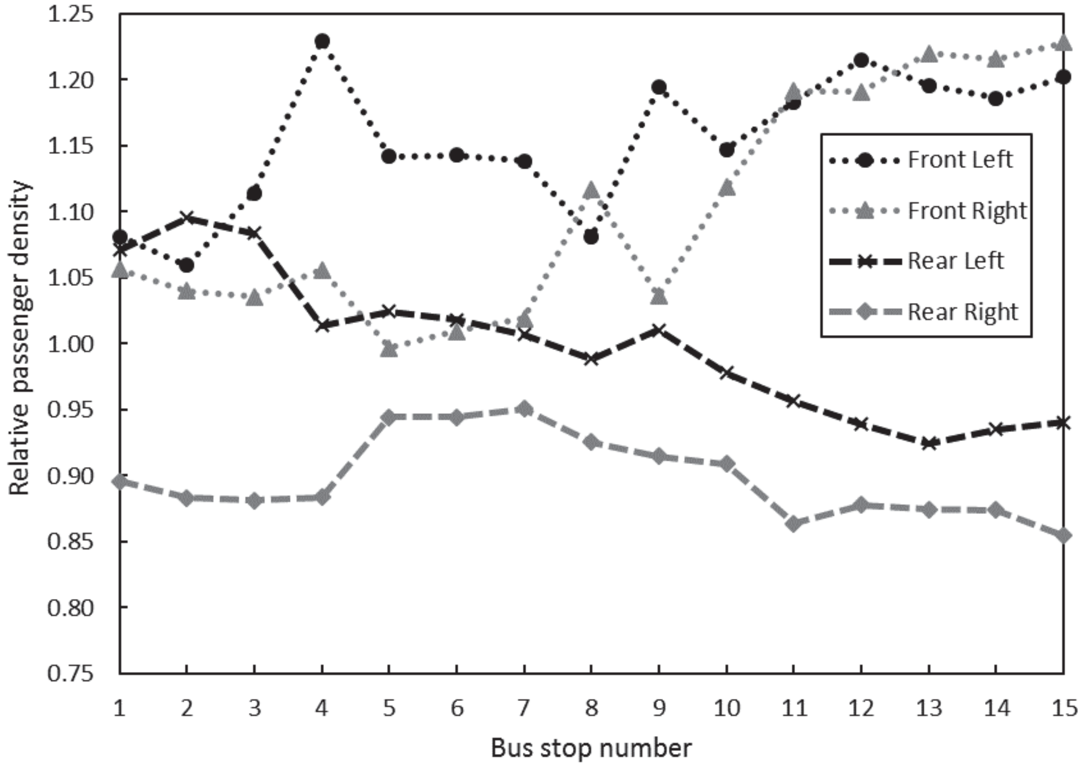

Figure 5. Mean bus seat occupancy by quadrant relative to overall bus seat occupancy.

Hypothesis 2

The numbers of passengers occupying window and aisle seats were compared to assess whether passenger occupancy of window seats was significantly greater than passenger occupancy of aisle seats across all 26 bus journeys. Only paired seats were included for comparison, including that of the observer. Paired seats were considered to be the seats or benches intending two passengers to sit exclusively and directly adjacent to one another. Of each pair, one seat was by a window and the other was by the aisle.

The number of passengers occupying window seats was summated across all 26 bus journeys for bus stop #6, bus stop #9 and bus stop #12. The same was done with the number of passengers occupying aisle seats. Total window seat and aisle seat occupancy was compared for each of the three bus stops. Bus stops #6 and #12 were selected as per Rivano-Fischer (1988) and bus stop #9 was later included in the present study to explore if a relationship existed between window versus aisle seat occupancy and total passenger density. Data from bus stop #9 on journey Q and for bus stop #12 on journeys C, K and Q was excluded because passengers were seated such that a choice between window and aisle seating was no longer available.

One-tailed Z-score tests were used to test whether the greater occupancy of window seats over occupancy of aisle seats was statistically significant. Results, supported the hypothesis. Table 6 below shows the greater passenger occupancy of window seats than of aisle seats across all journeys to be statistically significant for bus stops #6, #9 and #12 at $p < 0.01$, using one-tailed Z-score tests of significance.

Table 6

Number of Passengers Occupying Window Seats Compared to Aisle Seats Across the 26 Bus Journeys for Bus Stops #6, #9, and #12

	Window	Aisle	*Z*	*p*
Bus stop #6	153	43	11.11	< 0.01
Bus stop #9	180	60	10.95	< 0.01
Bus stop #12	207	81	10.50	< 0.01

Analysis suggested a close relationship between the proportion of bus passengers occupying window seats and aisle seats. Figure 6 and Figure 7 show very strong positive linear relationships between the number of bus passengers in paired seats and the number of bus passengers in window seats, as evidenced by the R-squared coefficient of determination values at bus stop #6 and bus stop #9. Figure 8 shows a strong positive linear relationship between the number of passengers in paired seats and the number of passengers in window seats at bus stop #12.

Analysis additionally suggested a relationship between seating distribution and mean passenger density, with the proportion of passengers occupying window seats reducing as overall passenger density increased. At bus stop #6, the mean number of passengers in the paired seats across all journeys was eight (7.54) and passengers were 3.56 times more likely to occupy window seats than aisle seats. Seventy-eight percent of the passengers in paired seats at bus stop #6 were seated by the window, as shown in Figure 6. At bus stop #12, the mean number of passengers in the paired seats across all journeys was 13 (12.52), and passengers were 2.56 times more likely to occupy window seats than aisle seats. Seventy-two percent of the passengers in paired seats were seated by the window at bus stop #12, as shown in Figure 8. A post hoc analysis of window and aisle seat occupancy for bus stop #9 found the mean number of

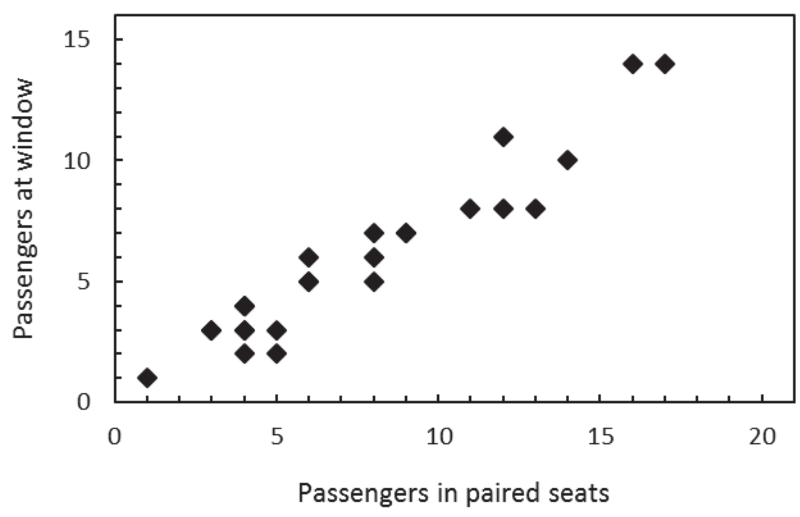

Figure 6. Proportion of passengers in window seats at bus stop #6.

passengers in paired seats across all journeys to be 10 (9.60), passengers were 3.00 times more likely to occupy window seats than aisle seats, and 75% of passengers were seated at the window, as shown in Figure 7.

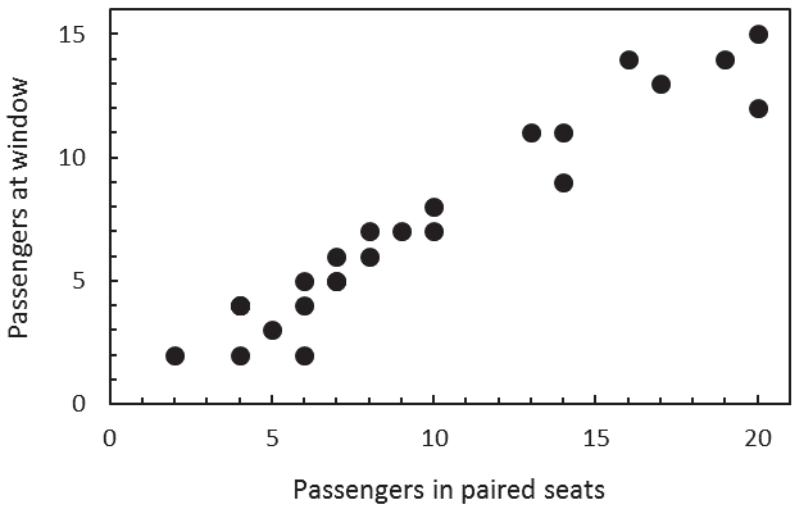

Figure 7. Proportion of passengers in window seats at bus stop #9.

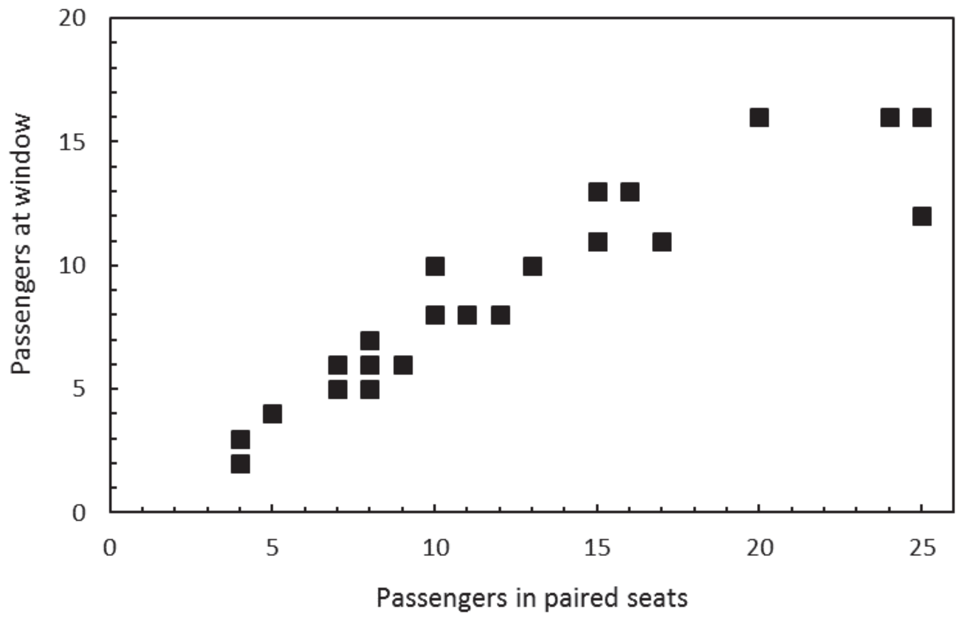

Figure 8. Proportion of passengers in window seats at bus stop #12.

Table 7 shows greater variance in the number of passengers on each bus journey in the present study than in that of Rivano-Fischer. This is particularly so in terms of variance as a proportion of mean passenger density. As such, the frequency of journeys on which passenger occupancy of window seats was greater than passenger occupancy of aisle seats was tested. for statistical significance at bus stops #6, #9 and

Table 7

Descriptive Statistics for the Number of Passengers in Paired Seats at Bus Stop #6 and Bus Stop #12 in Rivano-Fischer and in the Present Study

		N total	Mean	SD
Rivano-Fischer	Bus stop #6	210	12.35	4.26
	Bus stop #12	308	18.12	4.46
Present study	Bus stop #6	196	7.54	4.33
	Bus stop #12	288	12.52	6.40

#12. The frequency of journeys on which passenger occupancy of window seats was greater than passenger occupancy of aisle seats was found to be statistically significant for all three bus stops at $p < 0.001$, using one-tailed Z-score tests of significance. This provides support for hypothesis two.

Hypothesis 3

Observations were made to assess whether passengers selected seats that avoided sitting beside a stranger. This was analysed based on the occurrence or absence of coupling behaviour. Coupling was defined as an individual sitting directly beside a stranger when an alternative was possible. Analysis compared observed occurrences of coupling to random chance rates in order to assess whether passengers selected seats that avoided sitting beside a stranger more often than would be expected if seats were selected by passengers at random chance.

Coupling was present on ten of the 26 bus journeys in the study. The chance of an individual coupling if assigned a seat at random was calculated for each of the 207 passengers boarding prior to and inclusive of the first passenger coupling (i.e. the first passenger to sit directly beside a stranger when an alternative was possible). Random chance of coupling was operationalised as the number of seats available from the aisle that are directly beside another passenger divided by the total number of seats available from the aisle at the time of the individual boarding the bus. The numbers assigned to label each passenger refer to the order in which they boarded the bus and therefore the order in which seats were chosen on that journey. A summated chance of coupling equal to or greater than 1 could be expected to result in a passenger coupling.

Table 8 compares the boarding order number of the passenger observed to first couple with the number of the passenger that could be expected to first couple if seat selection occurred by random chance, for each of the ten bus journeys on which coupling took place. For example, the table shows that if seats were chosen at random, it could have been expected for coupling to have occurred on journey A by passenger number 12. However, coupling only first occurred on the journey upon passenger number 20 being seated.

Over the ten journeys on which coupling was present it could have been expected that, on average, coupling would occur by the time the 12th passenger was seated (M = 11.57, *Median* = 12) if seat selection was made at random. However, on average, coupling was only observed to occur upon the 21st passenger being seated (*M* = 20.6, *Median* = 21). Journeys J and K had the greatest difference between the expected and observed passenger numbers, with each journey having 14 more passengers boarding before coupling occurred than would have been expected if seats were selected by chance. The smallest difference between expected and observed number of passengers to result in coupling occurred on journey C. Even so, three more passengers boarded journey C before coupling occurred than would be expected through random probability alone. For each of the ten journeys, the number of passengers seated on the bus before the first passenger observed coupling was greater than that expected if seating occurred by random chance, and this difference was statistically significant at $p < 0.01$.

Table 9 presents the probabilities of coupling having occurred prior to when it did, if the passengers had all selected seats at random from the seats available to them upon boarding. The journeys shown are those ten bus journeys on which coupling occurred. The row for journey A in Table 9 can be interpreted in that the first 19 passengers boarded bus journey A and seated without anybody coupling. As was shown in Table 8, passenger number 20 was the first individual observed to couple on this journey. The probability of coupling upon boarding was calculated for each of the 19 individuals and these scores were added to find a summated probability of coupling having already occurred before the 20th passenger boarded. The probabilities added to 2.27 that of chance and still no passengers on that journey had coupled. For the ten bus journeys on which coupling occurred there was, on average, a 3.06 chance of coupling having occurred on that journey before the first passenger actually coupled. These findings support the hypothesis that passengers deliberately select seats that avoid sitting beside a stranger.

Table 8

Passenger Expected to First Couple Based on Random Probability Compared with the Passenger Observed to First Couple on Each Journey

	First passenger coupling	
Journey	Expected	Observed
A	12	20
B	11	21
C	12	15
H	12	20
I	13	22
J	11	25
K	10	24
O	11	21
Q	13	21
S	12	17
Mean	11.57	20.6
Median	12	21
SD	0.95	2.95

Table 9

Cumulative Probabilities of Coupling Having Already Occurred if Passengers Selected Seats at Random

Journey	Passengers seated before first coupling	*p*
A	19	2.27
B	20	4.21
C	14	1.76
H	17	1.73
I	21	3.39
J	19	3.25
K	23	3.81
O	20	3.68
Q	20	4.29
S	16	2.22
Mean	18.9	3.06
Median	19.5	3.32
SD	2.6	0.98

Discussion

The present study aimed to explore human sensitivity to the spatial environment through naturalistic observation of passengers' seat selection in a public transport situation. It was expected that human sensitivity to the spatial environment would be reflected in the seat choices made by bus passengers, with passengers choosing seats that maximise interpersonal distances, maximise their privacy and sense of space, and avoid intrusion on the personal space of others, to best accommodate personal space needs. Findings supported all three hypotheses tested.

Hypothesis 1

The first hypothesis, being that passengers will distribute evenly throughout the bus, was supported by seven of the eight comparisons made between complimentary paired zones. Distribution was measured by comparing passenger densities between front and rear zones of the bus and between left and right zones of the bus. These two comparisons of the passenger densities of complimentary zones were made at four bus stops on each of the 26 journeys. This provided eight comparisons between the mean passenger densities of zones over all journeys.

Mean passenger densities for the 26 journeys were compared between front and rear zones and between left and right zones of the bus, at bus stops #3, #6, #9 and #12 as had been selected by Rivano-Fischer (1988). Results showed a statistically significant difference in mean passenger densities between the front zone and rear zone of the bus for bus stop #12 only at which passenger density in the front zone was significantly greater than passenger density in the rear zone of the bus ($p < 0.01$). No significant differences were found in mean passenger densities between the front zone and rear zone of the bus for bus stops #3, #6, and #9. No significant difference in mean passenger density was found between left and right zones of the bus for any of the four stops. The same pattern was evident using two methods of comparison.

It was observed that the number of passengers boarding on a single journey differed within the wide range of 6 to 48 passengers. This raised concern that the use of mean passenger density across all journeys could be a misleading measure of the spatial behaviour of passengers at any one point. For example, a disproportionately large number of passengers in a particular zone of the bus on any one journey could mask a pattern of distribution between zones that is present on less populated journeys. To avert this possibility, an alternative method of testing passenger distribution between zones of the bus was employed.

Comparisons were made between the number of journeys on which passenger density was greater in one zone of the bus and the number of journeys on which the reverse occurred, for each of the four stops. A statistically significant difference was found between the number of journeys on which passenger density was greater in the front zone of the bus and the number of journeys on which passenger density was greater in the rear zone of the bus at bus stop #12 ($p < 0.01$). All other comparisons for the four bus stops found no significant difference between the numbers of journeys on which passenger density was higher in one zone of the bus over its complimentary zone. As both methods of comparing passenger density between zones produced the same result, this provided sufficient reassurance that mean passenger density across all bus journeys was not likely misleading as a measure of the spatial behaviour of passengers.

The seven comparisons that found no significant difference in mean passenger densities between zones provide support for the hypothesis that passengers will distribute evenly throughout the bus. Dispersing evenly throughout the available space allows all individuals to maintain maximum interpersonal distances. The hypothesis was derived from the theory that humans attempt to regulate interpersonal distances to regulate their experience of stress. The close presence of strangers produces both physiological and psychological stress responses (Evans & Wener, 2007). Greater interpersonal distances reduce the intensity of stress experienced. Distributing evenly throughout the available space will allow passengers to each maintain maximum interpersonal distances and therefore minimise stress caused by close proximity to strangers.

It was realised, however, that if seat selection were to occur at random chance then this could also present as an even distribution of passengers between zones as a pattern of random distribution. Therefore, in order to interpret even distribution between zones of the bus as an outcome of passengers' choices, the alternative explanation that the result is simply a presentation of random chance needed to be ruled out. This possible alternative explanation is tested in Hypothesis 3.

Given that seat occupancy is not by chance, the seven comparisons finding no significant difference in mean passenger densities between zones of the bus lend support to the theory that humans attempt to reduce the stress experienced in close proximity to strangers by regulating interpersonal distances. The present study's finding of a statistically significant difference in mean passenger density between the front zone and the rear zone of the bus at bus stop #12 was unexpected and does not provide support for the hypothesis. Issues of visual exposure, seat visibility, accessibility, and the differing affordances of different zones of the bus, and construct validity were considered in order to account for this finding.

The front zone of the bus had significantly greater mean passenger density compared to the rear zone of the bus at bus stop #12 in both the present study and in

Rivano-Fischer. This tendency may be able to be accounted for by the presence of factors that deter individuals from moving to sit in the rear of the bus at higher passenger densities, and similarly, factors that promote individuals remaining in the front zone of the bus at higher passenger densities. At higher passenger densities, the potential for reducing the stress experienced in close proximity to strangers by maximising interpersonal distance from others may become outweighed by the stress involved in taking a seat in the rear zone of the bus or outweighed by the affordances of sitting in the front zone of the bus.

Visual exposure. Passengers' avoidance of visual exposure may have contributed to the front zone of the bus becoming more densely occupied than the rear zone of the bus as passenger numbers increased. Visual exposure is the extent to which visual information can be exchanged between individuals, it is similar in effect to an invasion of privacy, is experienced as stress, and is the most difficult interpersonal interaction to control (Kutner, 1973). The mean number of passengers increased over the course of the bus journeys as passenger numbers accumulated heading towards the city. As the bus becomes fuller, passengers boarding are at risk of being looked at by more people and so may feel more exposed. Therefore, with a larger number of passengers, the extent of visual exposure experienced by newly boarding passengers also increased over the course of the bus journeys.

Visual exposure, especially having the face visible, elicits the same psychological and physiological stress response as being in closer proximity to others (Kutner 1973; McBride, King & James, 1965). Eye contact similarly promotes intimacy. The majority of seated passengers occupy regular seats so are oriented to face the front of the bus. All passengers enter through the front door of the bus and then turn to stand in the aisle facing the rear of the bus, entailing a front-on angle of orientation to a bus of strangers. The face is most exposed at a front-on angle of orientation such as when face to face with another person. A front-on angle of orientation also entails greatest potential for eye contact. Close proximity, a face-on angle of orientation and eye contact all increase potential for the exchange of information between people. People attempt to moderate the exchange of visual information to moderate stress. This supports a theory of passengers choosing to sit in the front zone of the bus if walking down the aisle to the rear zone will entail unwanted and extensive visual exposure. Finding a seat after boarding the bus at high passenger densities entails a situation of extensive visual exposure.

After boarding the bus, individuals walking down the aisle are face to face with the other passengers. Rivano-Fischer (1988) suggested that walking down the aisle to the rear zone of the bus involved encountering the ‘glances and looks’ (p. 13) of seated passengers. These glances and looks are experienced as visual exposure. Upon boarding at the front of the bus, passengers could minimise visual exposure by selecting a nearby seat and quickly sitting. Quickly sitting down in a regular seat after boarding changes the passenger’s angle of orientation and instantly averts this visual exposure.

Walking down the aisle to the rear zone of the bus means walking past the already seated passengers. The further down the aisle somebody walks, the greater the number of passengers they must pass in close proximity and be more intimately exposed to. The experience of stress in response to visual exposure would have also increased as passenger density increased. This in turn would have increased passenger’s motivation to reduce exposure. Increased motivation of passengers to quickly sit after boarding at the front of the bus would have increased passenger density of the front zone over the rear zone of the bus. When there are a lot of seated passengers, sitting in the front zone of the bus instead of of walking down the aisle may be a behavioural adaptation to avoid the visual exposure when it is appraised to be a greater stress than that of sitting in a higher density zone of the bus. Greater occupancy of seats in the front zone at bus stop #12 might therefore reflect an avoidance of the increased visual exposure experienced on boarding when the number of passengers are higher. Therefore, the behavioural strategy of minimising visual exposure to reduce stress provides a possible explanation for why the front zone of the bus had greater passenger occupancy than the rear zone of the bus at higher passenger densities in both Rivano-Fischer and the present study, given the greater stimulus intensity environment of higher passenger numbers by bus stop #12.

Limited visibility and accessibility. The greater passenger density in the front zone compared to the rear zone of the bus at bus stop #12 in the present study might also be accounted for in part by the differential visibility of seats and accessibility of seats in the front and rear zones to bus passengers boarding under different conditions. A potential explanation for the greater passenger density in the front zone of the bus would be if in higher passenger densities the passengers are less able to see from the entrance door whether there are seats available in the rear zone of the bus. Seats may be occupied by passengers, occupied by their belongings, or access to empty window seats may be blocked by people sitting at aisle seats. Passengers unsure of seating availability may avoid walking down the aisle to the rear zone if they will be at risk of failing to find a seat and needing to return to the front zone of the bus. There is some inherent embarrassment in seeking and not finding a seat, perhaps having an implication of public rejection. Selecting a seat in the front zone of the bus therefore both decreases the length of time standing in the aisle at a face-to-face angle of orientation to the seated passengers and minimises the risk of embarrassment at not finding a seat in the rear zone.

The number of bus passengers boarding at one stop may have also influenced where those passengers were able to sit. If passengers were to distribute evenly between zones, it would be expected that, when a greater number of passengers boarded at one stop, a greater number of those passengers would move to sit in the rear zone of the bus. However, the result of having a large number of people boarding at one stop might be that a greater proportion of those boarding chose to sit in the front zone of the bus. In the present study, a large number of passengers boarded at bus stop #10 and the passenger density increased to become significantly greater in the front zone compared to the rear zone of the bus between bus stops #9 and #12.

It was noticed in the present study that many passengers used electronic bus passes meaning that these passengers did not queue to engage with the bus driver in order to pay their fare. As a result, relatively little time was needed for each passenger to board in comparison to the time needed to find and take an unoccupied seat before the bus began moving, especially at already greater passenger densities. The large number of passengers boarding at one bus stop is then significant in that, although the bus may have been stationery for a longer period of time than at other stops in order for more passengers to board, the bus may not have been stationery for a longer time per passenger boarding.

It was observed that when the bus did begin moving from bus stop #10 there was often a larger group of passengers still standing in the aisle at the front of the bus. This larger group was most likely a greater proportion of boarding passengers than at bus stops where fewer passengers boarded. Consequently, a greater proportion of new passengers may have needed to find a seat in an environment in which the bus was moving and balancing to walk along the aisle was more difficult. The large number of passengers boarding at bus stop #10 therefore may have lead to more passengers sitting in the front zone of the bus and may have contributed to the imbalance in passenger density found between front and rear zones of the bus at bus stop #12.

Affordances of proximity. Greater occupancy of seats in the front zone compared to the rear zone of the bus at bus stop #12 might also reflect a growing importance of factors inherent to the front zone of the bus with increasing passenger density. One such factor may be proximity. A feature of the bus environment is access to exit doors. Ease of escape may become more important to passengers at higher passenger densities. The bus has two exit doors; one being at the very front and one midway down the bus. This means that the front zone of the bus is located between the two doors, thus affording those passengers in the front zone with two possible exit routes. Passengers in the rear zone of the bus have only the central exit door in close proximity. This is significant in that more passengers needing to use one door would mean more competition for escape. This survival scenario may only be registered at a subconscious level for most people, however, passengers do also have the practical need to exit the bus at their intended stop.

An obstruction in the aisle may impede a swift exit. Uncertainty as to whether they will have clear access to the exit before the bus leaves their intended stop may create anxiety, especially for those who feel less in control of their environment. As the front zone of the bus has two proximal exits it provides greater likelihood of finding an unobstructed route to an exit door. This may provide incentive for passengers to sit in the front zone of the bus, especially at higher passenger densities.

Comparison of findings between key study and the present study. Dissimilarly to the present study, the study by Rivano-Fischer found a significant difference in mean passenger density between front and rear zones of the bus for each of the four bus stops. Both Rivano-Fischer and the present study found mean passenger density to be significantly greater in the front zone of the bus compared to the rear zone of the bus for bus stop #12. However, unlike the present study, Rivano-Fischer additionally found statistically significant differences in mean passenger density at bus stops #3, #6 and #9. The differences found by Rivano-Fischer were of a significantly greater mean passenger density in the front zone compared to the rear zone of the bus for bus stops #6 and bus stops #9 and conversely, a significantly greater mean passenger density in the rear zone compared to the front zone of the bus for bus stop #3. Rivano-Fischer did not compare passenger densities of left versus right sides of the bus aisle.

Construct validity. The anticipated relationship of equal distribution of passengers between zones of the bus at all bus stops may have been obscured by the chosen measurement of passenger density. The operationalization of passenger density might account in part for the unexpected finding of a statistically significant difference in mean passenger densities between the front and rear zones of the bus at bus stop #12. Passenger density was operationalised by Rivano-Fischer and in the present study as the number of passengers to bus seats.

The discrepancy in findings between the present study and Rivano-Fischer’s study might possibly be explained by differences between the studies in the operationalization of passenger density of a zone. This is due to differences in which bus seats were included in analysis. In the present study, the decisions of which seats to include, whether to include the observer and whether to include the bus driver all posed dilemmas. Rivano-Fischer chose to differentiate between ‘relevant’ and ‘non-relevant’ seats, choosing to discount from analysis the seats he determined non-relevant. The present study chose to include all passenger seats in the analysis.

Including all passenger seats was considered to be more representative of the actual bus environment encountered by the passengers, and therefore the environment that would influence the behaviour being measured. This decision by Rivano-Fischer to define and exclude 'non-relevant' seats is a considerable design flaw of the study that risks producing a false effect.

Rivano-Fischer's statistically significant difference in mean passenger densities between front and rear zones for bus stops #6, #9 and #12 may be explained in part by Rivano-Fischer's decision to exclude particular seats from analysis. The 'non-relevant' seats in Rivano-Fischer's study were referred to in the present study as *irregular* seats. These seats were oriented irregularly compared to the majority of seats on the bus but were by no means irrelevant to the bus seating environment. The seats determined non-relevant and discounted by Rivano-Fischer therefore included all of the seats in the bus where passengers may be seated face to face with a stranger.

Previous studies have demonstrated that being oriented face to face with another individual increases the experience of proximity (e.g. Kutner, 1973) and increases the experience of stress (e.g. Kaya & Erkíp, 1999; Evans & Wener, 2007). If passengers regulate interpersonal distances to regulate stress they would likely avoid seats that heighten the experience of close proximity to a stranger. In the present study, the irregular seats were the least densely occupied as a group and decreased passenger density of their respective zones. Assuming that irregular, or non-relevant, seats were also the least occupied seats in Rivano-Fischer's study, excluding them from analysis would have produced results showing a falsely inflated passenger density for that zone.

In Rivano-Fischer, 7 of the 19 seats in the front zone of the bus were regarded as non-relevant and excluded from analysis while 5 of the 21 seats in the rear zone were regarded as non-relevant and excluded from analysis. The study's exclusion of these seats would have therefore distorted findings towards a greater passenger density being calculated for the front zone relative to the rear zone of the bus. If Rivano-Fischer was to have included all passenger seats in analysis, the passenger density of the front of the bus compared to the rear zone of the bus would have been less than that reported. It is possible that Rivano-Fischer may have then produced results showing no statistically significant difference in passenger densities between zones for some or all of bus stops #6, #9 and #12.

Placement and inclusion or exclusion of the observer required further consideration and was approached differently by each study. If passenger density had been operationalised differently, different results may have occurred. Mean passenger density as calculated by passengers per seat is not equivalent to passenger density as a measure of passengers per unit of area if the number of seats differs between equally sized areas. In the present study, the front left quadrant of the bus had considerably fewer seats per unit of area compared to the front right quadrant of the bus because the seating layout provided floor space for larger items (such as wheelchairs and prams). Bus models one and three in the present study both had two fewer seats in the front left quadrant compared to the front right quadrant (7:9 and 11:13, respectively). An even greater seating difference was seen in bus model two which had 60% fewer seats in the front left quadrant than in the front right quadrant (4:10). Using the measurement of people per seat meant that the front left quadrant of any of the three models of bus would be more densely occupied than the front right quadrant even if each occupied the same area of space and the passenger numbers were identical. If passenger density had been measured in the present study as passengers per area, the results would have shown a comparatively lower passenger density in the front left quadrant of the bus than presently found.

The observer in Rivano-Fischer (1988) sat in the rear corner of the bus. During pilot runs for the present study it was established that the very rear corner seat did not provide sufficient visibility of all other passenger seats as it had done in the bus model used in the study by Rivano-Fischer. The predominant issue was that the raised floor level of the rear zone of the bus meant that seats were higher in the rear zone and obscured the observer’s view of the seats just in front of the raised area. A different observation position was therefore chosen for the present study and afforded the observer a good view of all seats in the bus models encountered.

It was acknowledged that the observer in the present study sitting at the front of the rear zone may have influenced the seat choices of subsequent passengers differently to if the observer had been seated in the rear corner of the bus. However, as other passengers would respond accordingly in their seat choices to the position of the observer, the observer’s position should not matter as long as it was included in analysis. Rivano-Fischer’s observer sitting in the very rear corner of the bus and not being included in analysis furthers the study’s misrepresentation of the bus environment. By routinely discounting the observer from analysis, Rivano-Fischer’s comparison of passenger densities between front and rear zones would have consistently shown lower passenger density in the rear zone of the bus than that actually experienced by the passengers whose behaviour was being observed.

Whether the driver should be included as a passenger in calculating passenger densities posed a dilemma. The present study chose to include all passengers in the analysis because it was believed that the presence of every individual contributed to the bus environment that each new passenger responded to in choosing their seat. It was also considered therefore that the presence of the bus driver may similarly influence the seating behaviour of passengers. Inclusion or exclusion of the driver would have statistically affected results the most at very low passenger densities. Of the four bus stops, this would have had the greatest effect at bus stop #3 at which passenger density was lowest.

A New Zealand study by Thomas (2009) found that at low passenger numbers there was a preference for window seats on the left side of a bus over window seats on the right side of a bus. It was suggested by Thomas that the preference found for window seats on the left side of the bus over window seats on the right side of the bus may be due to the curb side of the bus (the left) providing a better view, although what exactly this better view consisted of was not articulated. The present study also found greater passenger numbers on the left side of the bus compared to the right side of the bus but this difference was not statistically significant. If such a pattern were found to be statistically significant it could suggest that passenger seating behaviour is responding to the presence of the bus driver on the right side of the bus at lower passenger densities.

The statistically significant difference in mean passenger densities between front and rear zones for bus stop #3 in Rivano-Fischer might therefore be explained in part by Rivano-Fischer’s decision to exclude the driver’s seats from analysis. Including the driver as being in the front zone of the bus would have increased the population density of the front zone. For bus stop #3 in Rivano-Fischer this would have created greater similarity in mean passenger density to that of the rear zone. It is not known whether by including the driver in calculations, the difference in passenger density between front and rear zones would have decreased enough to become statistically nonsignificant.

A conceptual problem arose, however, in considering whether the driver should be included in calculating passenger densities. In the present study the driver’s seat was at the very front of the bus and on the right. On most of the bus journeys there was a solid wall partition behind the driver's seat but on a smaller number of journeys the partition was a sheet of glass that left the driver in view of all passengers. This barrier behind the bus driver posed a particular issue to determining whether or how the driver should be included. The driver was certainly on the right side of the bus as divided by the central aisle and was visible there to all upon boarding through the front door. However, a solid wall partition behind the bus driver's seat meant that while the driver was visually present to passengers seated on the left side of the bus they had in effect been removed from the environment of the passengers seated on the right side of the bus. Including the driver as being in the right zone of the bus would have further decreased the difference in passenger densities between left and right zones, resulting in a more equal passenger distribution. The present study chose to exclude the bus driver from all analyses, as had Rivano-Fischer. It was decided that the driver's seat should not be included in the right zone of the bus for the purpose of this study if the passengers seated in the right zone of the bus could not see him or her from their seats on the majority of journeys.

Comparison of findings between past studies and the present study. Findings of Edney, Walker and Jordan (1976) support the hypothesis of people actively distributing themselves equally across confined spaces. Edney, Walker, and Jordan measured the distance between strangers settled on a public beach and found that distances to the two groups nearest an individual were strongly correlated. Highly correlated measurements suggests that individuals had positioned themselves to maximise all distances to those surrounding them and evidences motivation for maximising interpersonal distances within a confined space.

Findings of Nesbitt and Steven (1974) support the theory of equal distribution as the attempt of individuals to regulate stimulus intensity of their environment. The presence of a stranger provides greater stimulus intensity and in turn, greater stress, than an empty section of bus. Nesbitt and Steven found that in high stimulus conditions, individuals increased interpersonal distances. This would lower stimulus intensity and stress. This theory that people distribute equally within a space in order to minimise stimulus intensity and stress from proximity is supported the seven of eight comparisons in the present study that found no significant difference in passenger density between zones.

Analysis of irregular versus regular seat occupancy in the present study suggested a relationship between seat orientation and mean passenger density. The present study found that irregular seats were the least populated group of seats on the bus. The irregular seats may have been the least populated group of seats because of the implications of their angle of orientation.

In the present study, a greater proportion of the front zone of the bus was comprised of irregular seats compared to the proportion of irregular seats in the rear zone of the bus. Passengers attempting to moderate stress by actively avoiding a high degree of visual exposure likely contributed to the present study’s findings of the front zone of the bus having greater passenger occupancy. Findings of Kutner (1973) and McBride, King and James (1965) indicated the significance of angle of orientation in determining visual exposure and the experience of stress. The greater occupancy of regular seats and greater occupancy of the front zone of the bus in high stress conditions also agree with these findings.

The angle of orientation of the irregular seats produces greater visual exposure to occupants than does the angle of orientation of regular seats on the bus. In the present study, the rear-facing (therefore irregular) bus seats created a situation of greater visual exposure in that occupants were oriented face to face with most of the rest of the bus passengers. Sitting face to face facilitates the greatest exchange of visual information between individuals. Angle of orientation moderates visual exposure (Kutner, 1973) which moderates stress. Kutner found that on average, participants seated facing each other underestimated interpersonal distances and reported greater stress than participants not seated facing each other.

The increased stress experienced because of greater visual exposure when seated face to face likely contributed to the lower occupancy of the rear-facing seats. An element of visual exposure is eye contact. Minimising eye contact is a behavioural adaptation to manage insufficient privacy. In the present study, the rear-facing bus seats promoted the greatest amount of eye contact as occupants were at a face to face angle of orientation with a large proportion of other passengers. Avoidance of eye contact to regulate visual exposure agrees with findings by Greenberg and Firestone (1977). Greenberg and Firestone found that participants whose personal space was severely intruded upon by the experimenter would use less eye contact than participants whose personal space was not encroached on. Findings suggested that passengers compensate for the inability to sufficiently increase personal space by decreasing their visual exposure. The arrangement of the regular bus seats better facilitated eye contact minimisation compared to the arrangement of the irregular seats. The greater potential for privacy may have provided incentive for bus passengers to select regular seats over irregular seats. Passengers will therefore select a seat so as to minimise eye contact, lessen visual exposure and to also minimise intrusion on the privacy of others.

Side-facing (therefore also irregular) seats were a feature of bus model two in the present study. The seats were located in the front zone of the bus with the backs against the left window. Sommer (1969) observed that an individual's personal space is generally smaller to each side of them than to their front and so individuals can better tolerate encroachment on personal space from the side than from in front. The lack of structural barrier between these side-facing seats and the aisle exposed their occupants to possible encroachment on personal space from in front of them. Sitting in regular seats mostly avoided the possibility of approach from in front as the next row of seats provided a physical barrier. Regular seats risked encroachment on personal space only from the side which, as Sommer (1969) found, is easier to tolerate. The greater stress related to the risk of encroachment on personal space from in front may have likely contributed to the lower occupancy of the side-facing seats.

Occupying the rear-facing and side-facing irregular seats may have also put passengers at greatest risk of being engaged in unwanted conversation. Sommer (1959) had observed that individuals seated face to face, and even more so the individuals seated perpendicular to one another at a corner of the table, interacted more frequently than individuals sitting directly side by side. Sommer's (1959) study of seating position around a table had suggested that opportunity for exchange of visual information had factored into the spatial arrangements of interpersonal interactions. Sitting corner to corner, and particularly face to face, provides greater opportunity for exchange of visual information than between individuals sitting directly side by side. However, based on the reviewed literature, it may be that bus passengers seated perpendicularly to one another or seated face to face are more inclined to engage in conversation. Perhaps because they already have prior engagement in sharing visual information as a result of the seating arrangement, or it may be that passengers who are more willing to engage with others choose to sit in those irregular seats as they facilitate greater interaction.

Passengers actively avoiding a high degree of visual exposure likely contributed to the present study's findings of the front zone of the bus having greater passenger occupancy only later in the journey upon which mean passenger densities were higher. Higher occupancy of the front zone of the bus compared to the rear zone of the bus occurred at a much earlier stage in Rivano-Fischer's study than in the present study, i.e. the rear zone had higher passenger density in Rivano-Fischer at bus stop #3 only, versus the present study where a greater proportion of seats (although not statistically significant) were occupied in the rear zone of the bus at bus stops #3, #6 and #9 before passenger densities evidenced a statistically significant preference for the front zone. The later seating preference of the front zone of the bus in the present study, or alternatively, the extended preference of the rear zone of the bus, might be accounted for in part by the three dimensional layout of seating. The seats in the rear zone of the bus in the present study were elevated in two tiers above those in the front zone. Being able to see clearly to the front of the bus from the rear zone could create an illusion of having more space

On some journeys in the present study, passengers were observed to stand in the aisle in the front zone of the bus although seats were still available. Standing in the aisle in the front zone of the bus increased passenger density of the front zone meanwhile there were still unoccupied seats in the rear zone of the bus. This observation does not support a theory of passengers actively distributing evenly throughout the bus. Such an occurrence might be explained in that bus passengers standing in the aisle had an elevated view above the high passenger density seating and so were provided a sense of space. These passengers also generally stood oriented towards the front of the bus as if in a queue. Queuing involves people having the same angle of orientation to one another in that they are all facing the same direction, as is the case for passengers sitting in regular seats on the bus. A difference between occupancy of regular seats and the aisle is that people queuing can better regulate interpersonal distances, whereas bus seats are at fixed distances. This suggests that passengers may stand in the aisle of the bus in high passenger density conditions rather than slot into a seat in the rear zone of the bus as queuing in the aisle allows them to better provide for their personal space needs.

Hypothesis 2

In the present study, each of two methods of analysis produced findings in support of the hypothesis that bus passenger density will be greater at window seats than at aisle seats. The present study observed the number of occupied seats beside a window and the number of occupied seats beside the aisle for each bus stop on all journeys. Analysis concerned the paired seats, each pair consisting of one window seat and one aisle seat, therefore including equal numbers of each. The data was analysed for bus stops #6, #9 and #12. Over all journeys, the number of passengers at window seats was significantly greater than the number of passengers in aisle seats at each of bus stops #6, #9 and #12 ($p < 0.01$).

The second method of testing was used to ensure that variance did not obscure other relationships. There was greater variance in the number of passengers on each bus journey in the present study than in that of Rivano-Fischer (1988). The large variance was particularly so compared to Rivano-Fischer in terms of variance as a proportion of mean passenger density. This raised concern that the use of mean passenger numbers across all journeys had potential to be a misleading measure of passenger distribution between window and aisle seats at any one point. For example, an unusually large number of passengers in window or aisle seats on any one bus journey could mask a different pattern of distribution between window and aisle seats that is only observed on less populated journeys.

As was employed in hypothesis one to reduce the likelihood of producing misleading results, an alternative method of comparison was used. The comparison tested whether the frequency of journeys on which more passengers sat in window seats than aisle seats was significantly greater than the frequency of journeys on which this did not occur. The number of journeys on which more passengers sat at window seats than aisle seats was found to be significantly higher than the number of journeys on which the reverse occurred, and this was consistent for all three of the bus stops ($p < 0.01$).

The second hypothesis is derived from Rivano-Fischer’s (1988) theory that passengers select seats with the aim to maintain maximum interpersonal distances. ‘People will preferentially select window seats, as they ensure greater distance from other passengers than do aisle seats’ (Rivano-Fischer, 1988, p. 3). The present study’s findings of a significantly greater mean passenger density in window seats than in aisle seats at each of the three bus stops are consistent with those of Rivano-Fischer, however, they do not necessarily support the rationale stated by Rivano-Fischer.

There is an issue with construct validity in Rivano-Fischer’s (1988) analysis of window versus aisle seating as what Rivano-Fischer aims to test is different from what is measured. Rivano-Fischer used the comparison of passenger density at window seats versus aisle seats as a measure of seat preference. While Rivano-Fischer claims to be measuring preferential seat selection by passengers, the data collected is actually a measure of seat occupancy. What Rivano-Fischer actually tests is whether passenger density at window seats is greater than passenger density at aisle seats at bus stops #6 and #12, using forward-facing paired seats only. While a measure of the position of seat occupancy, comparison of passenger density at window seats versus aisle seats is only a valid measure of seat preference under the assumption that new passengers consider paired seats to both be unavailable when either one of the pair is occupied by a passenger. Without testing this assumption, it cannot be automatically inferred that window seats were chosen preferentially over aisle seats, even though window seats were occupied more than aisle seats. This assumption is tested in the present study in hypothesis three.

A factor to consider is that shorter journey times in the aisle seats would mean that more passengers could occupy the same seats on any one journey. It is possible that a greater proportion of individual passengers could choose to occupy aisle seats and yet the total journey time occupancy of aisle seats could still remain less than that of window seats. For example, it could be that passengers on shorter journeys tend to select aisle seats. If somebody takes the window seat they risk having another person sit beside them in the aisle seat. It is then more difficult for the passenger at the window to exit the bus if the aisle seat is occupied. The personal space benefits of sitting at the window seat may therefore be appraised by some passengers on shorter journeys as not worth the risk of this inconvenience. This scenario cannot be ruled out by inspection of the summary data presented by Rivano-Fischer (1988).

Another issue with Rivano-Fischer’s (1988) rationale for greater occupancy of window seats over aisle seats is the assumption that sitting at window seats ensures maintenance of greater interpersonal distances. Firstly, for window seats to provide for greater interpersonal distances it assumes equal distribution of passengers. Additionally, the distance between window seats in consecutive rows is less than the diagonal measurement from a window seat to an aisle seat one row in front or behind. If an individual chose a window seat where the nearest passengers were at the same window one row in front and one row behind, their physical distance from either would be less than if the individual were to sit in the aisle seat. Window seats may ensure maintenance of greater mean interpersonal distances, however, the proximity of the nearest people was found by Evans and Wener (2007) to be a more salient measure of the experience of crowding than the mean distance from other passengers. Therefore, the rationale that Rivano-Fischer gives for passengers choosing window seats because they allow greater distance from other passengers is not substantiated in measures of physical distance or by past studies on the experience of crowding. Despite this, window seats were occupied more than aisle seats in the present study, as was found in Rivano-Fischer. Therefore, the greater occupancy of window seats compared to aisle seats must be influenced by environmental factors outside of interpersonal distances.

Past studies may provide some explanation for the greater occupancy of window seats found in the present study. Firstly, avoidance of physical contact with strangers could motivate the greater occupancy of window seats over aisle seats in the present study. Greenberg and Firestone (1977) found that participants adjusted their posture to avoid physical contact with a stranger. Individuals in window seats are less likely than those in aisle seats to be touched by other bus passengers moving up and down the aisle.

Selecting an aisle seat entails risking being touched by a passing stranger, being hit in the head by a bag, or even landed on by a new passenger thrown off balance when the bus lurches back into the traffic, to name only a few examples. Window seats provide a buffer of space from the aisle. A study of locomotor adaptation by Gérin-Lajoie, Richards and McFayden (2005) found that pedestrians kept a greater distance from objects whose trajectory was less known. They suggested that distancing provided greater protection from potential threats. A bus passenger seated beside the window has a greater buffer of space from the aisle therefore affording the passenger more time to detect and react to a potential violation of their personal space. Sitting at the window also decreases the available approach angles so further increases the likelihood of detecting a physical intrusion into personal space.

If passengers do choose window seats over aisle seats, it may possibly be explained in that physical interpersonal distance does not account for the angle of orientation passengers have to one another. It has been found that angle of orientation between people affects their experience of physical distance (Kutner 1973; Sommer, 1959).

Windows provide a direction for passengers to turn their head towards or angle their whole body towards in order to create some privacy. Felipe and Sommer (1966, cited in Kutner, 1973) found that individuals reacted to an encroachment on personal space by turning their head away. Obtaining privacy by turning the head to face away from others is only possible if an individual has nobody to one side of them. Sitting beside a window guarantees that the individual will have nobody seated immediately beside them in at least one direction and so provides a direction to turn towards.

If passengers do choose window seats over aisle seats, another possible explanation is that passengers may be able to use the window seats to create a greater sense of space. Although a window is a physical barrier from intrusion of other passengers from one side, windows are contrastingly also utilised by passengers for their lack of presence as a barrier. As a window provides effectively no visual barrier, looking out of a window likely increases a passenger's sense of space. Furthermore, directing attention out of window can reduce conscious awareness of immediate surroundings. Humans detect stimulus more intensely with closer proximity. Being aware of less stimulus may create the experience of greater distance from nearby stress-inducing stimulus from the close presence of strangers.

As a rule, closer proximity provides for greater availability of stimulus. Hall (1966, cited in Holahan, 1982) classified personal space by stimulus availability based on the five senses. At the proximity of passengers sitting in adjacent seats, a distance within Hall's innermost concentric zone of 0 to 18 inches, stimulus includes sight, sound, smell, and even touch with the sensation of heat. A stranger seated in such close proximity provides a high intensity of stimulus. Turning towards the window both decreases the availability of stimulus from the bus environment and lessens the individual's visual exposure. The window also provides a socially approved place to look, allowing the passenger to turn slightly towards the window.

Passengers may select window seats to allow others a seat; happily or begrudgingly. Passengers in window seats are more likely than passengers in the aisle seat to have a stranger sit down next to them. Sitting at an aisle seat blocks access to the window seat so prevents another passenger from sitting beside them. However, blocking access to a seat and thereby occupying two seats when another passenger may be without a seat breaks social protocol. Conforming to norms of social politeness is a powerful determinant of behaviour, as was demonstrated in the study by Greenberg and Firestone (1977) where interviewees did not move their chair away from the deliberately uncomfortably close interviewer. Even though a passenger may want to avoid having someone sit beside them, the stress resulting from feeling rude or awareness that other passengers may perceive them as rude, may be greater than the stress from risking a stranger sitting beside them.

Rivano-Fischer (1988) suggested a theory that choice of seat position reflects more and less territorial tendencies in the population. R-Squared values for the three bus stops demonstrated a very close relationship between the numbers of bus passengers sitting in window seats versus aisle seats on each journey. High correlation between journeys of window to aisle seat occupancy ratios lends support for consistent proportions of individuals exhibiting more and less territorial behaviour. As such, the ratios of window to aisle seat occupancy by bus passengers could reflect the proportions of people in the general population with more and less territorial tendencies, as suggested by Rivano-Fischer.

Although Rivano-Fischer (1988) implies choice of window or aisle seat to be related to territoriality, such a relationship is only speculative. Rivano-Fischer's concept and operationalization of territoriality are not made clear. A greater tendency towards territoriality might be operationalised as having the intention to claim both of the paired seats, the ability to retain both seats even though the aisle seat is left physically available, or securing both seats by sitting at the aisle and thus physically blocking others from accessing the area. Rivano-Fischer did not specify a directional relationship between bus passengers' occupancy of window versus aisle seats as being more or less territorial. The suggestion of passenger's seating choices reflecting tendencies of territoriality that may be proportional to those in the population is therefore not substantiated by either study.

Analysis of passenger occupancy of the paired seats across bus stops #6, #9 and #12 found that as average passenger density increased, the number of passengers in window seats relative to aisle seats decreased. Passengers were on average 3.00 times more likely to occupy window seats than aisle seats, giving a mean of 75% of passengers seated by the window across all journeys. As average passenger density increased, the number of passengers in window seats relative to aisle seats decreased. The mean window to aisle seat occupancy ratios were 3.56 window seats occupied for every aisle seat occupied at bus stop #6, 3.00 window seats occupied for every aisle seat occupied at bus stop #9, and 2.56 window seats occupied for every aisle seat occupied at bus stop #12. This curvilinear trend may be explained in that other affordances become more valued as total passenger density increases, such as accessibility to the exit door.

As was observed in the present study (addressed in hypothesis three), people avoid sitting beside strangers until there are few alternative seating options so although initially the risk of an individual in a window seat having a stranger sit beside them this increases as population density increases.

Hypothesis 3

Hypothesis three tested whether an even passenger distribution between zones of the bus, as found in hypothesis one in the present study, was related to passengers actively regulating interpersonal distances. Hypothesis one found support for mean passenger densities being evenly distributed between complimentary zones of the bus in seven out of eight comparisons. Random chance would also produce a pattern of equal distribution between zones. It therefore needed to be determined whether seating behaviour reflected deliberate choices by passengers or whether the evenly distributed seat occupancy reflected a pattern of random chance. To ascertain whether passengers actively regulate their spatial environment the explanation of random chance needed to be eliminated.

Hypothesis three was derived from the theories that passengers actively choose seats to regulate their spatial environment, that the bus environment places strangers in uncomfortable proximity to one another, and that equal distribution of passengers in the bus best allows passengers to all maximise interpersonal distances. In the present study, the act of sitting directly beside a stranger when other seats not requiring such close proximity were available was referred to as *coupling*. A seat was determined to be available if it was unoccupied and could be accessed from the aisle without necessitating physical or verbal contact with another passenger (such as stepping over them or asking them to move over).

Coupling occurred on 10 of the 26 bus journeys. The random chance of coupling occurring on boarding was calculated for each passenger on the ten journeys. The random chance of coupling having occurred upon each individual passenger boarding and taking a seat was summated for each journey. It can be expected that coupling will occur on half of journeys by the time the journeys each reach a 0.5 summated chance of having a passenger coupling. Similarly, it can be expected that, on average, coupling will occur on any one journey by the time the journey reached a 1.0 summated chance of having a passenger coupling upon boarding and taking a seat. As the observer's seat was predetermined, no random chance was applicable. It was also assumed that passengers travelling together would generally seek to sit together. As most of the bus seats were arranged as paired seats there was limited opportunity for passengers travelling together to simultaneously sit together and couple with a stranger. As such, passengers travelling together were each assigned a conservative zero probability score of coupling with a stranger.

Analysis of the occurrences versus probabilities of coupling produced findings in support of the theory that passengers actively choose seats to maximise interpersonal distance. As expected, when the option was available, bus passengers were observed to select an unoccupied pair of seats instead of sitting beside a stranger at a rate significantly greater than would occur by random chance. Coupling did not occur on any of the ten journeys until the summated probability of coupling was considerably greater than random chance. The first passenger coupling on any journey was the 15th passenger to board, while coupling could be expected to occur at chance on half of the ten journeys by the time the 12th passenger was seated. These results indicate that passengers generally avoid sitting by a stranger if there is an alternative choice and provide support for rejecting the null hypothesis that the position of the seats occupied by bus passengers was due to random chance. This is a necessary assumption in order to interpret the findings of hypothesis one. It supports interpretation of an even passenger density across zones of the bus as a deliberate feature of passengers' seat choices and not just a feature of random distribution. The results also provide support for the assumption made by Rivano-Fischer that seat occupancy is a measure of seat preference.

The present study's findings agree with past studies of how people manage potential stressors in their spatial environment. Fried and DeFazio (1974) suggested that paired seats are considered unavailable when one of the pair is occupied by a passenger. This suggestion is supported by the present study. The present study's finding that passengers will generally avoid sitting beside a stranger if an alternative is available agrees with Milgram's (1970) observation that city inhabitants adhere to a norm of non-involvement with strangers. Studies of how passengers manage the spatial environment in a public transport setting have demonstrated an observance of cultural norms in spatial behaviour. However, expectations and patterns of behaviour in a public transport setting will likely differ between cultures. Perhaps a pair of seats are considered as one unit in the context of the present study but in a culture with much smaller units of space, a pair of seat might be considered two units and there may not be an avoidance of sitting beside a stranger as it would not intrude on their unit of space.

The norm in the present study of selecting an unoccupied pair of seats instead of sitting beside a stranger may serve to preserve the privacy and conserve information processing demands for both the individual choosing a seat and the seated passengers whom they might otherwise sit beside. Milgram (1970) had attributed the norm of non-involvement to serving the adaptive functions of preserving privacy and reducing the information processing demands of the environment. The individual avoids an increase in information processing demands by avoiding the increase in stimulus that would arise from the close presence of another passenger.

The ability of bus passengers to reduce stress is likely constrained by adherence to expected behavioural norms. The norm of non-involvement with strangers encompasses behavioural expectations around intrusion into the physical territory and personal space of another person. In the bus situation, the acceptability of sitting beside another passenger, especially without their consent, is circumstantially complex. These cultural and social behavioural constraints can hinder a person's ability to dissipate stress in some situations. This was demonstrated in Greenberg and Firestone (1977) when behavioural expectations in an interview situation meant that, even when participants were physically able to move their chairs away from an uncomfortably close interviewer, they did not feel socially able to do so.

However, behavioural expectations have a more generalised and beneficial effect of helping to reduce stress. When behaviour follows cultural and social norms it organises society, thus providing for a predictable, regulated spatial environment. For example, the present study demonstrated passengers conforming to a general behavioural norm of one person having sole occupancy of a pair of seats instead of sitting alongside a stranger, while seating availability allowed for this. Culturally and socially held behavioural expectations guide the extent of intrusion on territory or personal space that is considered acceptable in a given situation. There are also behavioural expectations as to when it is acceptable to mark public territory and the acceptable size of an individual's territory under changing pressures of seating availability. Having expectations of the behaviour of others may allow individuals to sit by the window with some confidence that they are unlikely to have a stranger sit beside them while overall passenger density is still low.

Application to Urban Intensification

The Proposed Auckland Unitary Plan is intended to govern the use of land and the management of resources other than private residential land. By increasing allowable housing density, the plan aims to provide greater housing availability and more affordable home ownership. The real estate system in New Zealand denotes ownership of an area of land by a written legal document. This indirectly marks a property as a person's or persons' territory. In the animal world, the behaviour of claiming territory is an adaptive response to competition for limited resources. It can mean the survival of those able to assert ownership over an area and resources and the demise of those who are not able to do so. In the human society, legal title to territory is less linked to survival but it can impact on who will flourish and who will not. The size of a person's territory, regardless of ownership and the number of others with whom they share it will influence their ability to meet their personal space needs.

The present study's predominant finding of an even distribution of passengers across zones of the bus might suggest expectations of an even distribution of the

Auckland population over its landscape. However, this would not be accurate. In a densely populated area, space is a desirable resource but not all space is equally desirable. The different affordances and restrictions of locations contribute to an uneven distribution of population density across the city.

Some residential areas will become higher density than others for features implicit to their area. Locations can facilitate differential access to limited resources and differential exposure to both protective factors against stress, and to threats to wellbeing. These factors make some locations more desirable than others and may be reflected in the affordability of housing. Those who can afford property that provides more desirable resources can benefit the most from these resources. In the urban environment, affordances additional to the availability of space may include access to employment, education, transport (motorways and public transport), retail shops, and recreation and relaxation opportunities (such as parks, children's playgrounds, areas with established trees, and other aesthetically pleasing natural environments).

Residential zoning affects opportunities and limitations to land use and ownership. For example, residential zones 7, 8, and 9 allow smaller minimum section sizes, creating more densely populated housing areas and given all other factors are equal, making property ownership less expensive per section. Residential zones 1 and 5 stipulate larger minimum section sizes per dwelling and so housing is less densely arranged. Residential zones 1 and 5 are generally the older more established suburbs with protected character villas or are leafy and green with mature trees.

The appeal of a residential area can be affected by many council imposed opportunities and limitations. Although what is considered desirable will differ from individual to individual, the differential access to schooling is a clear example of the different affordances of areas. Many parents aspire to send their children to high performing schools that will provide a better learning environment than other schools, greater opportunities within which their children will flourish, and the promise a successful future for their children. For the vast majority of students, public schools are much less expensive to attend than private schools. Access to particular public schools is determined by the location of a person's residence.

The Auckland landscape is symbolically divided into school zones loosely based on their proximity to each school and the schools' capacities. This creates differential demand for property in different school zones. High performing schools contribute to high demand for housing in the area zoned for those schools. Residential properties that are in zone for schools in high demand are therefore better resourced. House ownership in such an area affords access to good schooling for the owners' own children or the capacity for higher rental income due to competition by other families to reside in that school zone. At any point in time there is a limit on housing availability within an area so this can dramatically increase the market value of real estate in that area.

The affordances and restrictions in the urban environment may be more pronounced than between zones in the bus environment. However, the same applies in that some areas on the bus may become higher density than others for features of their location. In the present study, the resources identified as additional to the availability of personal space were the accessibility of the seat, the ability to see out of a window, and ease of access to exit doors. Factors that threatened to increase stress included needing to walk a greater distance along the aisle, higher passenger seat density denoting greater proximity to others, and potential for being blocked from exiting the bus.

Just as passengers attempted to regulate their sensitivity to passenger density, the urban environment can be managed to best facilitate population density so as to minimise stress and promote psychological wellbeing. Urban inhabitants could benefit from urban planning and housing designs that facilitate the various adaptations individuals utilise to moderate their stress levels in a high density public transport environment. One such insight highlighted by studies of personal space is the use of behaviours that decrease personal space needs and create the experience of having more space available such as passengers looking out the window. This suggests strategizing to increase population density of areas in a way that creates a sense of space for inhabitants.

In the present study, the front zone of the bus was not preferred until bus stop #12. In comparison, the front zone of the bus was not preferred until bus stop #6 in Rivano-Fischer (1988). This disparity might be related to different affordances in the vertical aspects of seating arrangements between the two studies' buses. The seats in the rear zone of the bus in the present study were elevated in two tiers above those in the front zone. Being able to see clearly to the front of the bus from the rear zone could create an illusion of having more space, an affordance not provided in the rear zone of the bus in Rivano-Fischer. The elevation may have made the rear zone of the bus comparatively more desirable in the present study.

Auckland's landscape provides opportunities for developing the built environment while minimising the psychological and physiological impact of living in closer proximity to others. Auckland is geographically unique with its numerous dormant volcanoes. Many of the volcanoes are significant to the area's cultural history and the prominent cones are iconic, treasured features of the city. The volcanic activity has shaped Auckland's landscape to be steeply sloping in many parts. People likely do not think of the steep urban areas as still being part of the volcanos as their geographical impact stretches well away from the volcanoes' protected peaks.

Housing intensification utilising the city's sloping geography might help to create a sense of space. It may buffer for the impact of housing intensification on inhabitants' perceptions of the spatial environment. Similarly to the tiered seating, hillsides afford views beyond the immediate area and although physically not accessible, a view provides an illusion of space. The sloping hillsides can afford dense single-level housing that is terraced for views. This could afford greater population density from smaller property sizes without causing greater stress than would a similar housing development built on flat land. It can be deduced that an effective means of both accommodating a greater population and providing more affordable home ownership would be to allow smaller property sizes and promote smaller houses. Amending building density restrictions to enable staggering of small residential dwellings in areas that can utilise the slopes and ridgelines could create high density housing that maintains a sense of space, therefore contributing to lower stress experienced with proximity to others and better psychological wellbeing.

Limitations and Suggestions for Further Research

While the present study categorised seats as being regularly or irregularly oriented and being located in the front or rear zone and in the left or right zone, further study could look more specifically into the effect of bus seat orientation and position on seat occupancy by passengers. Rivano-Fischer (1988) used only one model of bus in analysis. Three models of bus were encountered in the present study. Including all three models increased the number of journeys able to be analysed, providing a large enough data sample size to test for statistical significance of effects. Analysing results by model of bus could allow comparison of the different seating layouts and the patterns of passenger seating that result. To make the comparison between bus models would require a large enough data sample for each model of bus so as to have enough power to produce statistically significant results.

Performing a multivariate data analysis of factors contributing to interpersonal distances could add to understanding of which individuals are most sensitive to what environmental stimulus. It would also be interesting to know what factors precipitated coupling behaviour. Such an analysis would aim to find weightings for relative sensitivity of passengers to different positions, angles of orientation, distance across aisle, window versus aisle seat, front versus rear zone, left versus right zone, and account for other environmental, individual and interpersonal variables. However, conducting the study would be a difficult task.

Attending to the boarding order and seat selection of individuals was particularly challenging when multiple passengers boarded at the same stop. Attending to the boarding order and seat selections would become more difficult if multiple items of information needed to be recorded about each passenger. Additionally, coding of natural observations into data on the variables of interest presents both design issues and ethical issues. For example, it would be extremely difficult for an observer to accurately guess a passenger’s age and ethnicity. In designing the present study, this proved to be ethically contentious. However, although ethnic identity and age may be important to the individual’s choice of seat, it is other people’s appraisal of that individual’s ethnicity and age that becomes relevant to seat selection by subsequent passengers. Therefore both an individual’s own identity and other people’s assumptions around the individual’s identity become relevant.

Factors previously found in studies to influence interpersonal distancing that are not accounted for in the present study include the use of markers, passengers' gender, social status, the auditory environment, and a passenger's intention. Pilot tests ascertained that the present study would be unable to collect multivariate data due to practical difficulties in observing, attending to and categorising passengers' individual and behavioural variables. Observing passengers' use of markers was particularly difficult from the rear of the bus in the present study as the markers were often obscured by the backrests of seats so any such data collected accordingly would be unreliable.

Passengers may use markers as a means to maintain temporary ownership of a public area, that is, public territory. Markers are usually possessions that are recognised as items normally belonging to someone. In the present study, markers were observed to predominantly be bags and brief cases or study materials. In Sommer's (n.d., cited in Sommer, 1969) study of library seating, it was observed that pretty much any object, as long as it was not appraised to be rubbish, could effectively claim and defend a seat as being an occupied territory in the person's absence. In the bus environment, the owner of the marker is present with the marker typically used to defend one of a pair of seats while the owner occupies the other of the pair of seats.

Unlike a passenger, a marker does not actually require the amount of space it is defending. The passenger may be in the window and marking the aisle seat or they may be in the aisle seat and marking the window seat. Both scenarios communicate the pair of seats as being an occupied territory. It indicates to subsequently boarding passengers a desire to avoid close proximity and to discourage intrusion on personal space. Defending the adjacent seat from other passengers avoids the accompanying experience of stress and discomfort from an intrusion on personal space, high intensity of stimulus caused by the close proximity of strangers, and an intimate interpersonal distance that fosters social engagement. . If the marker is successful, nobody will attempt to sit in the marked aisle seat or ask the person to move along to the marked window seat in order to free up the aisle seat.

The effect of auditory stimulus and the use of personal stereos could be an interesting topic for further research. The popular use of personal stereos in public transport suggests their use having an adaptive feature for managing close proximity to others. Lloyd et al.’s (2009) study of auditory stimulus on personal space boundaries found that individuals maintained greater interpersonal distances when there was a lack of external auditory cues that would normally inform them about their environment. Use of personal stereos reduces an individual’s perception of environmental auditory cues, therefore increasing personal space needs. However, it is not logical for commuters to deliberately increase their personal space needs in a potentially crowded situation because it would mean feeling encroached on by other passengers at greater interpersonal distances.

Another theory for the use of personal stereos in public transport is based on the stimulus overload model. Under the stimulus overload model, personal stereos are used to regulate auditory stimulus, thus regulating stimulus intensity. Personal stereos can eliminate unwanted social interaction from other passengers. Their use appears to be a socially recognised exhibition of an unwillingness to engage with others. Perhaps the success is due to the difficulty of engaging with the wearer successfully without their first making eye contact or initiating interaction. Sommer (1969, p. 142) referred to people listening to loud music as enveloping themselves in a ‘curtain of sound.’ The common use of personal stereos in public transport might therefore be a psychological adaptation to increase an individual’s privacy, to decrease the discomfort of being aware of unwanted proximity to others, and to increase control over their environment when their extent of control over interpersonal distances is limited. The effect of personal stereo use on perceptions of personal space in the public transport setting is still empirically unexplored and perhaps an area for further research.

Personal stereos were also particularly difficult to observe from the rear of the bus as the headphones used with personal stereos were predominantly very small in-ear speakers and therefore often completely obscured from behind by the wearer's hair. Therefore, the method of observation would need to be adapted from the present study in order to more reliably detect the use of personal stereos or markers.

Gender is another factor previously found to influence interpersonal distancing that is not accounted for in the present study. Gender could be expected to affect the likelihood of an individual sitting alongside another person. Edney, Walker and Jordan (1976) found that, in general, females attempted to claim a greater area of public territory than males and found that this was related to the individuals' appraisals of control over the environment at the time. In contrast, Sommer (1959) found that females sat closer to another person than males did when intending to engage in conversation, and this disparity was particularly so for same-gender pairings. The gender of passengers was not observed for in the present study.

Social status has been found to influence interpersonal distancing and is not accounted for in the present study. Rosenfeld, Giacalone and Kennedy (1987) explored how a person's social status moderated the likelihood of others intruding into their personal space. The study found that individuals were less likely to intrude on the personal space of someone of high status than of low status. The observer in the present study did not observe for differences in social status.

Other factors that may influence an individual’s choice of seat not accounted for in the present study include passengers’ intentions for conservation of physical effort, greater assurance of privacy, greater opportunity for social engagement, or observance of specially demarcated seats. Seat occupancy may be influenced by propensity to choose the option requiring the least effort short term. In the extreme, this would mean selecting the first available seat from the entry regardless of proximity to other passengers. Some passengers may desire to sit in one of the single passenger seats that afford greater assurance of social isolation. These are located in the very front row of passenger seats and their presence differed by model of bus. Individual seats ensure that the occupant will have nobody sit beside them or verbally engage in attempt to sit beside them. This may be desirable to somebody struggling with severe social anxiety, for example.

Conversely, some passengers may select seats based on the opportunity they provide for interaction with others. This may be interaction amongst those travelling together as a group, interaction with acquaintances made through routine bus journeys, or the opportunity for interaction with strangers. For example, the bus environment might provide a forum for social contact desirable to passengers whom have otherwise limited social opportunities. Passengers might therefore select seats for their greater facilitation of social engagement, such as the irregularly oriented seats and seats in closer proximity to others already seated.

Several seats in the front zone of the bus models encountered were usually demarcated as priority seating. Anybody can sit in these seats if unoccupied but it is expected that they are vacated for somebody with impaired mobility. The seats are specifically designated for their affordance of easy accessibility and sufficient space. It could be expected that, as such, they might be particularly desirable for passengers.

However, passengers may avoid sitting in seats demarcated as priority seating if they anticipate the hassle of needing to move upon others boarding, or if the seats are irregularly oriented. Alternatively, passengers may avoid occupying these seats out of respect for the people they are intended for, or they might consider the priority seating as reserved, just as car parking designated for people with disabilities require cars to display a mobility parking permit in order to use those parking spaces (Land Transport NZ, 2007).

There are grounds for concern around the construct validity of seats being the chosen unit of measurement. Passenger density was operationalised in Rivano-Fischer (1988) and in the present study as the number of passengers per seat. However, the experience of crowding being a function of proximity rather than the number of people or population density (Evans & Wener, 2007) indicates the significance of interpersonal distancing in our appraisal of the environment. Seats were not uniformly distributed throughout the interior area of the bus and a more densely populated zone facilitates greater proximity. Passenger density, therefore, may not be an accurate measure of the experience of crowding. It should be considered whether the results would have been different if the unit of measurement, passenger density, had been operationalised as the number of passengers per area of space.

In the present study, the lower density of seating in the front left quadrant of the bus may have influenced statistical results under the chosen operationalization of passenger density. Mean passenger densities were found to be slightly greater in the front zone as compared to the rear zone of the bus at each of bus stops #3, #6, #9 and #12. Mean passenger densities were also slightly greater in the left zone of the bus compared to the right zone of the bus for the four bus stops. These differences in mean passenger densities between complimentary zones were only found to be statistically significant in comparing front and rear zones at bus stop #12. All other differences were statistically non-significant, however, they do suggest a possible role of the front left quadrant in increasing passenger density of its respective zones. Under the present study's operationalization of passenger density as passengers per seat, the lower density of seating available in the front left zone of the bus would have contributed to the statistical findings of a greater mean passenger density in the front zone compared to the rear zone of the bus and greater mean passenger density in the left zone compared to the right zone of the bus. The lower density of seating in the front left zone of the bus therefore could have contributed to mean passenger densities deviating from the hypothesised results of no significant difference in passenger densities between zones as was found in comparison of the front zone with the rear zone of the bus at bus stop #12.

If humans do in fact negotiate their spatial environment to create more comfortable interpersonal distances from strangers, these findings suggest that equal distribution would better be measured by passenger density as operationalised by the number of passengers per area of space and not as the number of passengers per seat. It could be advantageous to continue the present line of study using alternative units of measurement. Suggested alternatives are to operationalise passenger density as the number of passengers per square metre of floor area or the number of passengers per cubic metre inside the bus. These are two different measures in the present study as the floor level of the rear zone of the bus was raised a couple of steps above the floor level of the front zone of the bus. Therefore, the rear zone provided a smaller cubic area of space per area of floor space compared to that in the front zone of the bus. Measuring human spatial behaviour in a three-dimensional environment might provide insight into the sensitivity of humans to the vertical spatial environment. This is a potentially important aspect to study as the built environment is occupying increasingly greater vertical space.

Conclusion

The present study has met its aim in demonstrating a high sensitivity of humans to the spatial environment. This sensitivity is important to acknowledge and consider when making deliberate changes to the urban environment. Population growth predictions in conjunction with the intention to restrict expansion of Auckland’s geographical area predict a considerable and ongoing increase in population density. Housing intensification will be necessary in order to provide sufficient housing to accommodate the population growth within the existing urban boundaries. Results of the present study provide support for the importance of considering the potential psychological impact on inhabitants when developing plans. Urban intensification might then be strategically facilitated to manage inhabitants’ perceptions of, and responses to, their spatial environment.

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Appendix A

Template sheet of charts used in collecting the data.

Date **Time**

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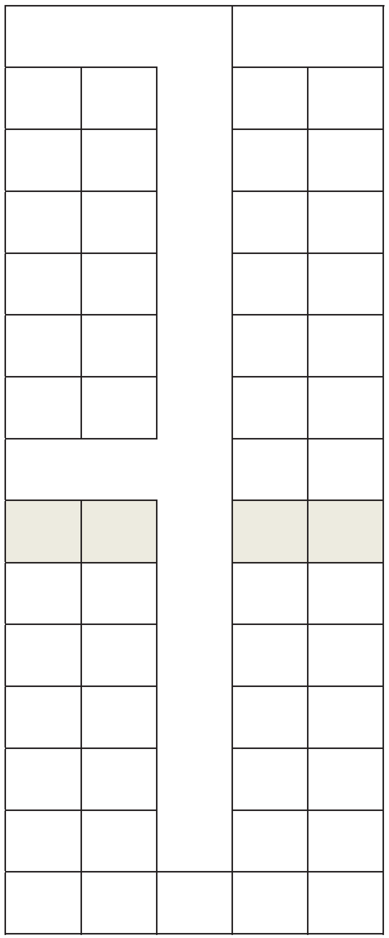

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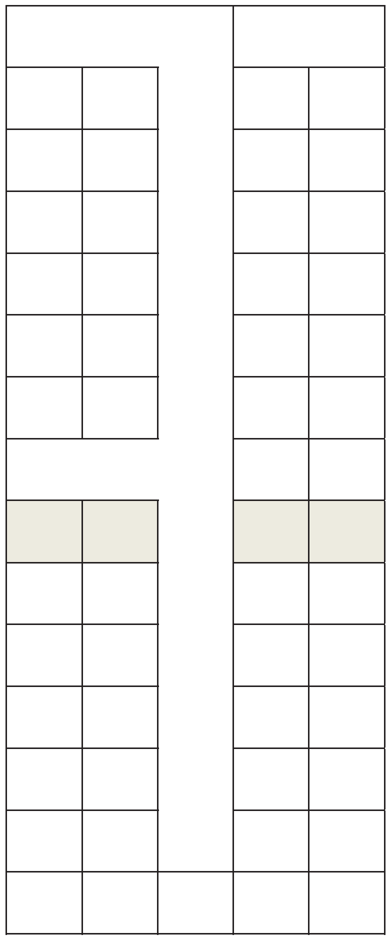

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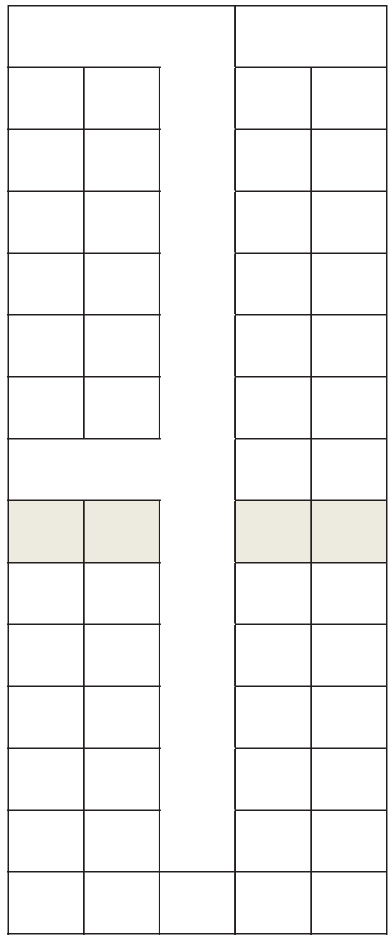

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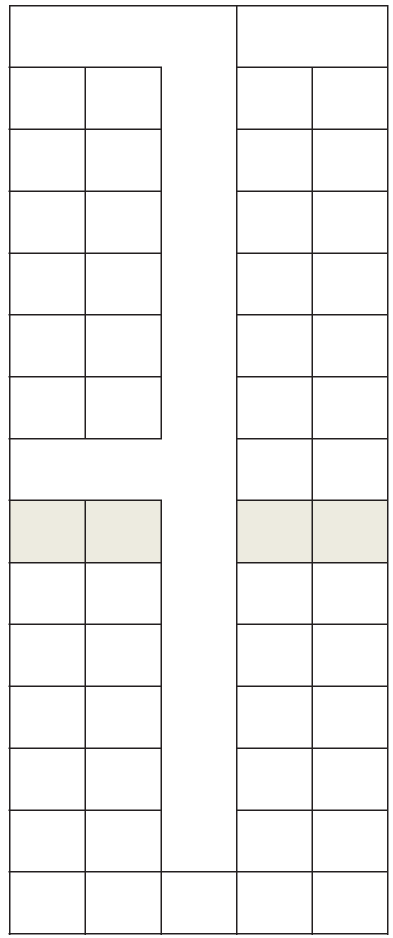

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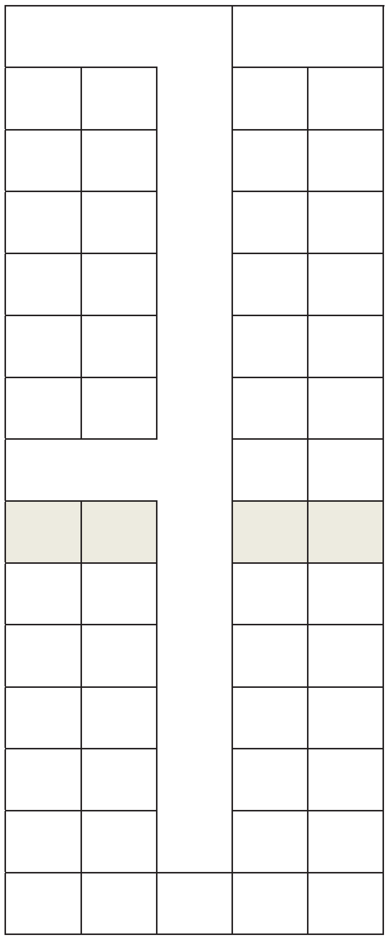

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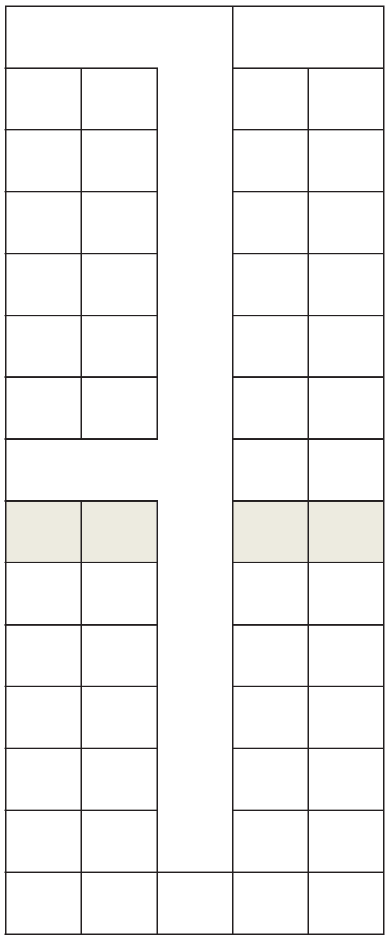

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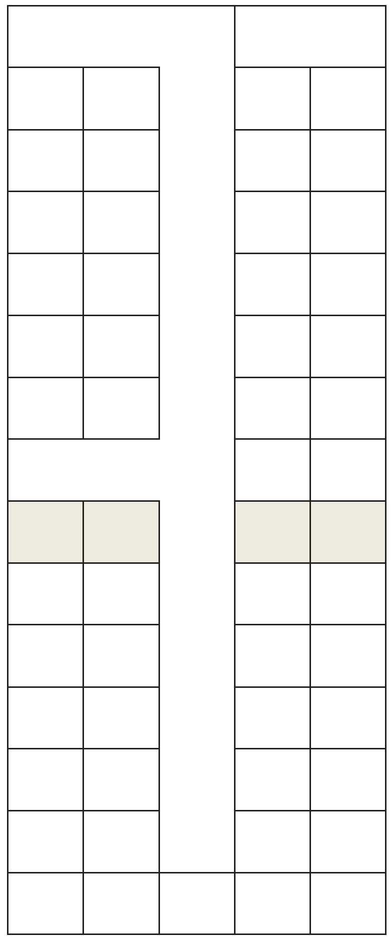

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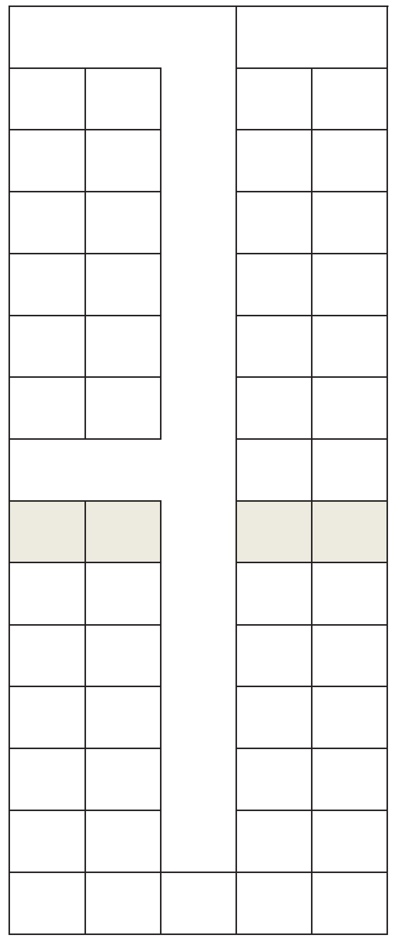

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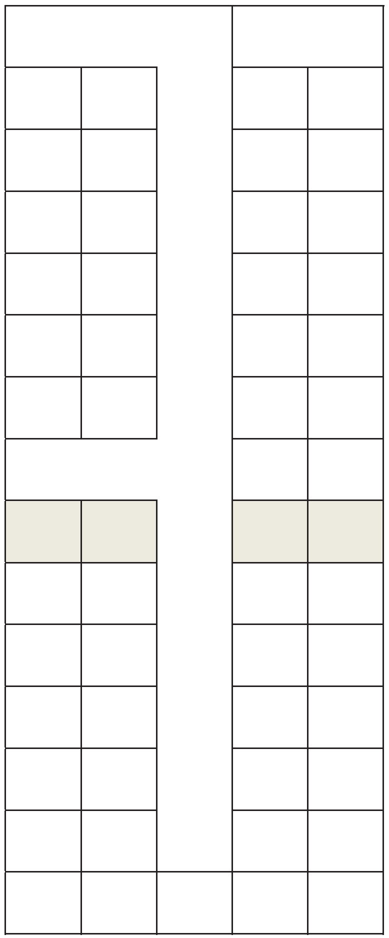

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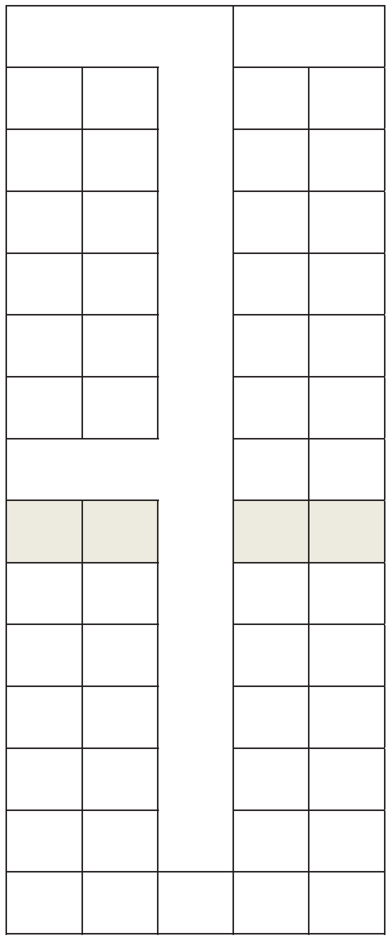

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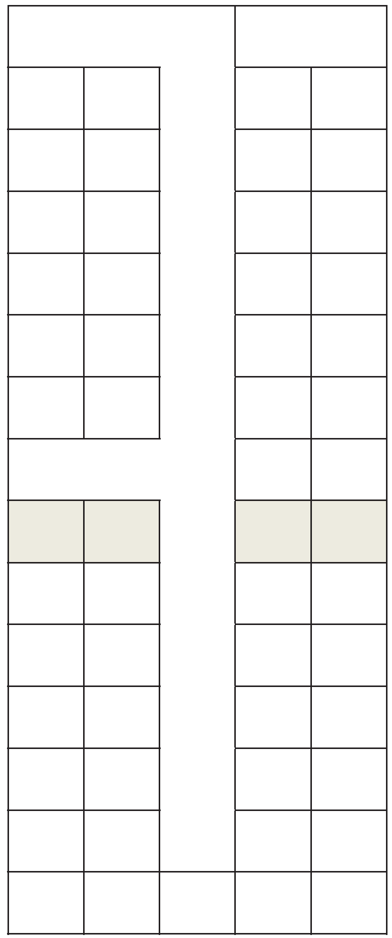

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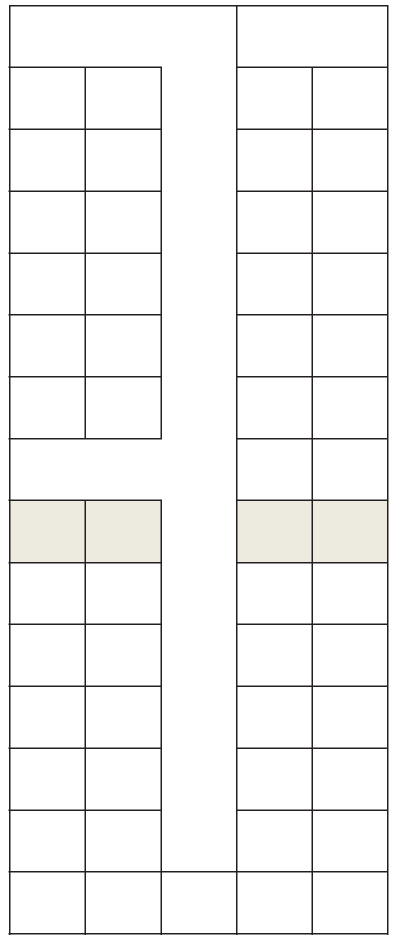

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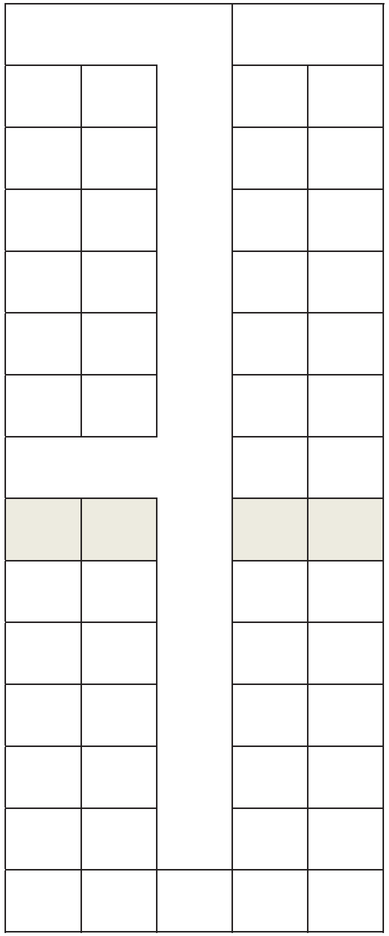

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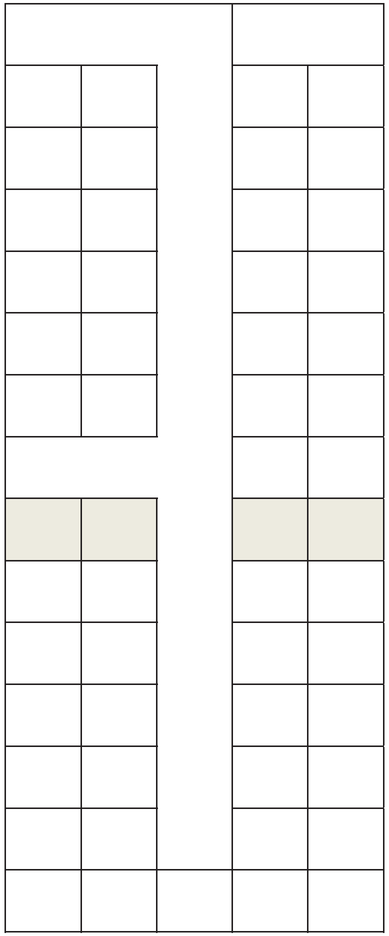

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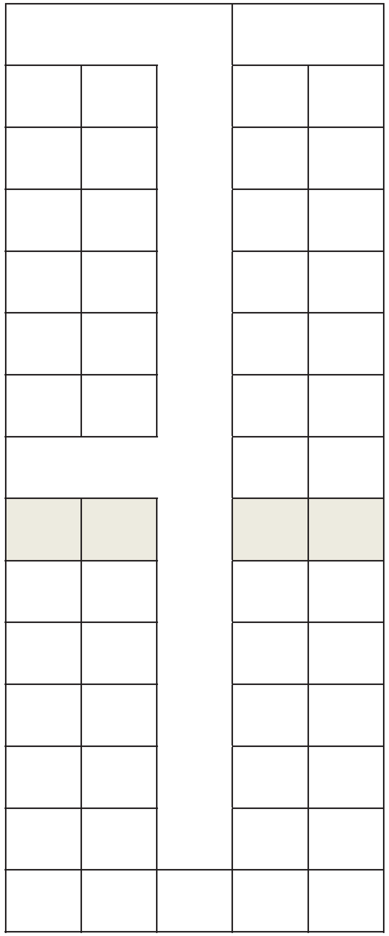

Appendix B

Charted data for the 26 bus journeys.

Date **Monday 20th August** **Time** **10.55am** **Journey A**

Bus stop # 1
Exit
Board 1 - 8
Change

			Driver	
↓	↓		4	5
			8	
7				
				6
2				1
3				

Bus stop # 2
Exit
Board 9
Change

			Driver	
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			0	
0				
				0
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9				
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Bus stop # 3
Exit
Board
Change

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Bus stop # 4
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Board
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Date Monday 20th August **Time 10.55am** **Journey A**

Bus stop # 5
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Board
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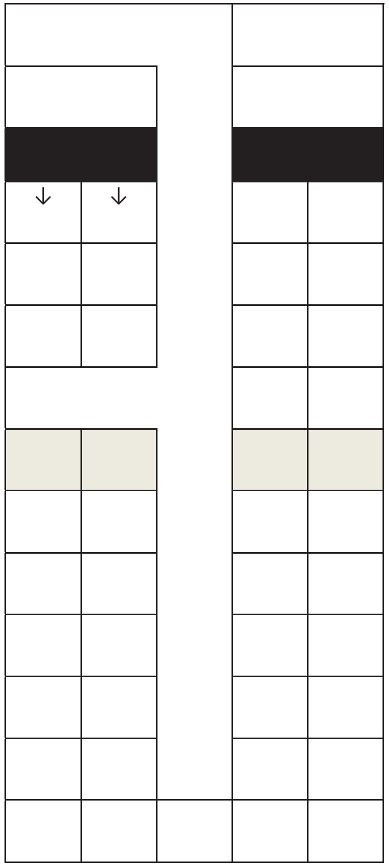

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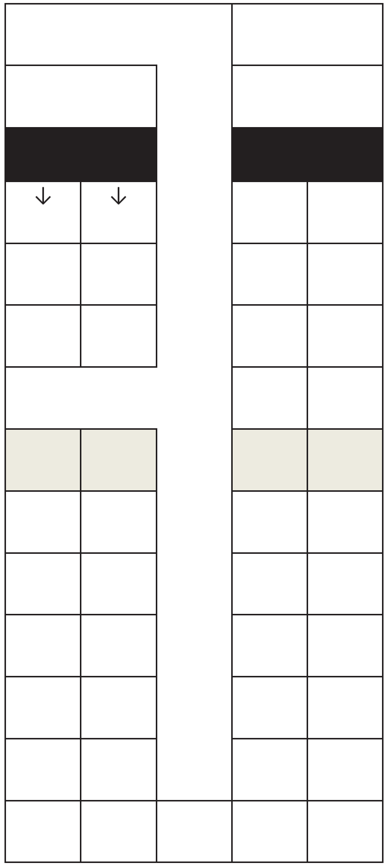

Bus stop # 7
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Board 10
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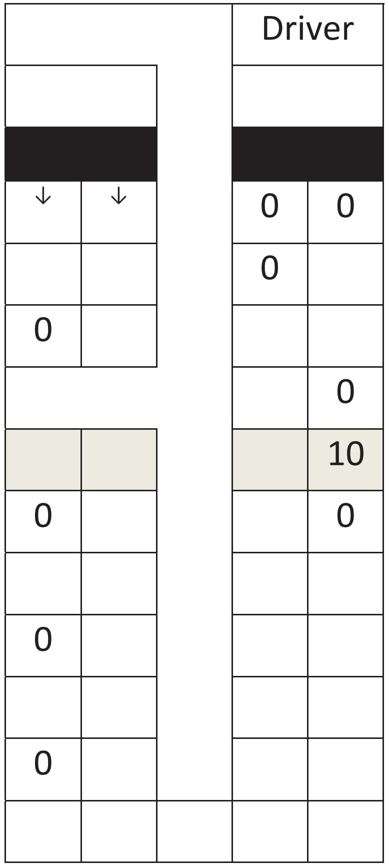

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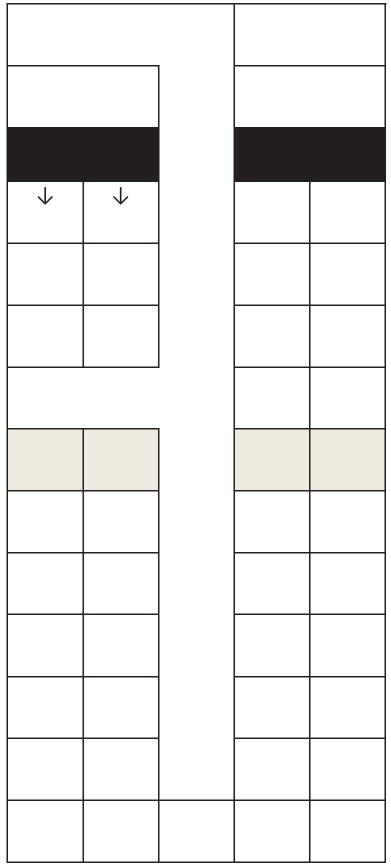

Date **Monday 20th August** **Time** **10.55am** **Journey A**

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0				12
0				

Bus stop # 10
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				19
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		25		

Bus stop # 11
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Board 26 - 27
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				0
0	0		26	0
0				0
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Bus stop # 12
Exit
Board
Change

↓	↓			

Date **Monday 20th August** **Time** **10.55am** **Journey A**

Bus stop # 13
Exit
Board
Change

↓	↓			

Bus stop # 14
Exit
Board 28
Change

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			28	0
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Bus stop # 15
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Board
Change

↓	↓			

Date **Monday 20th August** **Time** **11.25am** **Journey B**

Bus stop	# 1
Exit	
Board	1 - 8
Change	

			Driver	
5				
↓	↓		↓	↓
1				
				4
				8
2				3
				7
6				

Bus stop	# 2
Exit	
Board	
Change	

↓	↓		↓	↓

Bus stop	# 3
Exit	
Board	9 - 11
Change	

			Driver	
0				
↓	↓		↓	↓
0				
				10
				0
				0
				11
0				0
9				0
0				

Bus stop	# 4
Exit	
Board	
Change	9

			Driver	
0				
↓	↓		↓	↓
0				
				0
				0
				0
				0
0			9	0
c				0
0				

Date Monday 20th August **Time 11.25am** **Journey B**

Bus stop # 5
Exit
Board 12
Change

			Driver	
0				
↓	↓		↓	↓
0				
				0
				0
				0
				0
0			0	0
				0
0				
				12

Bus stop # 6
Exit
Board 13 - 14
Change

			Driver	
0				
↓	↓		↓	↓
0				
				13
				0
				0
				0
				0
0			0	0
				0
0				
				0
14				

Bus stop # 7
Exit
Board
Change

↓	↓		↓	↓

Bus stop # 8
Exit
Board 15
Change

			Driver	
0				
↓	↓		↓	↓
0				15
				0
				0
				0
				0
				0
0			0	0
				0
0				
				0
0				

Date Monday 20th August **Time 11.25am** **Journey B**

Bus stop # 9
Exit
Board 16 - 18
Change

			Driver	
0				
↓	↓		↓	↓
0				0
				0
				0
18				0
				0
	16			0
0			0	0
17				0
0				
				0
0				

Bus stop # 10
Exit 1
Board 19 - 27
Change

			Driver	
0			25	
↓22	↓		↓	↓
x20	21			0
	19			0
				0
0				0
				0
	0			0
0			0	0
0				0
0			24	23
26	27			0
0				

Bus stop # 11
Exit
Board 28 - 30
Change

			Driver	
0			0	
↓0	↓		↓	↓
0	0		28	0
	0			0
	30			0
0				0
			29	0
	0			0
0			0	0
0				0
0			0	0
0	0			0
0				

Bus stop # 12
Exit
Board 31
Change

			Driver	
0			0	
↓0	↓		↓	↓
0	0		0	0
	0			0
	0			0
0				0
			0	0
	0			0
0			0	0
0				0
0			0	0
0	0			0
0				31

Date **Monday 20th August** **Time** **11.25am** **Journey B**

Bus stop # 13
Exit
Board 32 - 33
Change

			Driver	
0			0	
↓0	↓		↓	↓
0	0		0	0
	0			0
	0			0
0	33		32	0
			0	0
	0			0
0			0	0
0				0
0			0	0
0	0			0
0				0

Bus stop # 14
Exit
Board 34
Change

			Driver	
0			0	
↓0	↓		↓	↓
0	0		0	0
	0			0
	0			0
0	0		0	0
			0	0
	0			0
0			0	0
0				0
0			0	0
0	0			0
0		34		0

Bus stop # 15
Exit 16
Board
Change 32, 33

			Driver	
0			0	
↓0	↓		↓	↓
0	0		0	0
	0			0
	0			0
0	c		c	0
			0	0
32	x33			0
0			0	0
0				0
0			0	0
0	0			0
0		0		0

Date **Tuesday 21st August** **Time** **10.15am** **Journey C**

Bus stop # 1	Bus stop # 2	Bus stop # 3	Bus stop # 4
Exit	Exit	Exit	Exit
Board 1 - 5	Board 6 - 9	Board	Board
Change	Change	Change	Change

Bus stop # 1

			Driver	
5				
→			↓	↓
→				
→				
				1
			3	
2				4

Bus stop # 2

			Driver	
0			7	
→			↓	↓
→				
→				8
				0
	6		0	
0				0
9				

Bus stop # 3

→			↓	↓
→				
→				

Bus stop # 4

→			↓	↓
→				
→				

Date **Tuesday 21st August** **Time** **10.15am** **Journey C**

Bus stop # 5
Exit
Board 10 - 13
Change

			Driver	
0			0	
→			↓	↓
→				
→				0
				0
	0		0	
0				0
0				11
12				
				10
	13			

Bus stop # 6
Exit
Board 14 - 17
Change

			Driver	
0			0	
→16			↓	↓
→			17	
→14				0
				0
	0		0	
0	15			0
0				0
0				
				0
	0			

Bus stop # 7
Exit 17
Board 18 - 20
Change

			Driver	
0			0	
→0			↓	↓
→			x	
→0			19	0
				0
	0		0	
0	0		18	0
0				0
0				
20				0
	0			

Bus stop # 8
Exit 7
Board
Change

			Driver	
0			x	
→0			↓	↓
→				
→0			0	0
				0
	0		0	
0	0		0	0
0				0
0				
0				0
	0			

Date **Tuesday 21st August** **Time** **10.15am** **Journey C**

Bus stop # 9
Exit
Board 21 - 27
Change 6

			Driver	
0				24
→0			↓	↓
→				27
→0			0	0
				0
6	c23		0	
0	0		0	0
0	25		26	0
0				
0				0
	0			21
			22	

Bus stop # 10
Exit 3, 14
Board 28 - 32
Change

			Driver	
0				0
→0			↓	↓
→				0
→ x29			0	0
				0
0	0		x32	28
0	0		0	0
0	0		0	0
0			31	
0			30	0
	0			0
			0	

Bus stop # 11
Exit
Board 33 - 38
Change

			Driver	
0				0
→0			35↓	34↓
→				0
→0			0	0
	38		36	0
0	0		0	0
0	0		0	0
0	0		0	0
0			0	
0	37		0	0
	0		33	0
			0	

Bus stop # 12
Exit
Board 39 - 40
Change

			Driver	
0				0
→0			0↓	0↓
→			39	0
→0			0	0
	0	40	0	0
0	0		0	0
0	0		0	0
0	0		0	0
0			0	
0	0		0	0
	0		0	0
			0	

Date **Tuesday 21st August** **Time** **10.15am** **Journey C**

Bus stop # 13
Exit
Board
Change

→			↓	↓
→				
→				

Bus stop # 14
Exit
Board 41 - 46
Change

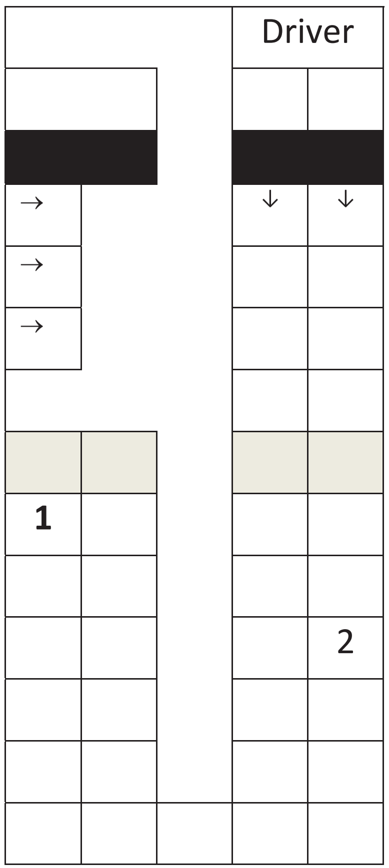
			Driver	
0		46		0
		45		
→0		44	0↓	0↓
→42		43	0	0
→0		41	0	0
	0	0	0	0
0	0		0	0
0	0		0	0
0	0		0	0
0			0	
0	0		0	0
	0		0	0
			0	

Bus stop # 15
Exit
Board 47 - 48
Change 38, 40, 41, 43, 44, 45, 46

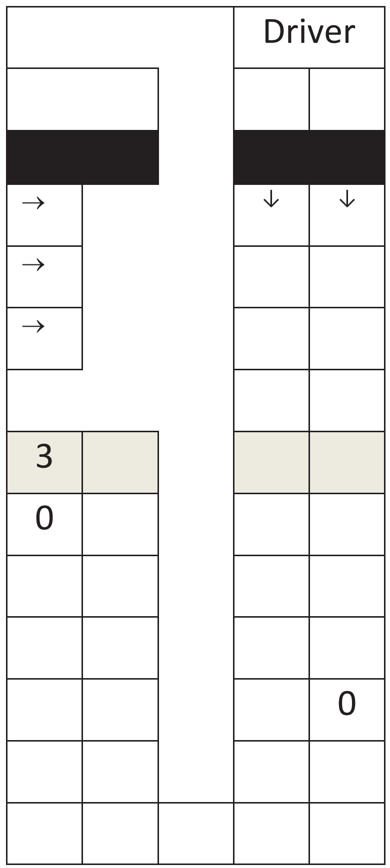
			Driver	
0		48		0
		47		
→0		46	0↓	0↓
→0		45	0	0
→0		44	0	0
38	41	43	0	0
0	0	40	0	0
0	0		0	0
0	0		0	0
0			0	
0	0		0	0
	0		0	0
			0	

Date **Tuesday 21st August** **Time** **11.15am** **Journey D**

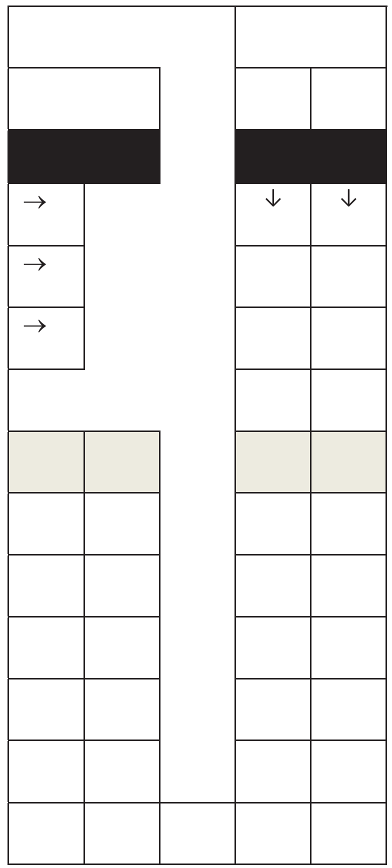
Bus stop # 1
Exit
Board 1 - 2
Change



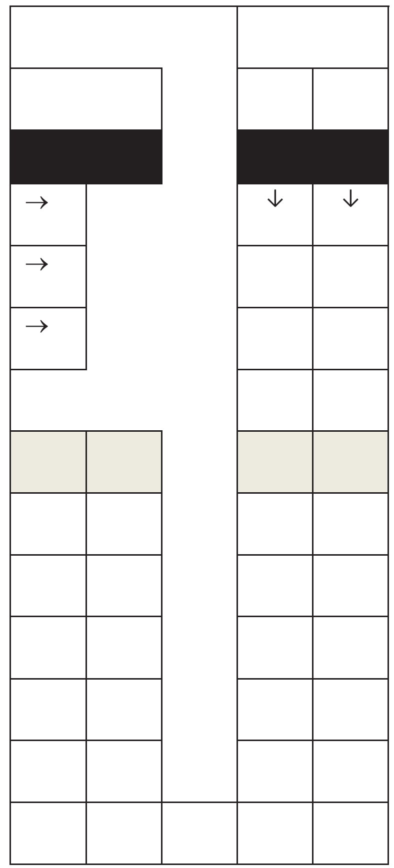
Bus stop # 2
Exit
Board 3
Change



Bus stop # 3
Exit
Board
Change

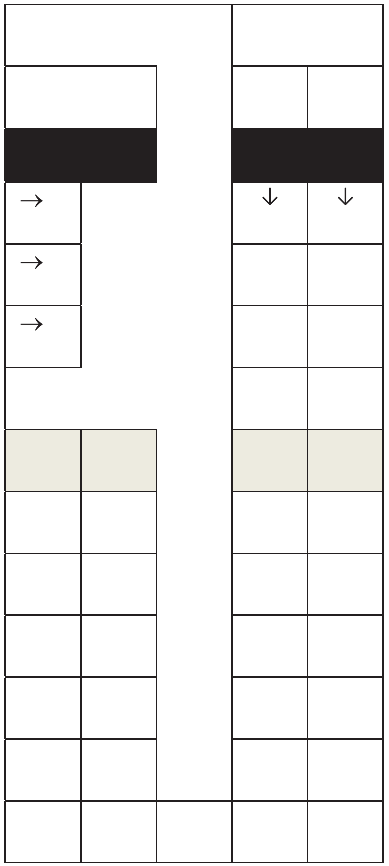


Bus stop # 4
Exit
Board
Change

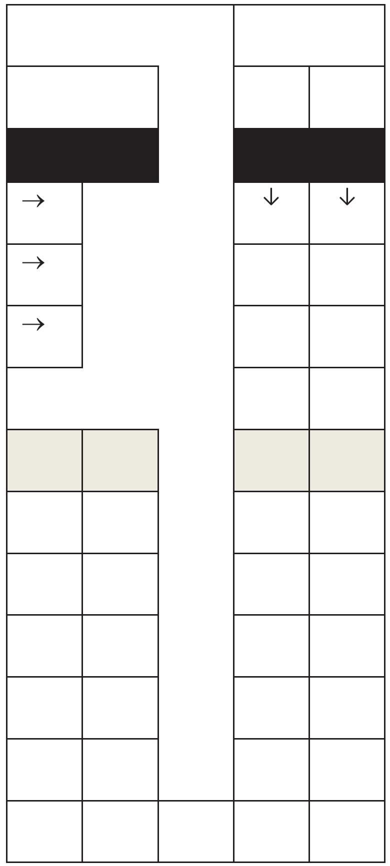


Date Tuesday 21st August **Time 11.15am** **Journey D**

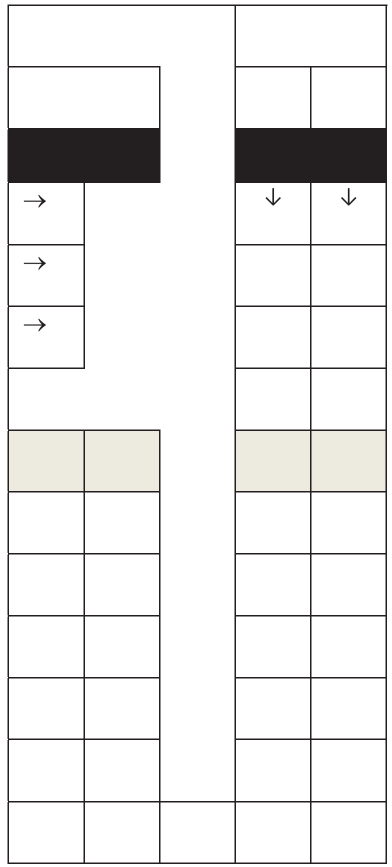
Bus stop # 5
Exit
Board
Change



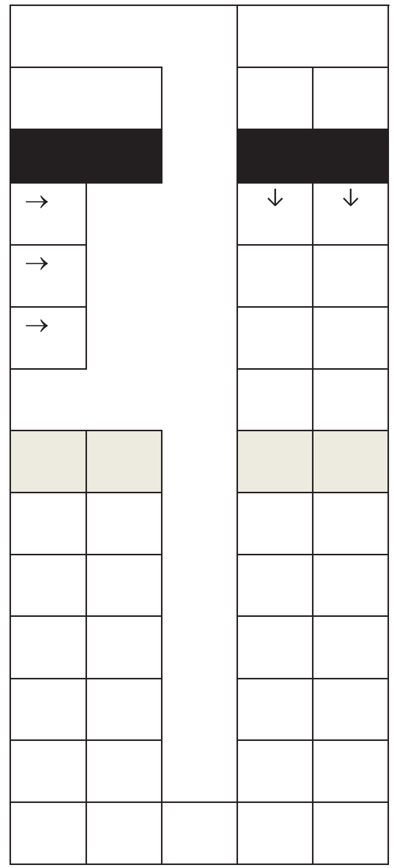
Bus stop # 6
Exit
Board
Change



Bus stop # 7
Exit
Board
Change



Bus stop # 8
Exit
Board
Change



Date Tuesday 21st August **Time 11.15am** **Journey D**

Bus stop # 9
Exit
Board 4 - 5
Change

			Driver	
4				
→			↓	↓
→				
→				
0				
0				5
				0

Bus stop # 10
Exit
Board 6 - 7
Change

			Driver	
0				
→			↓	↓
→				
→				7
0				
0				0
6				
				0

Bus stop # 11
Exit
Board 8
Change

			Driver	
0				
→			↓	↓
→				
→				0
			8	
0				
0				0
0				
				0

Bus stop # 12
Exit 7
Board 9
Change

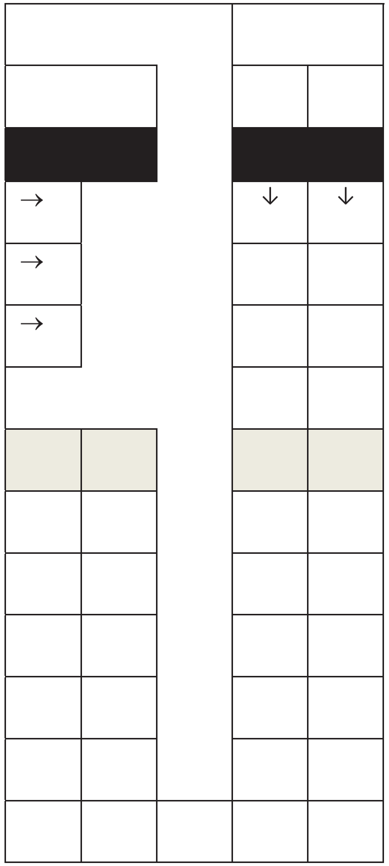
			Driver	
0				
→			↓	↓
→				
→				x
			0	
0				9
0				0
0				
				0

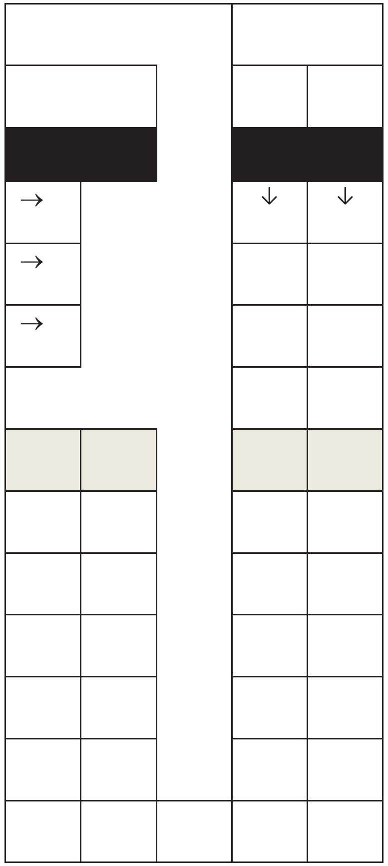
Date **Tuesday 21st August** **Time** **11.15am** **Journey D**

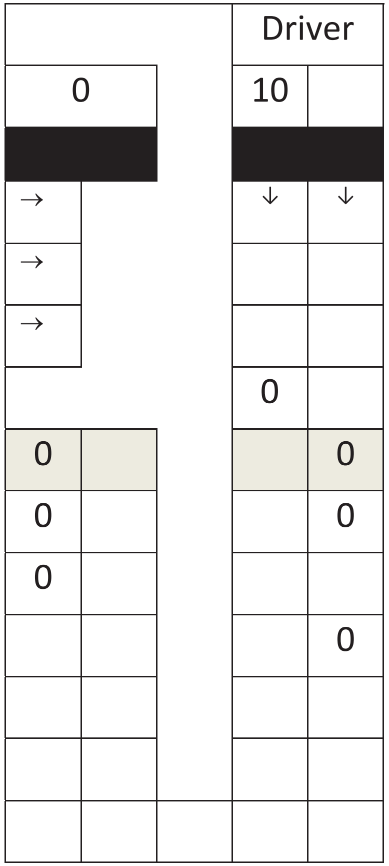
Bus stop # 13
Exit
Board
Change

Bus stop # 14
Exit
Board
Change

Bus stop # 15
Exit
Board 10
Change

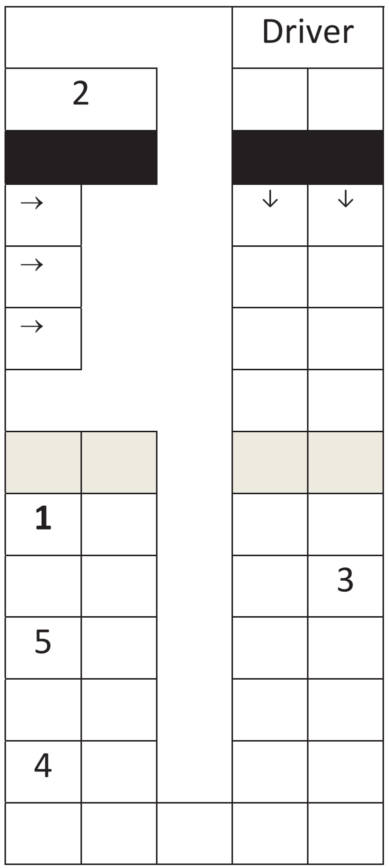




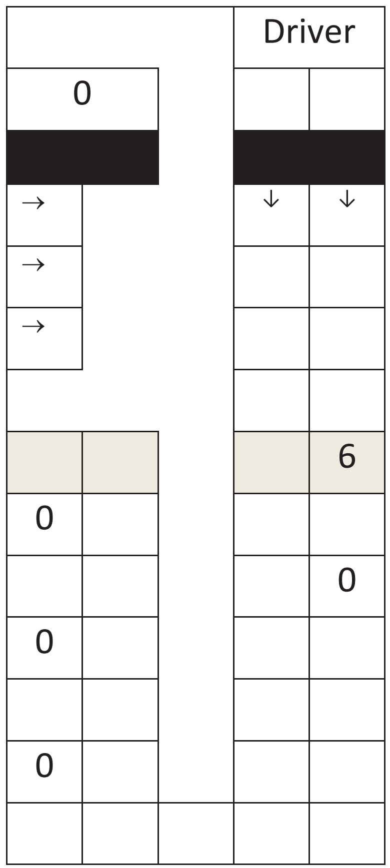


Date **Tuesday 21st August** **Time** **11.55am** **Journey E**

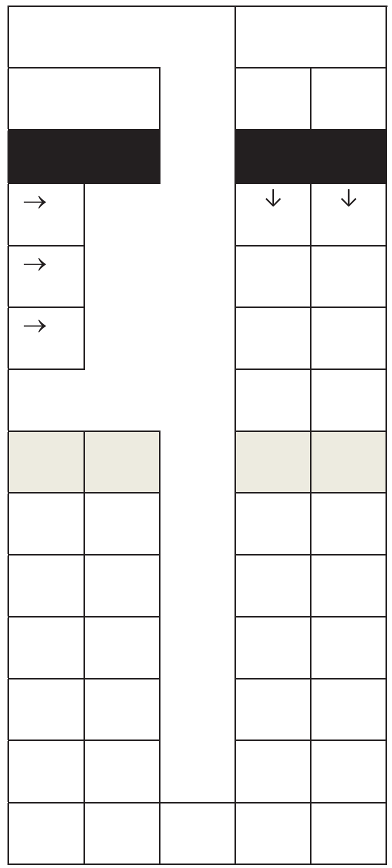
Bus stop # 1
Exit
Board 1 - 5
Change



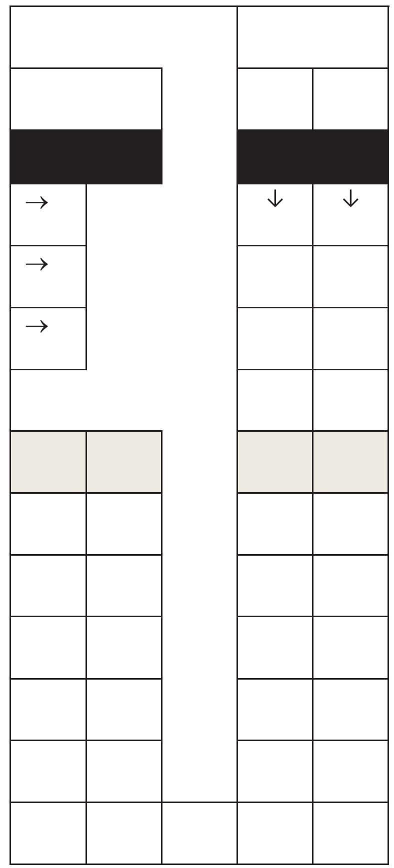
Bus stop # 2
Exit
Board 6
Change



Bus stop # 3
Exit
Board
Change



Bus stop # 4
Exit
Board
Change



Date **Tuesday 21st August** **Time** **11.55am** **Journey E**

Bus stop # 5
Exit
Board
Change

→			↓	↓
→				
→				

Bus stop # 6
Exit
Board 7
Change

			Driver	
0				
→			↓	↓
→				
→				
				7
				0
0				
				0
0				
0				

Bus stop # 7
Exit
Board 8
Change

			Driver	
0				
→			↓	↓
→				8
→				
				0
				0
0				
				0
0				
0				

Bus stop # 8
Exit
Board
Change

→			↓	↓
→				
→				

Date **Tuesday 21st August** **Time** **11.55am** **Journey E**

Bus stop # 9
Exit
Board 9 - 10
Change

			Driver	
0				
→			↓	↓
→				0
→				
				0
	10			0
0				
				0
0				
0				
			9	

Bus stop # 10
Exit
Board 11 - 16
Change

			Driver	
0				16
→			↓	↓
→				0
→			11	
				0
	0			0
0			13	
14				0
0				12
0				15
			0	

Bus stop # 11
Exit 16
Board
Change

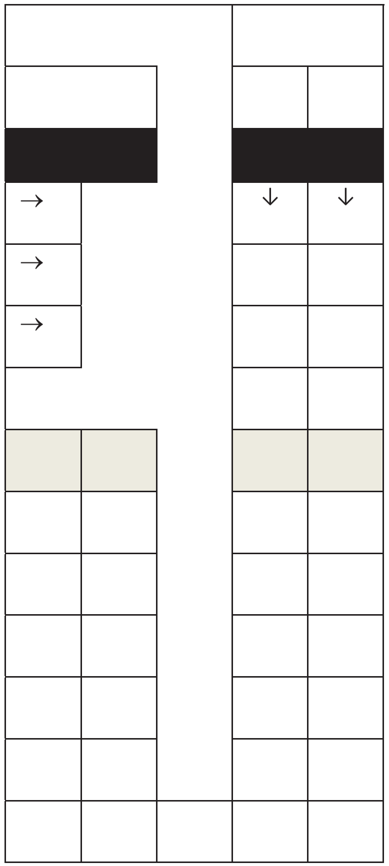
			Driver	
0				x
→			↓	↓
→				0
→			0	
				0
	0			0
0			0	
0				0
0				0
0				0
			0	

Bus stop # 12
Exit
Board
Change

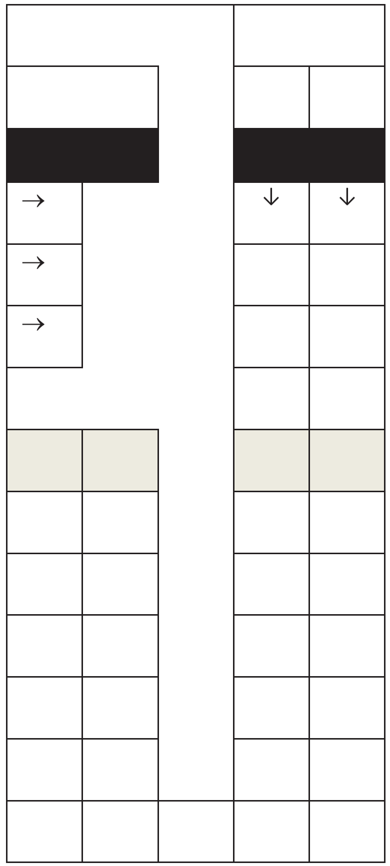
→			↓	↓
→				
→				

Date **Tuesday 21st August** **Time** **11.55am** **Journey E**

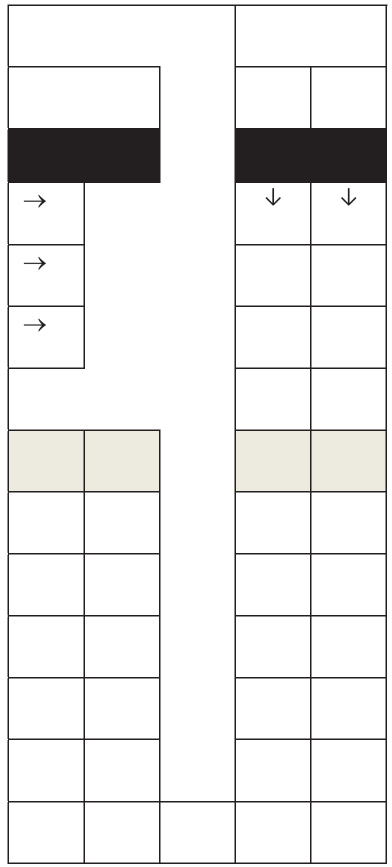
Bus stop # 13
Exit
Board
Change



Bus stop # 14
Exit
Board
Change

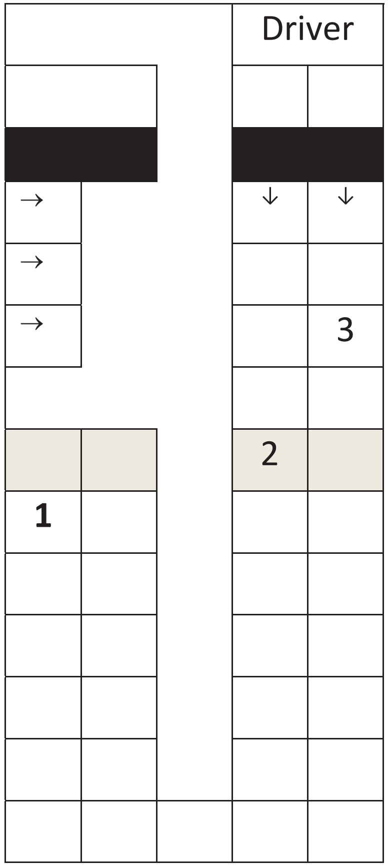


Bus stop # 15
Exit
Board
Change

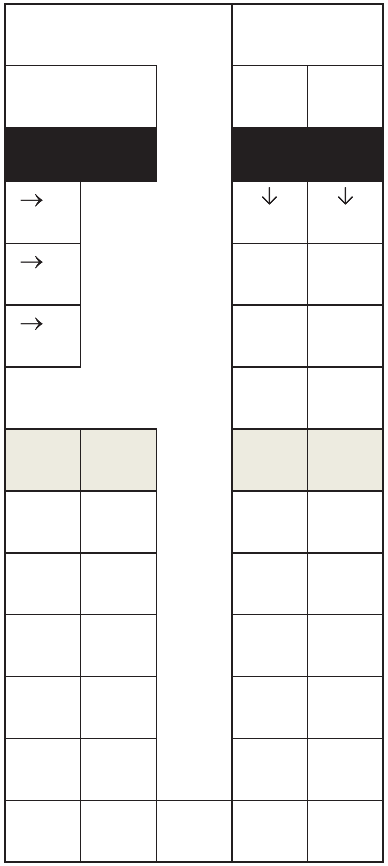


Date **Tuesday 21st August** **Time** **12.55pm** **Journey F**

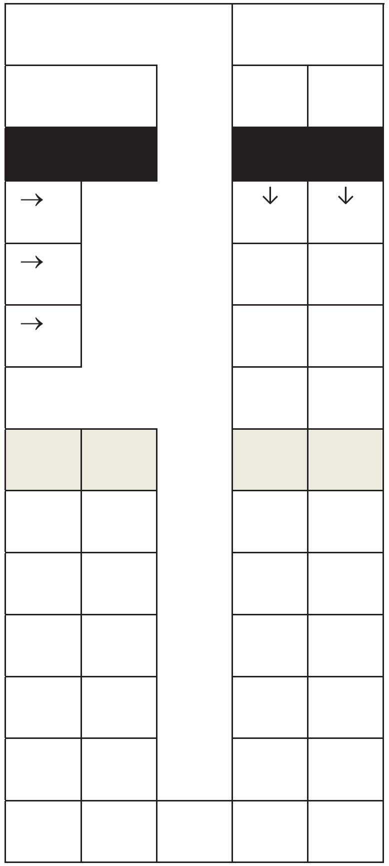
Bus stop # 1
Exit
Board 1 - 3
Change



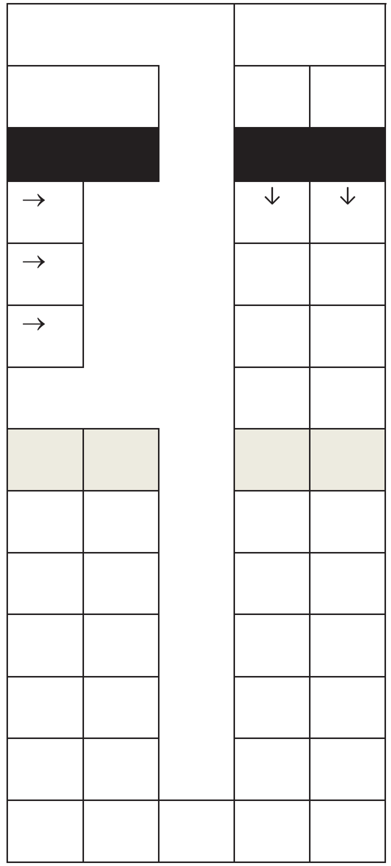
Bus stop # 2
Exit
Board
Change



Bus stop # 3
Exit
Board
Change

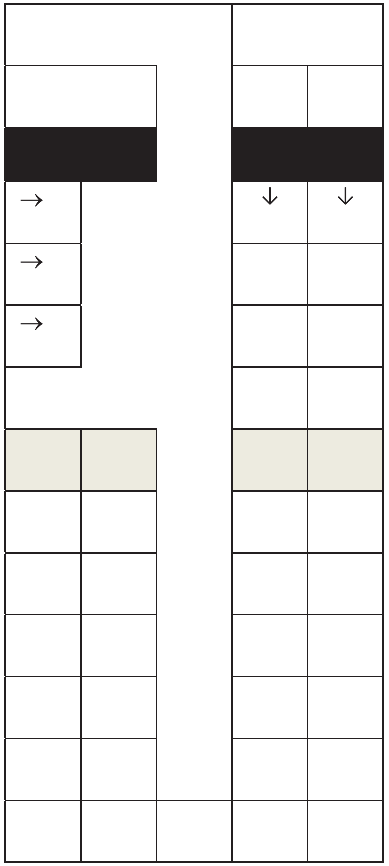


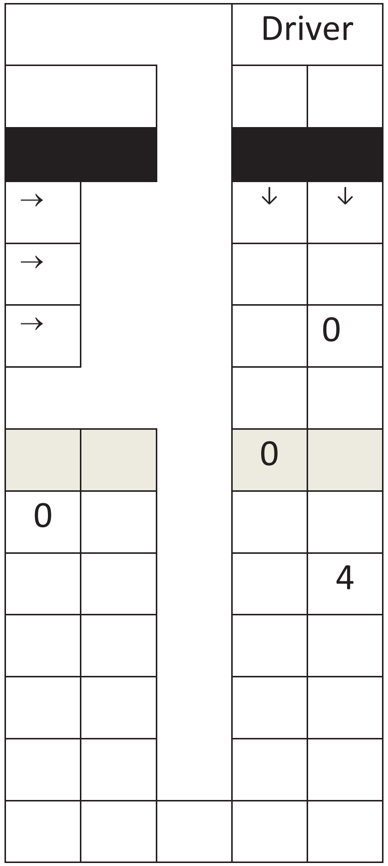
Bus stop # 4
Exit
Board
Change

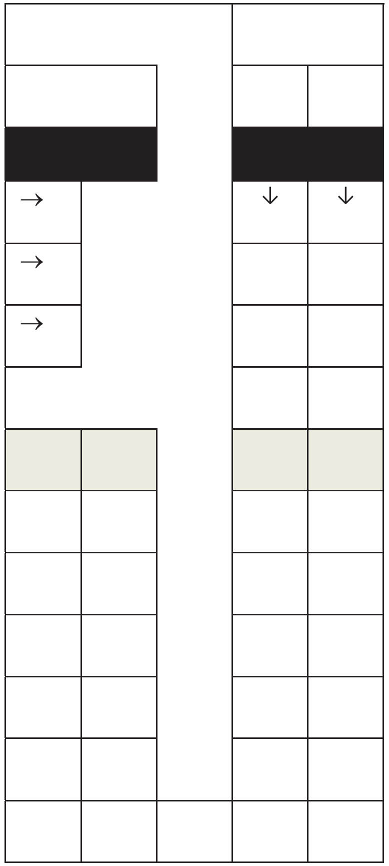


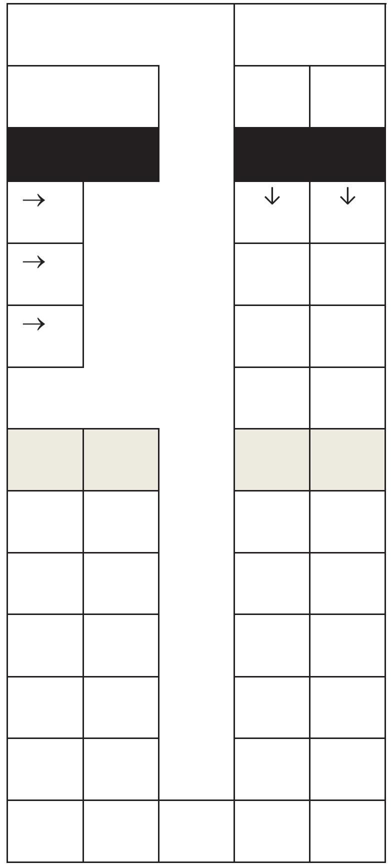
Date **Tuesday 21st August** | **Time** **12.55pm** | **Journey F**

Bus stop	# 5	Bus stop	# 6	Bus stop	# 7	Bus stop	# 8
Exit		Exit		Exit		Exit	
Board		Board	4	Board		Board	
Change		Change		Change		Change	









Date **Tuesday 21st August** **Time** **12.55pm** **Journey F**

Bus stop # 9
Exit
Board 5 - 7
Change

			Driver	
→			↓	↓
→				5
→				0
			7	
			0	
0				
				0
6				

Bus stop # 10
Exit
Board 8 - 9
Change

			Driver	
9				
→8			↓	↓
→				0
→				0
			0	
			0	
0				
				0
0				

Bus stop # 11
Exit
Board 10 - 11
Change

			Driver	
0				10
→0			↓	↓
→				0
→11				0
			0	
			0	
0				
				0
0				

Bus stop # 12
Exit
Board 12
Change

			Driver	
0				0
→0			↓	↓
→				0
→0				0
			0	
			0	
0				
				0
0			12	

Date **Tuesday 21st August** **Time** **12.55pm** **Journey F**

Bus stop # 13
Exit
Board
Change

→			↓	↓
→				
→				

Bus stop # 14
Exit 2
Board 13
Change

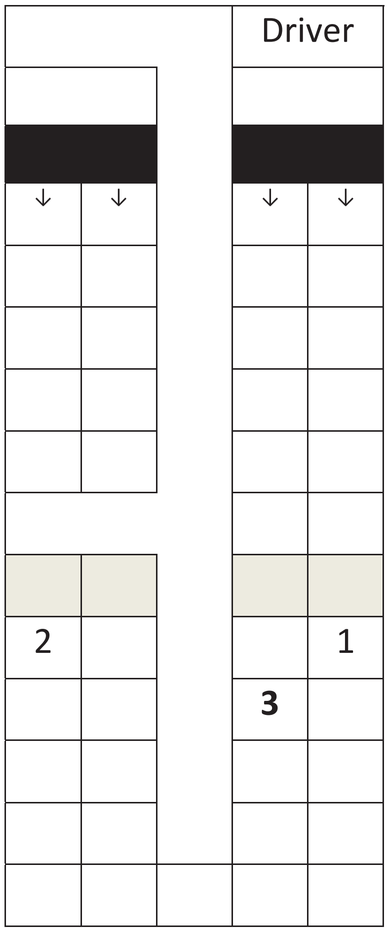
			Driver	
0				0
→0			↓	↓
→				0
→0				0
			0	
			x	
0				
				0
13				
0			0	

Bus stop # 15
Exit
Board 14
Change

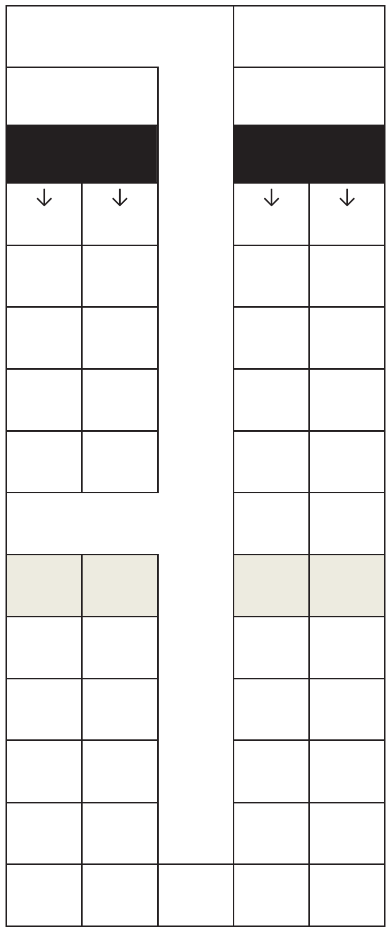
			Driver	
0				0
→0			↓	↓
→				0
→0				0
			0	
				14
0				
				0
0				
0			0	

Date **Tuesday 21st August** **Time** **1.45pm** **Journey G**

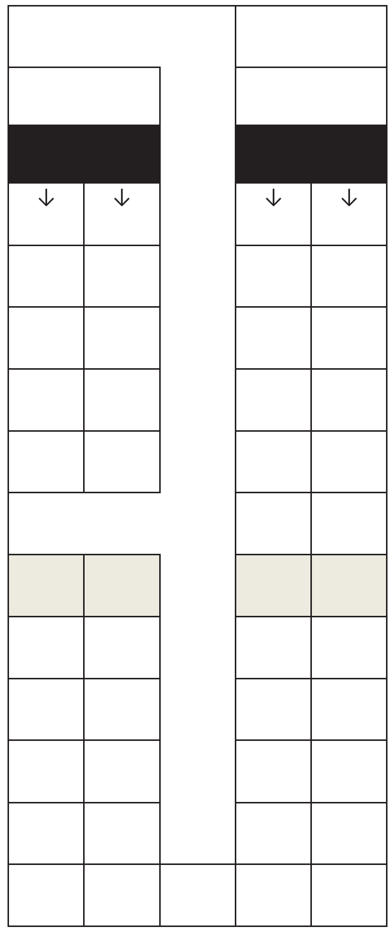
Bus stop # 1
Exit
Board 1 - 3
Change



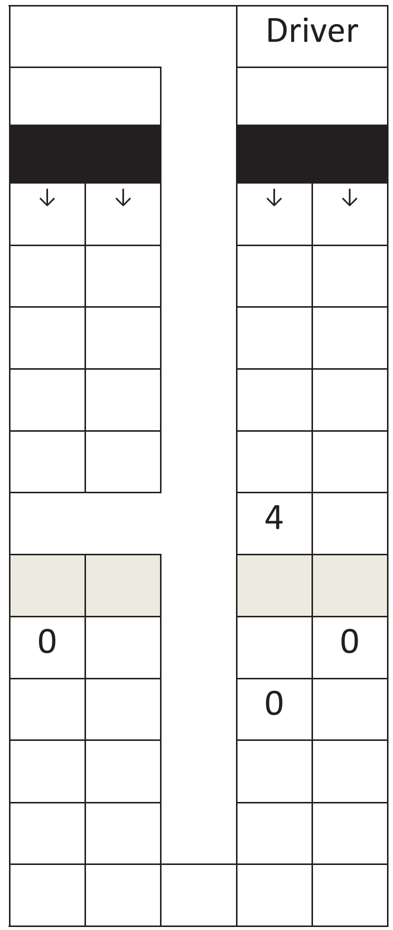
Bus stop # 2
Exit
Board
Change



Bus stop # 3
Exit
Board
Change

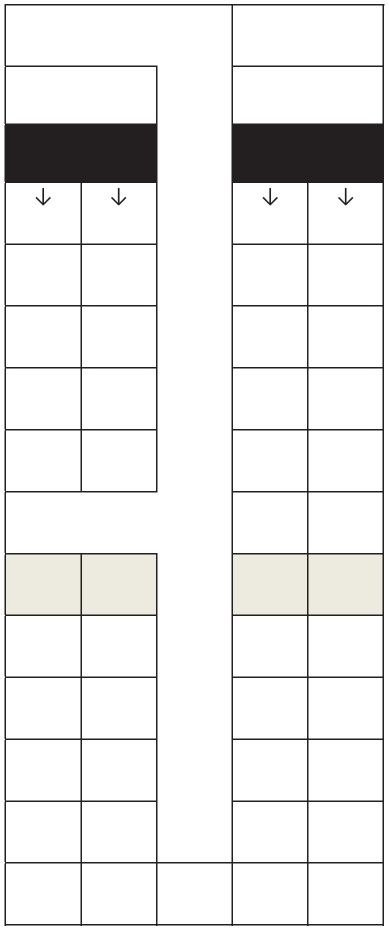


Bus stop # 4
Exit
Board 4
Change

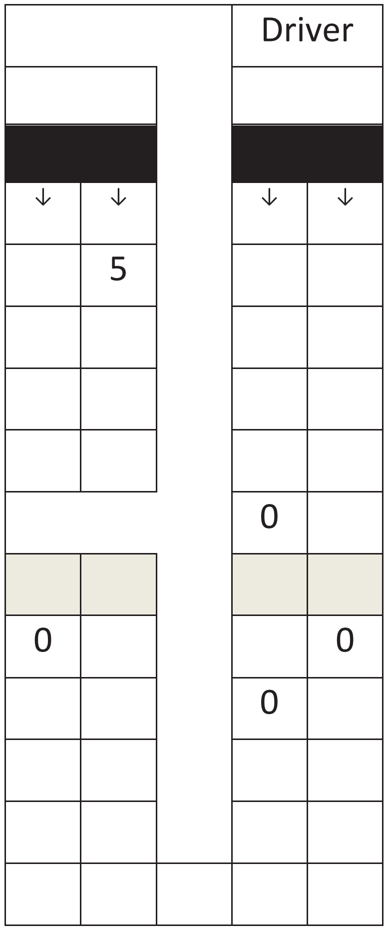


Date **Tuesday 21st August** **Time** **1.45pm** **Journey G**

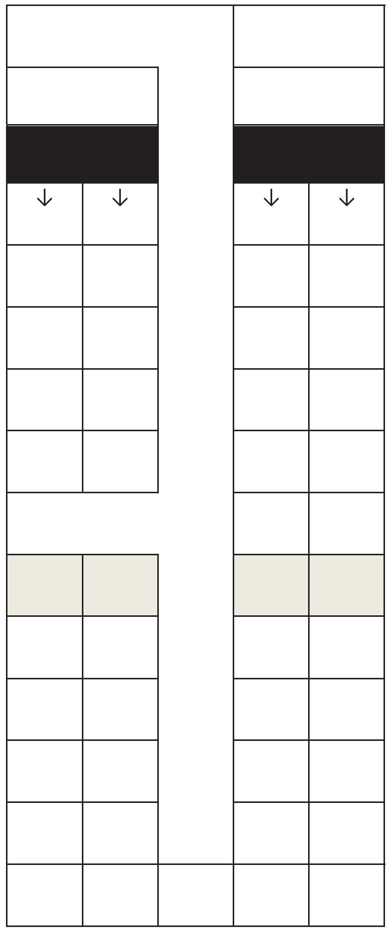
Bus stop # 5
Exit
Board
Change



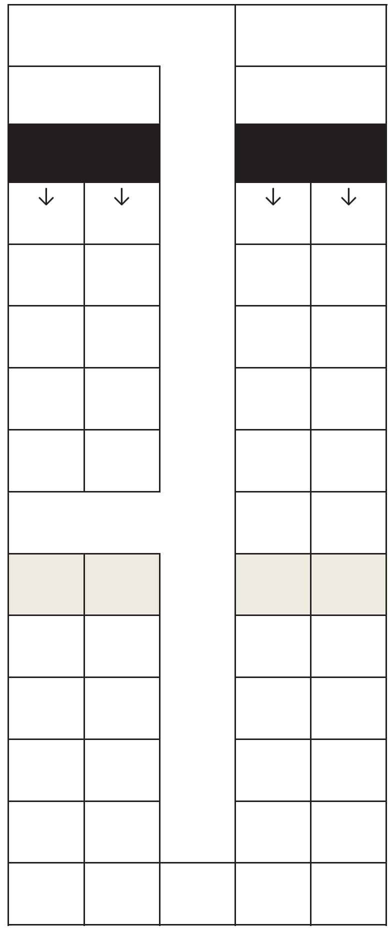
Bus stop # 6
Exit
Board 5
Change



Bus stop # 7
Exit
Board
Change



Bus stop # 8
Exit
Board
Change



Date **Tuesday 21st August** **Time** **1.45pm** **Journey G**

Bus stop # 9
Exit
Board 6 - 7
Change

			Driver	
↓	↓		↓	↓
	0			
			0	
0				0
			0	
	6			
			7	

Bus stop # 10
Exit 4 - 5
Board 8 - 11
Change

			Driver	
↓	↓		↓	↓
	x			10
8				
				9
			x	
0				0
11			0	
	0			
			0	

Bus stop # 11
Exit
Board
Change

↓	↓		↓	↓

Bus stop # 12
Exit
Board
Change

↓	↓		↓	↓

Date **Tuesday 21st August** **Time** **1.45pm** **Journey G**

Bus stop # 13
Exit
Board
Change

↓	↓		↓	↓

Bus stop # 14
Exit
Board 12 - 13
Change

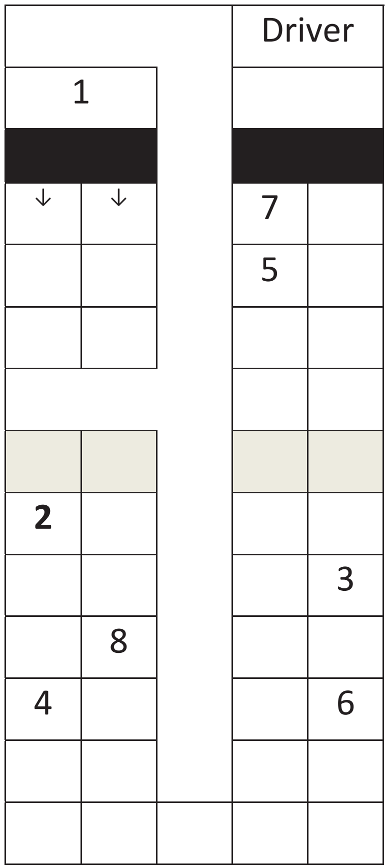
			Driver	
13			12	
↓	↓		↓	↓
				0
0				
				0
0				0
0			0	
	0			
			0	

Bus stop # 15
Exit
Board 14 - 15
Change

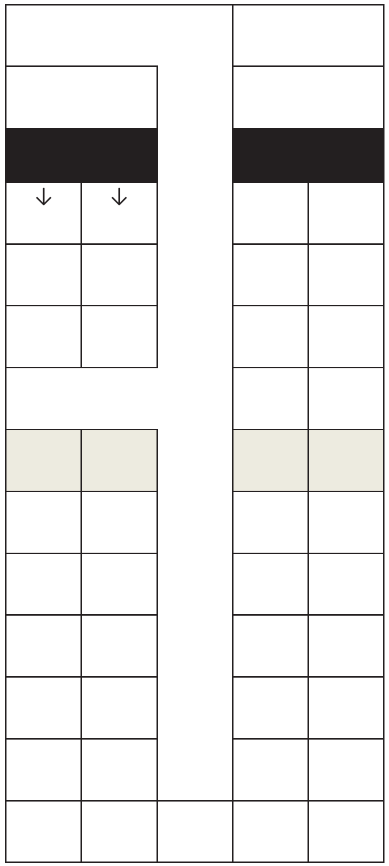
			Driver	
0			0	
↓	↓		↓	↓
15				0
0				
				0
	14			
0				0
0			0	
	0			
			0	

Date **Tuesday 21st August** **Time** **2.25pm** **Journey H**

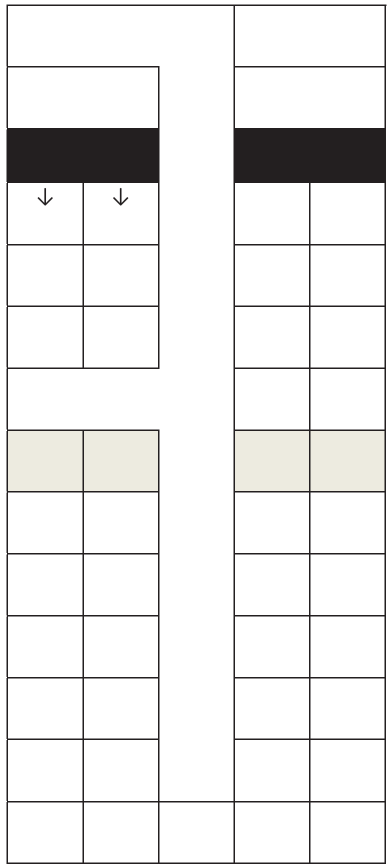
Bus stop # 1
Exit
Board 1 - 8
Change



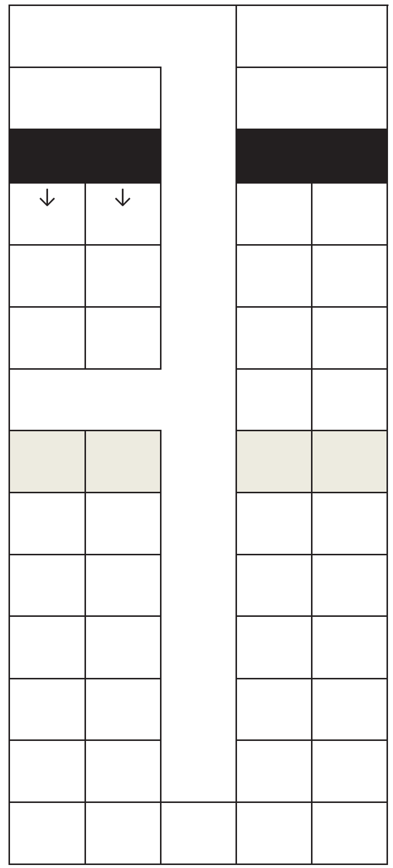
Bus stop # 2
Exit
Board
Change



Bus stop # 3
Exit
Board
Change



Bus stop # 4
Exit
Board
Change



Date **Tuesday 21st August** **Time** **2.25pm** **Journey H**

Bus stop # 5
Exit
Board 9 - 10
Change

			Driver	
0				
↓	↓		0	
	9		0	
				10
0				
				0
	0			
0				0

Bus stop # 6
Exit 5
Board
Change

			Driver	
0				
↓	↓		0	
	0		x	
				0
0				
				0
	0			
0				0

Bus stop # 7
Exit 7
Board
Change

			Driver	
0				
↓	↓		x	
	0			
				0
0				
				0
	0			
0				0

Bus stop # 8
Exit
Board
Change

↓	↓			

Date **Tuesday 21st August** **Time** **2.25pm** **Journey H**

Bus stop # 9
Exit
Board
Change

↓	↓			

Bus stop # 10
Exit 10
Board 11 - 20
Change 1

			Driver	
c16			1	
↓	↓			
	0			11
			20	17
				x12
13	14			15
0				
18	19			0
	0			
0				0

Bus stop # 11
Exit
Board 21 - 22
Change

			Driver	
0			0	
↓	↓			
	0		21	0
22			0	0
				0
0	0			0
0				
0	0			0
	0			
0				0

Bus stop # 12
Exit
Board
Change

↓	↓			

Date **Tuesday 21st August** **Time** **2.25pm** **Journey H**

Bus stop # 13
Exit
Board
Change

↓	↓			

Bus stop # 14
Exit
Board 23 - 24
Change

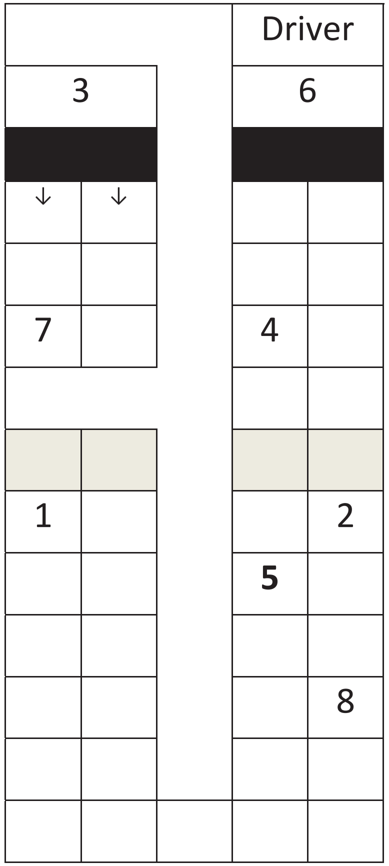
			Driver	
0			0	
	0		0	0
0			0	0
				0
0	0			0
0			24	23
0	0			0
	0			
0				0

Bus stop # 15
Exit 16
Board
Change

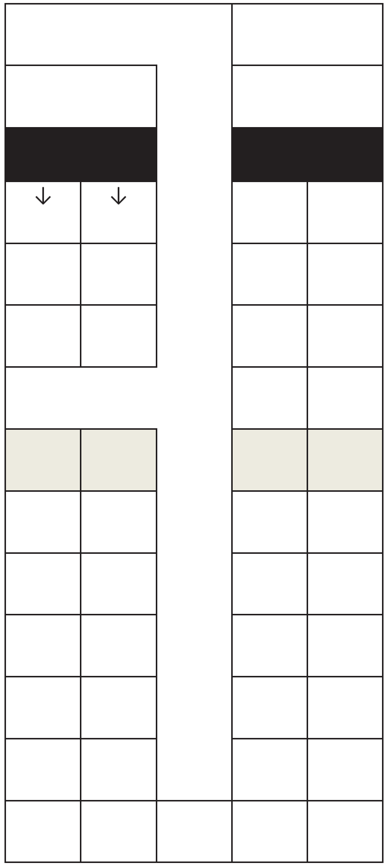
			Driver	
x			0	
↓	↓			
	0		0	0
0			0	0
				0
0	0			0
0			0	0
0	0			0
	0			
0				0

Date **Wednesday 22nd August** **Time 10.25am** **Journey I**

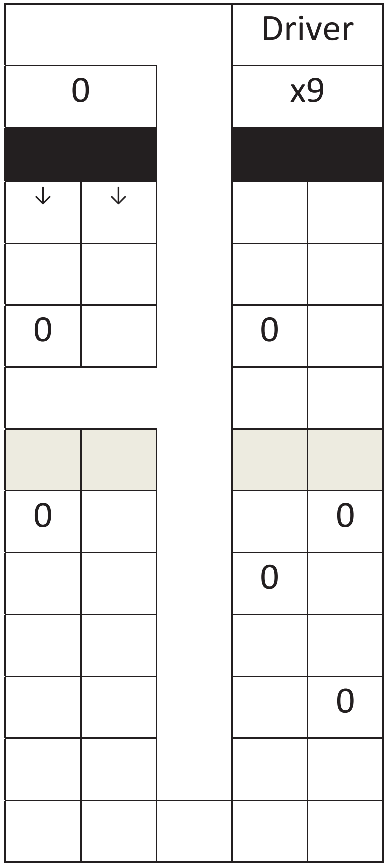
Bus stop # 1
Exit
Board 1 - 8
Change



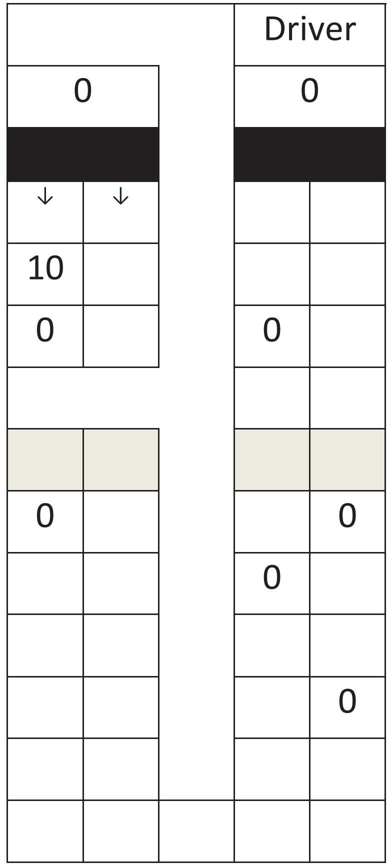
Bus stop # 2
Exit
Board
Change



Bus stop # 3
Exit 6
Board 9
Change

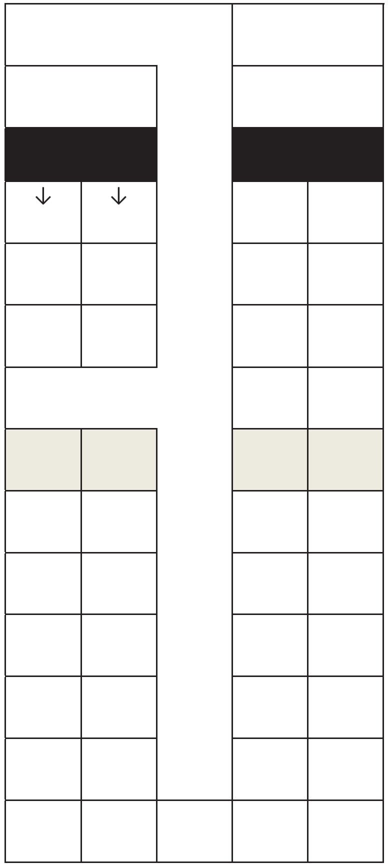


Bus stop # 4
Exit
Board 10
Change

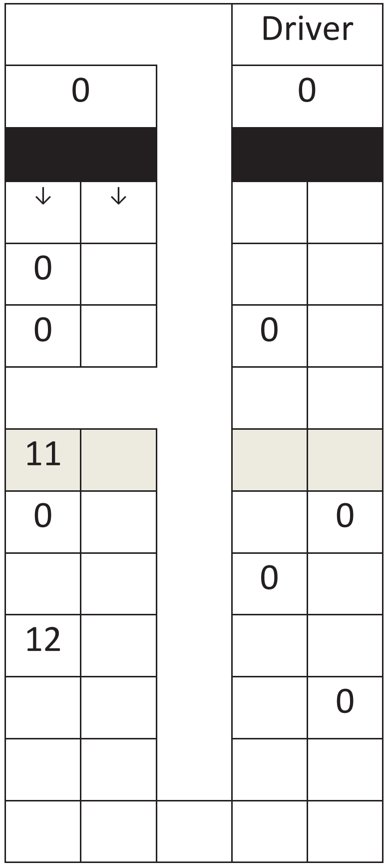


Date **Wednesday 22nd August** **Time 10.25am** **Journey I**

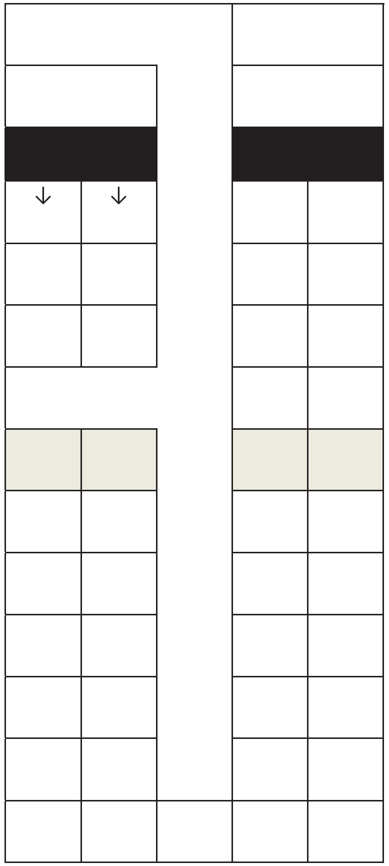
Bus stop # 5
Exit
Board
Change



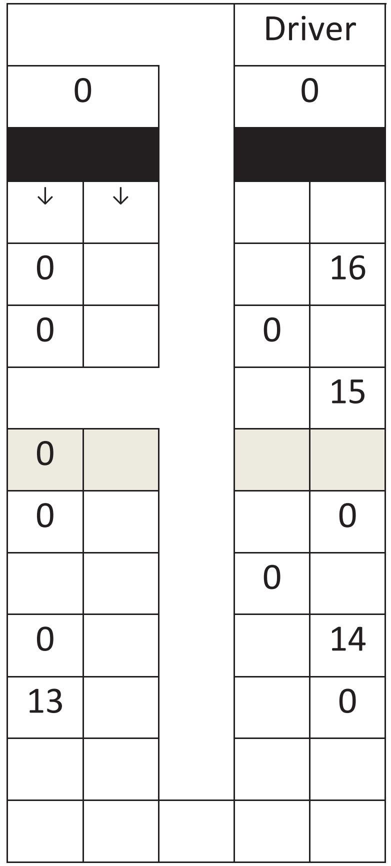
Bus stop # 6
Exit
Board 11 - 12
Change



Bus stop # 7
Exit
Board
Change



Bus stop # 8
Exit
Board 13 - 16
Change



Date **Wednesday 22nd August** **Time 10.25am** **Journey I**

Bus stop # 9
Exit
Board
Change

↓	↓			

Bus stop # 10
Exit 4
Board 17 - 21
Change

			Driver	
0			0	
↓	↓			21
0				0
0			x20	
				0
0				17
0				0
			0	
0				0
0				0
	18	19		

Bus stop # 11
Exit
Board
Change

Bus stop # 12
Exit
Board
Change

↓	↓			

Date **Wednesday 22nd August** **Time 10.25am** **Journey I**

Bus stop	# 13
Exit	
Board	
Change	

↓	↓			

Bus stop	# 14
Exit	
Board	22 - 24
Change	

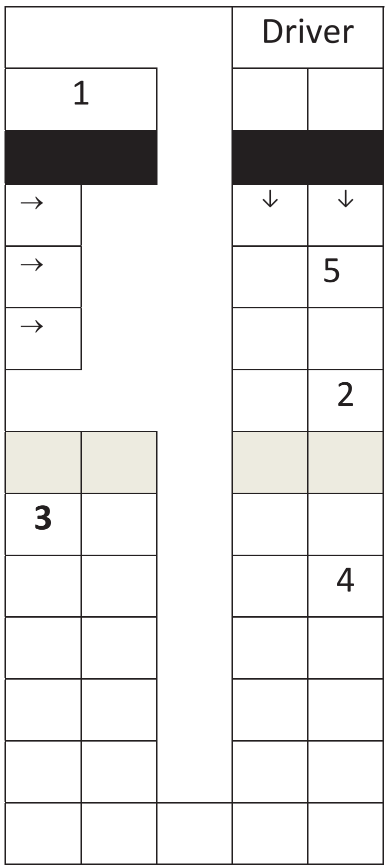
			Driver	
0			0	
↓	↓			0
0	23		22	0
0			0	
				0
0	24			0
0				0
			0	
0				0
0				0
	0	0		

Bus stop	# 15
Exit	
Board	25 - 27
Change	

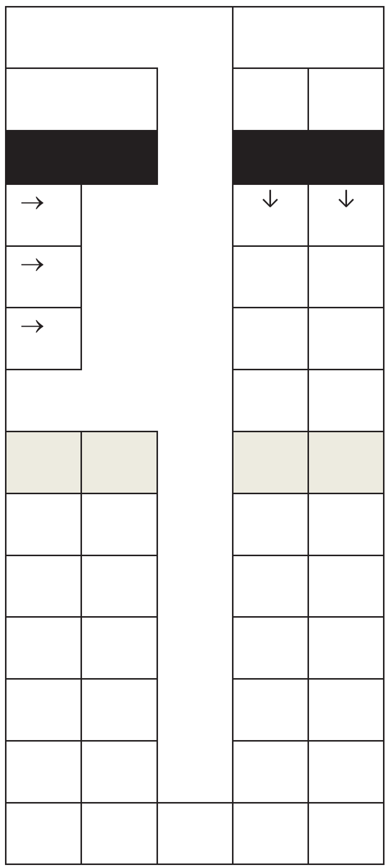
			Driver	
0			0	
↓	↓		26	0
0	0		0	0
0			0	
				0
0	0			0
0				0
	25		0	
0				0
0				0
27				
	0	0		

Date **Wednesday 22nd August** **Time** **11.15am** **Journey J**

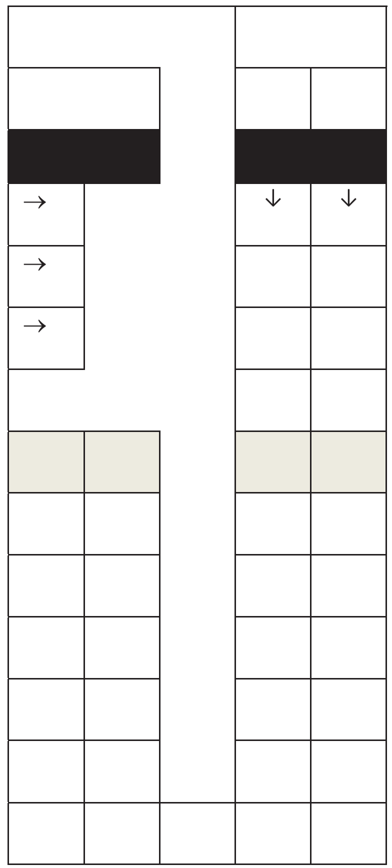
Bus stop # 1
Exit
Board 1 - 5
Change



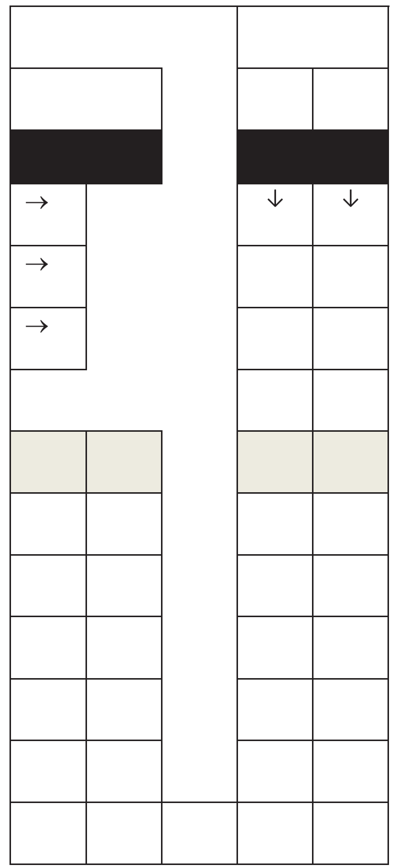
Bus stop # 2
Exit
Board
Change



Bus stop # 3
Exit
Board
Change

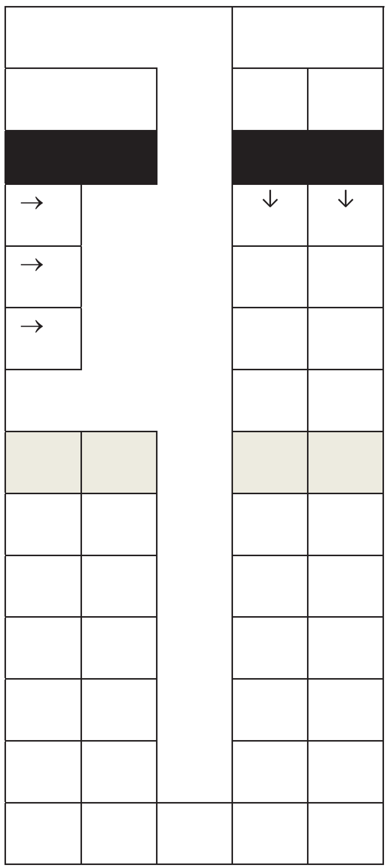


Bus stop # 4
Exit
Board
Change

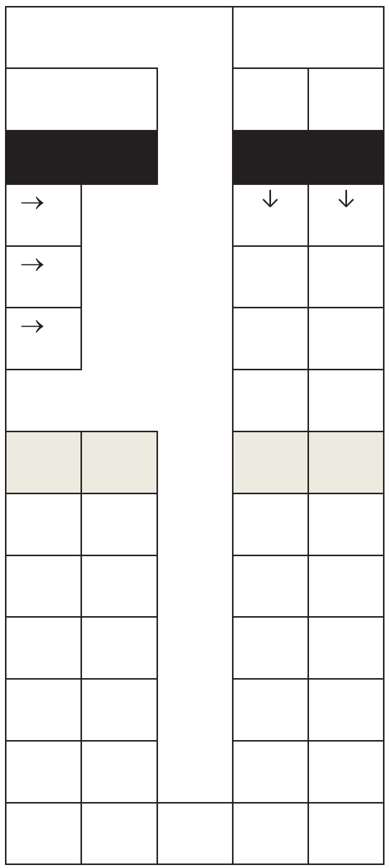


Date **Wednesday 22nd August** **Time** **11.15am** **Journey J**

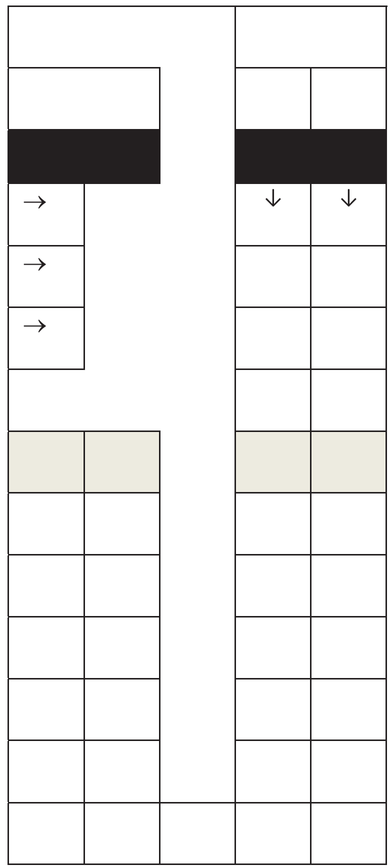
Bus stop # 5
Exit
Board
Change



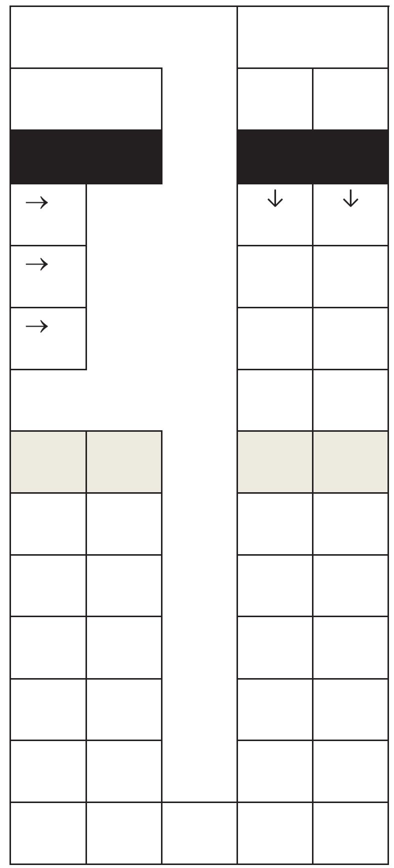
Bus stop # 6
Exit
Board
Change



Bus stop # 7
Exit
Board
Change



Bus stop # 8
Exit
Board
Change



Date **Wednesday 22nd August** **Time** **11.15am** **Journey J**

Bus stop # 9
Exit
Board 6 - 12
Change

			Driver	
0				11
→			↓	↓
→				0
→				8
				0
6				7
0				
9				0
	10			
			12	

Bus stop # 10
Exit 1
Board 13 - 18
Change

			Driver	
x13				0
→17			↓	↓
→				0
→				0
				0
0				0
0				
0				0
	0		16	
14			15	
18			0	

Bus stop # 11
Exit
Board
Change

→			↓	↓
→				
→				

Bus stop # 12
Exit
Board 19 - 24
Change

			Driver	
0				0
→0			↓	↓
→24				0
→23				0
				0
0				0
0				19
0				0
	0		0	
0			0	
0			0	
	20	21	22	

Date Wednesday 22nd August **Time 11.15am** **Journey J**

Bus stop # 13
Exit
Board 25
Change

			Driver	
0				0
→0			↓	↓
→0				0
→0				0
			25	0
0				0
0				0
0				0
	0		0	
0			0	
0			0	
	0	0	0	

Bus stop # 14
Exit
Board 26
Change

			Driver	
0				0
→0			↓	↓
→0				0
→0				0
			0	0
0				0
0				0
0	26			0
	0		0	
0			0	
0			0	
	0	0	0	

Bus stop # 15
Exit
Board
Change

→			↓	↓
→				
→				

Date Wednesday 22nd August **Time 11.45am** **Journey K**

Bus stop # 1
Exit
Board 1 - 7
Change

			Driver	
↓	↓			6
4				
7				
3				1
				5
2				

Bus stop # 2
Exit
Board 8
Change

			Driver	
↓	↓			0
0				
0				8
0				0
				0
0				

Bus stop # 3
Exit
Board 9
Change

			Driver	
↓	↓			0
0				
				9
0				0
0				0
				0
0				

Bus stop # 4
Exit
Board 10 - 11
Change

			Driver	
↓	↓			0
10				
0			11	
				0
0				0
0				0
				0
0				

Date **Wednesday 22nd August** **Time** **11.45am** **Journey K**

Bus stop # 5
Exit
Board 12 - 16
Change

			Driver	
				0
0				
0			0	
				0
0				0
0				0
12	13			0
0				
16				
			15	14

Bus stop # 6
Exit 10
Board 17 - 18
Change

			Driver	
↓	↓			0
x				18
0			0	
				0
0				0
0				0
0	0			0
0				17
0				
			0	0

Bus stop # 7
Exit
Board
Change

↓	↓			

Bus stop # 8
Exit
Board 19 - 21
Change

			Driver	
↓	↓			0
	21			0
0			0	
				0
0				0
0				0
0	0			0
0				0
0			20	19
			0	0

Date Wednesday 22nd August **Time 11.45am** **Journey K**

Bus stop # 9
Exit
Board
Change

↓	↓			

Bus stop # 10
Exit 6, 11
Board 22 - 27
Change 21

			Driver	
27				
↓	↓		23	x
25	c26			0
0			x22	
				0
0				0
0				0
0	0			0
0				0
0			0	0
21	24		0	0

Bus stop # 11
Exit 15
Board 28
Change

			Driver	
0				
↓	↓		0	
0	0		28	0
0			0	
				0
0				0
0				0
0	0			0
0				0
0			0	0
0	0		x	0

Bus stop # 12
Exit
Board
Change

↓	↓			

Date **Wednesday 22nd August** **Time** **11.45am** **Journey K**

Bus stop # 13
Exit
Board
Change

↓	↓			

Bus stop # 14
Exit
Board 29 - 32
Change

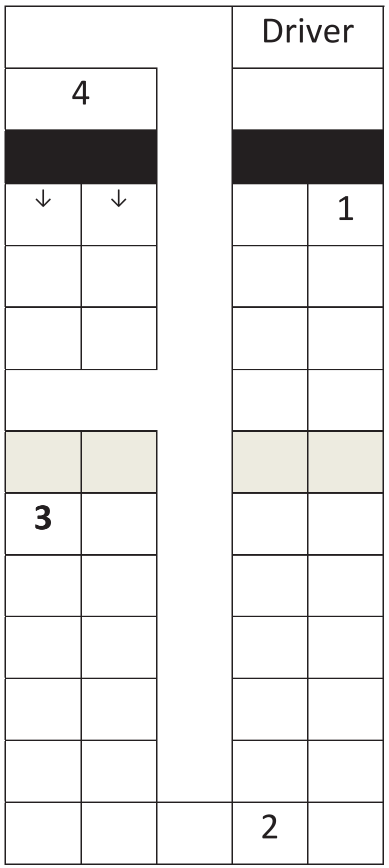
			Driver	
0			32	
↓	↓		0	
0	0		0	0
0	30		0	
				0
0				0
0				0
0	0			0
0				0
0			0	0
0	0			0
		31		29

Bus stop # 15
Exit
Board
Change

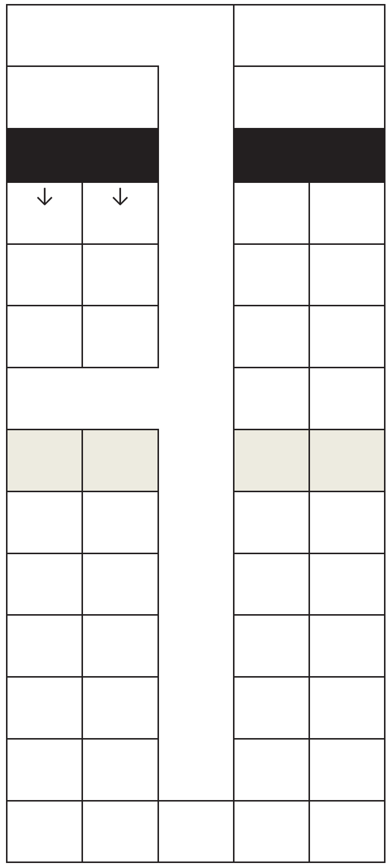
↓	↓			

Date **Wednesday 22nd August** **Time** **12.45pm** **Journey L**

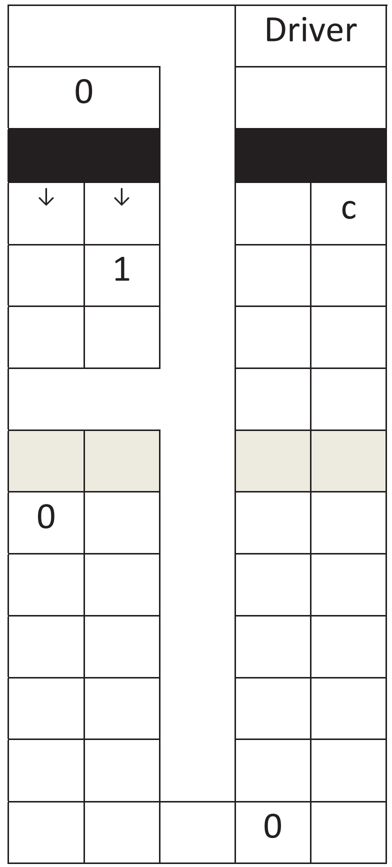
Bus stop # 1
Exit
Board 1 - 4
Change



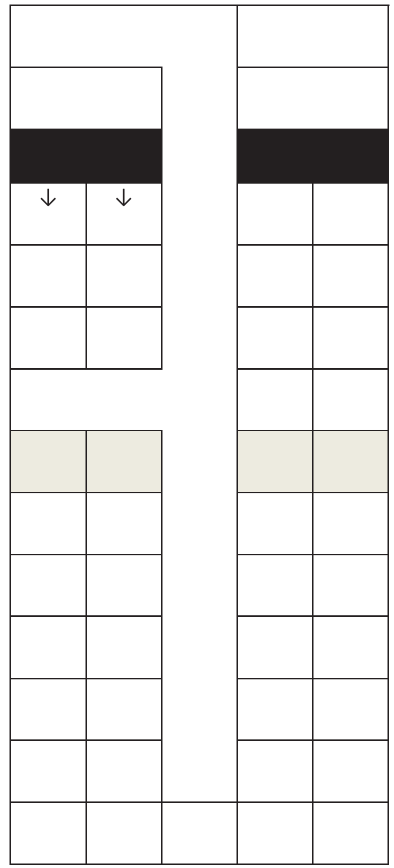
Bus stop # 2
Exit
Board
Change



Bus stop # 3
Exit
Board
Change 1

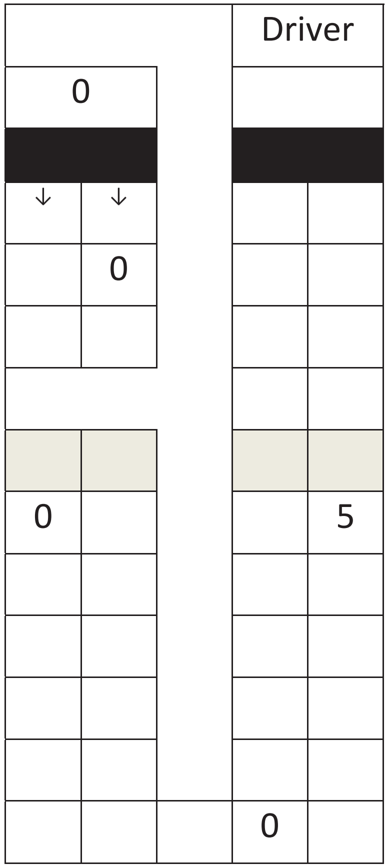


Bus stop # 4
Exit
Board
Change

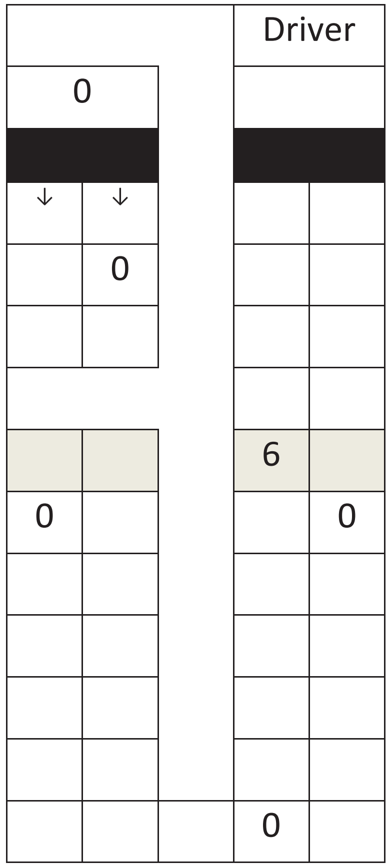


Date **Wednesday 22nd August** **Time** **12.45pm** **Journey L**

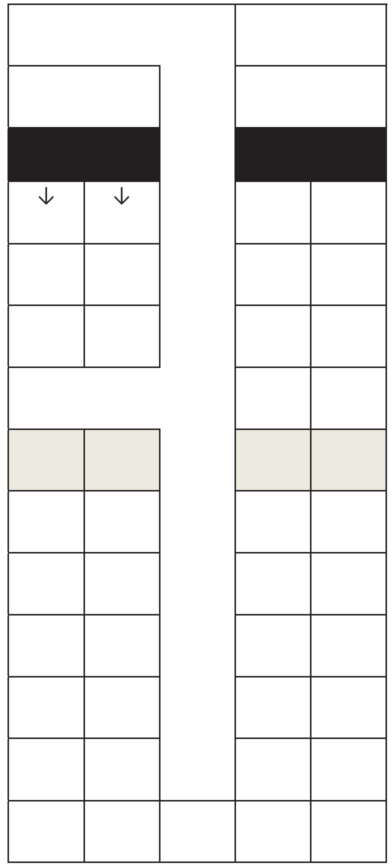
Bus stop # 5
Exit
Board 5
Change



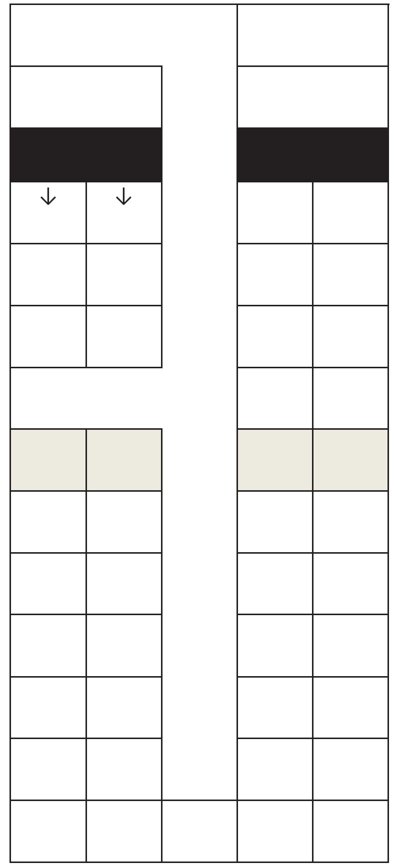
Bus stop # 6
Exit
Board 6
Change



Bus stop # 7
Exit
Board
Change

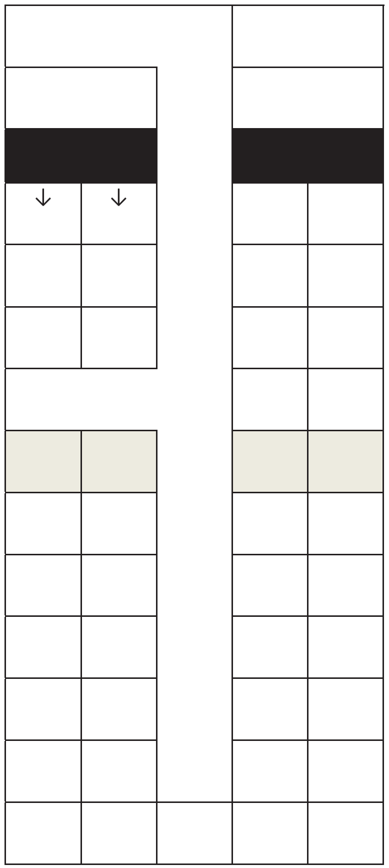


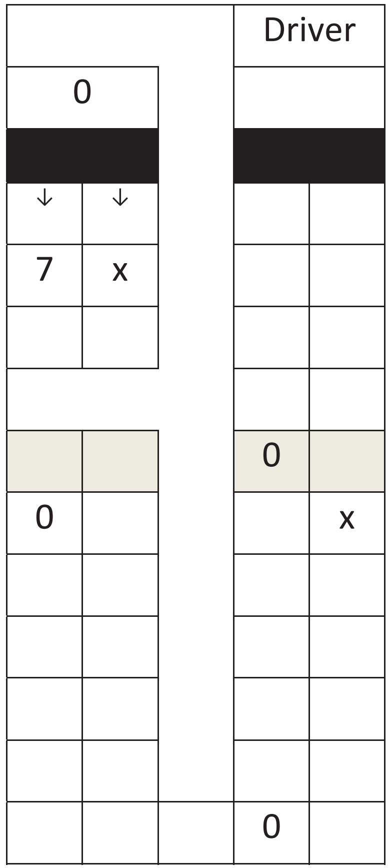
Bus stop # 8
Exit
Board
Change

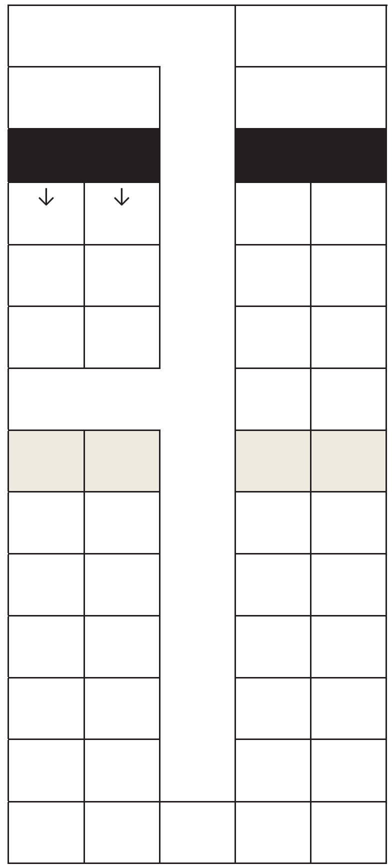


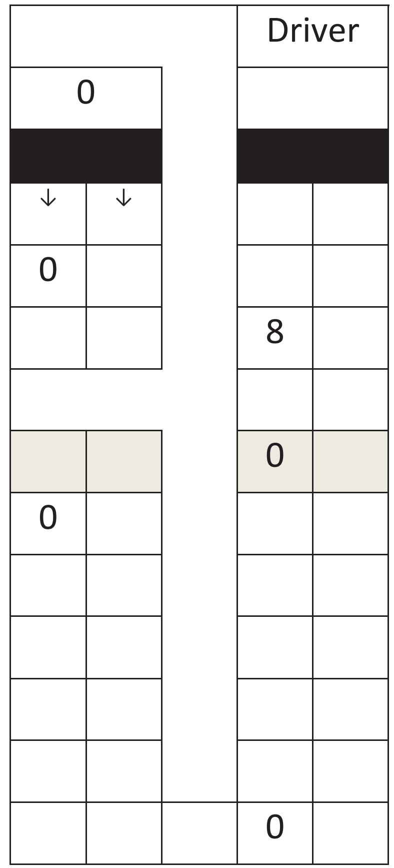
Date **Wednesday 22nd August** **Time** **12.45pm** **Journey L**

Bus stop	# 9	Bus stop	# 10	Bus stop	# 11	Bus stop	# 12
Exit		Exit	1, 5	Exit		Exit	
Board		Board	7	Board		Board	8
Change		Change		Change		Change	









Date **Wednesday 22nd August** **Time** **12.45pm** **Journey L**

Bus stop # 13
Exit
Board 9
Change

			Driver	
0				
↓	↓			
0			9	
			0	
			0	
0				
			0	

Bus stop # 14
Exit
Board 10 - 12
Change

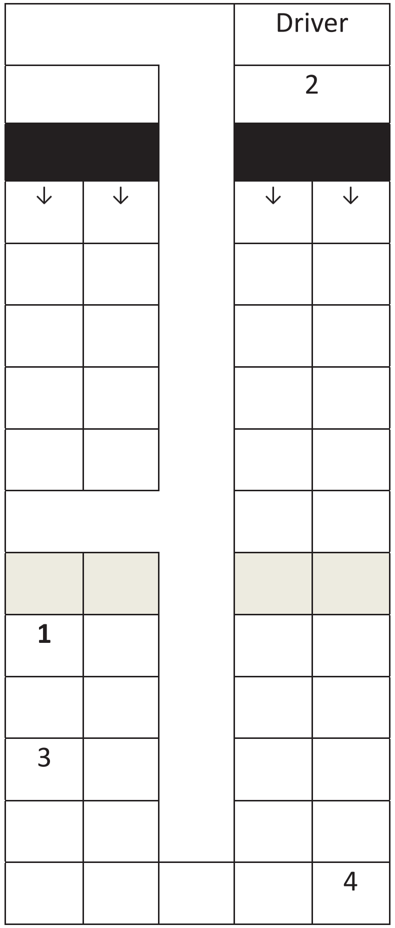
			Driver	
0				
↓	↓			10
0			0	
	11		0	
	12		0	
0				
			0	

Bus stop # 15
Exit
Board 13 - 14
Change

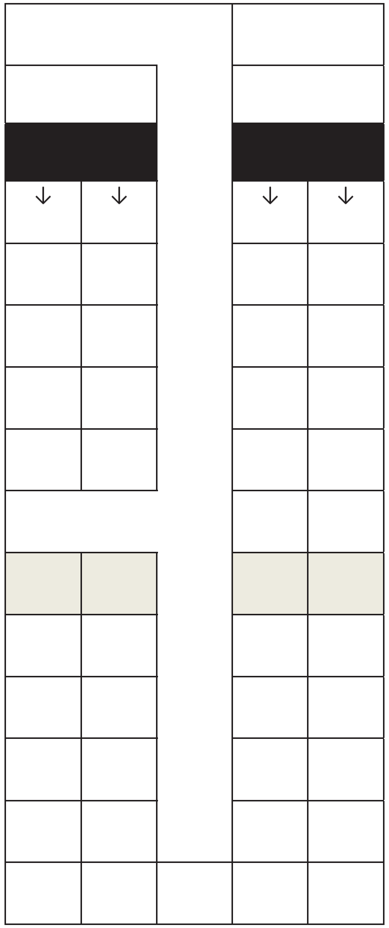
			Driver	
0			14	
↓	↓			0
0			0	
	0		0	
			13	
	0		0	
0				
			0	

Date Wednesday 22nd August **Time 1.45pm** **Journey M**

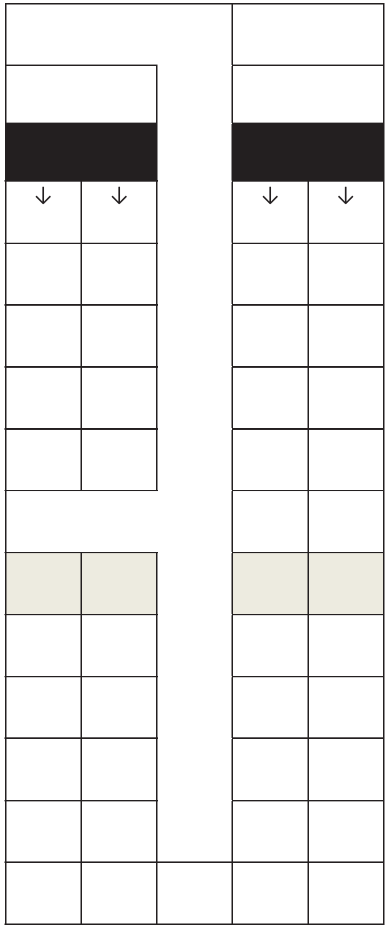
Bus stop # 1
Exit
Board 1 - 4
Change



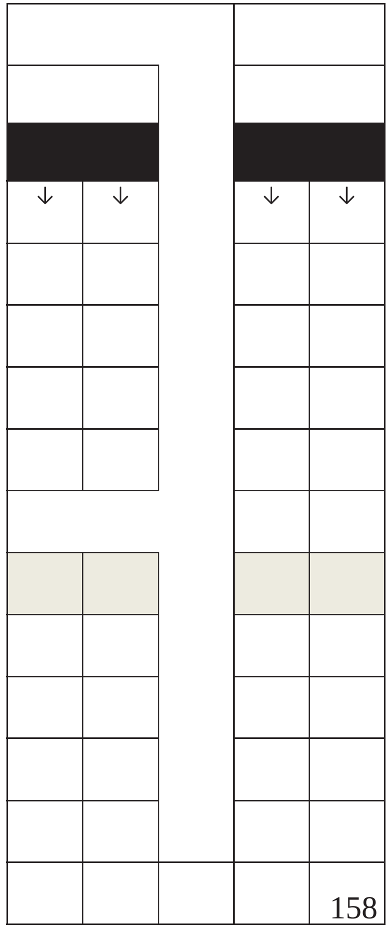
Bus stop # 2
Exit
Board
Change



Bus stop # 3
Exit
Board
Change



Bus stop # 4
Exit
Board
Change



Date **Wednesday 22nd August** **Time** **1.45pm** **Journey M**

Bus stop # 5
Exit
Board 5
Change

			Driver	
			0	
↓	↓		↓	↓
0				5
0				
				0

Bus stop # 6
Exit
Board 6
Change

			Driver	
			0	
↓	↓		↓	↓
				6
0				0
0				
				0

Bus stop # 7
Exit
Board
Change

↓	↓		↓	↓

Bus stop # 8
Exit
Board
Change

↓	↓		↓	↓

Date **Wednesday 22nd August** **Time** **1.45pm** **Journey M**

Bus stop # 9
Exit
Board
Change

↓	↓		↓	↓

Bus stop # 10
Exit
Board
Change

↓	↓		↓	↓

Bus stop # 11
Exit
Board 7
Change

			Driver	
			0	
↓	↓		↓	↓
				0
	7			
0				0
0				
				0

Bus stop # 12
Exit
Board
Change

↓	↓		↓	↓

Date Wednesday 22nd August **Time 1.45pm** **Journey M**

Bus stop # 13
Exit 7
Board
Change

			Driver	
			0	
↓	↓		↓	↓
				0
	x			
0				0
0				
				0

Bus stop # 14
Exit
Board 8
Change

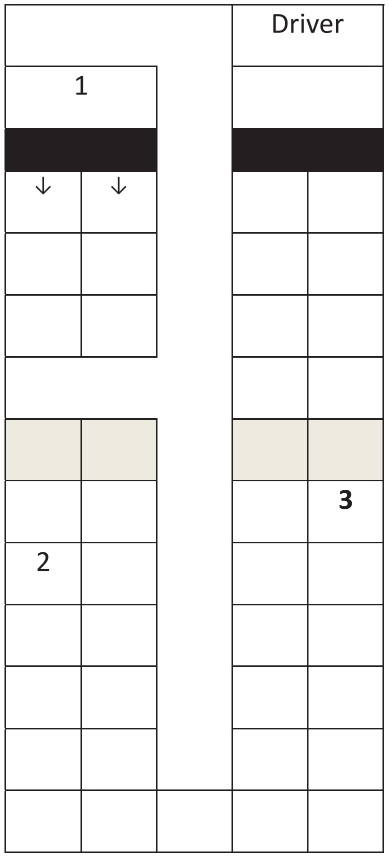
			Driver	
			0	
↓	↓		↓	↓
				0
0				0
0				8
				0

Bus stop # 15
Exit
Board 9
Change

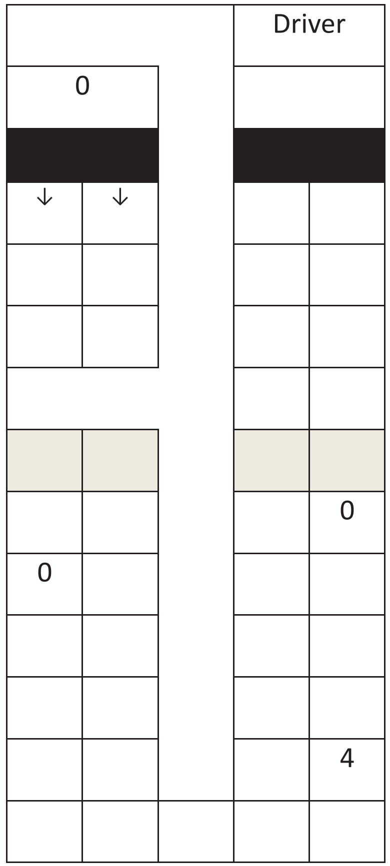
			Driver	
			0	
↓	↓		↓	↓
				0
			9	
0				0
0				0
				0

Date Wednesday 22nd August **Time 1.45pm** **Journey N**

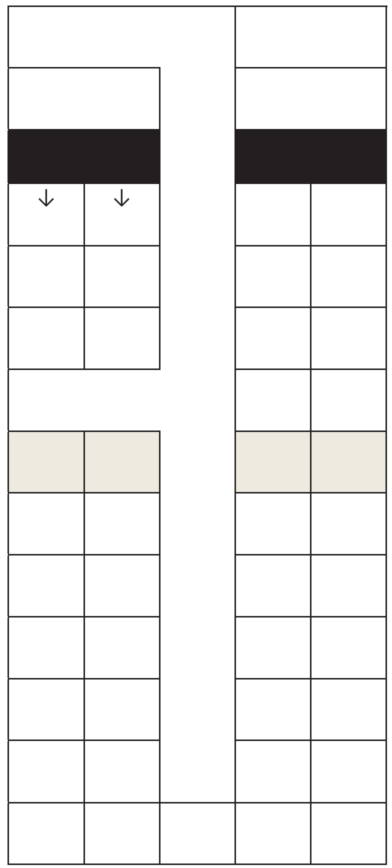
Bus stop # 1
Exit
Board 1 - 3
Change



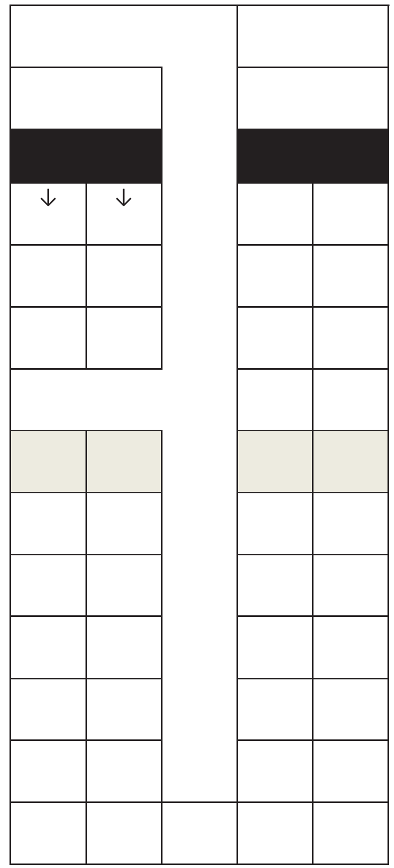
Bus stop # 2
Exit
Board 4
Change



Bus stop # 3
Exit
Board
Change

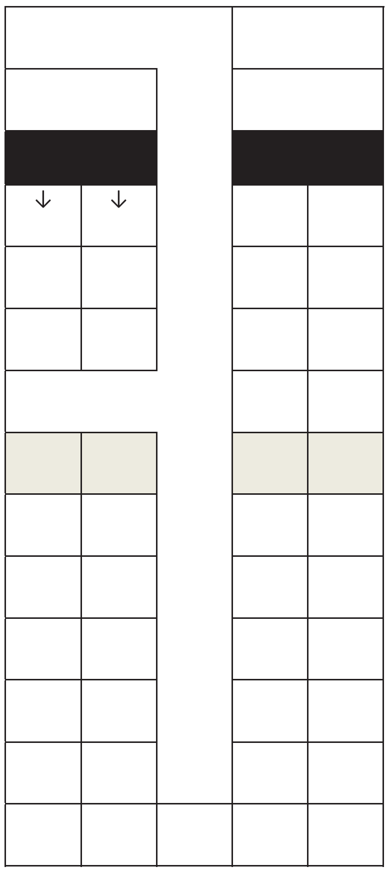


Bus stop # 4
Exit
Board
Change

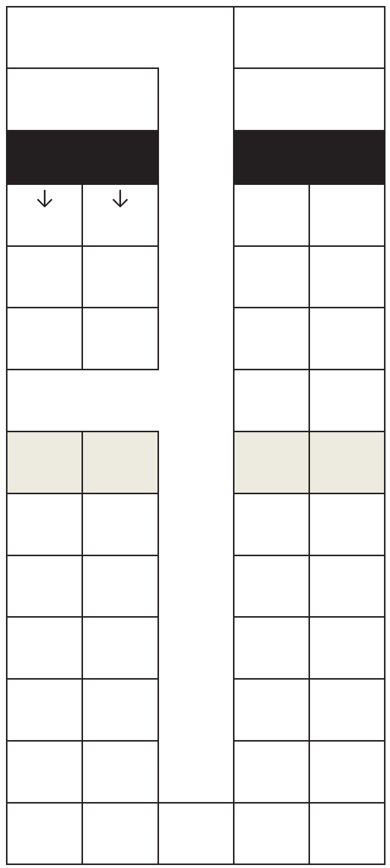


Date **Wednesday 22nd August** **Time** **1.45pm** **Journey N**

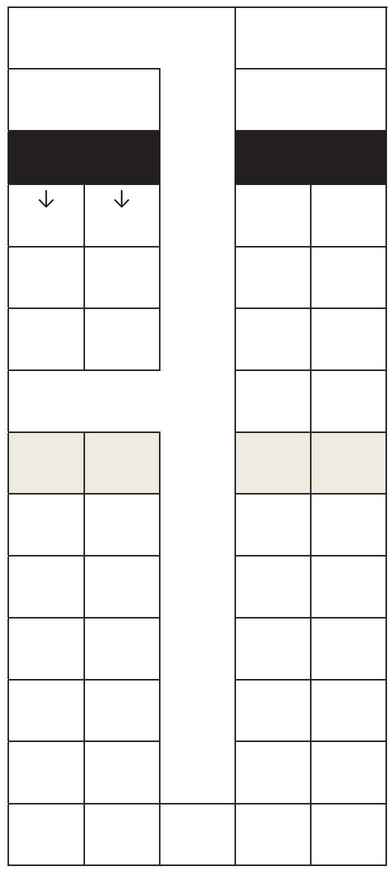
Bus stop # 5
Exit
Board
Change



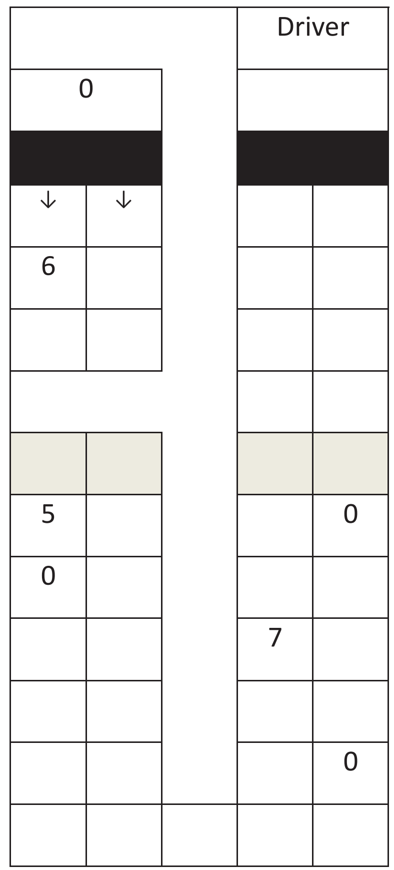
Bus stop # 6
Exit
Board
Change



Bus stop # 7
Exit
Board
Change



Bus stop # 8
Exit
Board 5 - 7
Change



Date **Wednesday 22nd August** **Time** **1.45pm** **Journey N**

Bus stop # 9
Exit
Board
Change

↓	↓			

Bus stop # 10
Exit
Board 8 - 14
Change 6

			Driver	
0				
14+pram			9	8
c13			6	
				10
11				12
0				0
0				
			0	
				0

Bus stop # 11
Exit
Board 15
Change

			Driver	
0				
pram			0	0
0			0	
				0
0				0
0				0
0				
			0	
15				
				0

Bus stop # 12
Exit
Board 16 - 17
Change

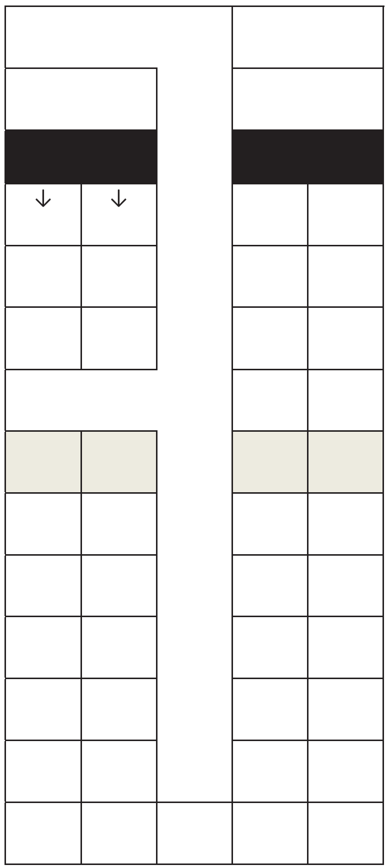
			Driver	
0				
pram			0	0
0			0	
			17	16
				0
0				0
0				0
0				
			0	
0				
				0

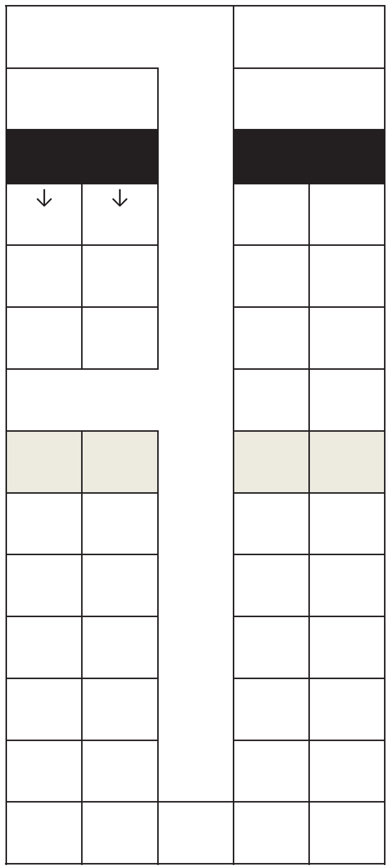
Date **Wednesday 22nd August** **Time** **1.45pm** **Journey N**

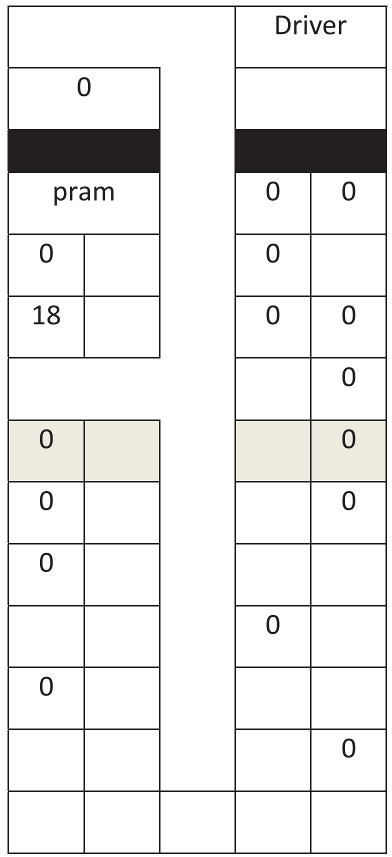
Bus stop # 13
Exit
Board
Change

Bus stop # 14
Exit
Board
Change

Bus stop # 15
Exit
Board 18
Change

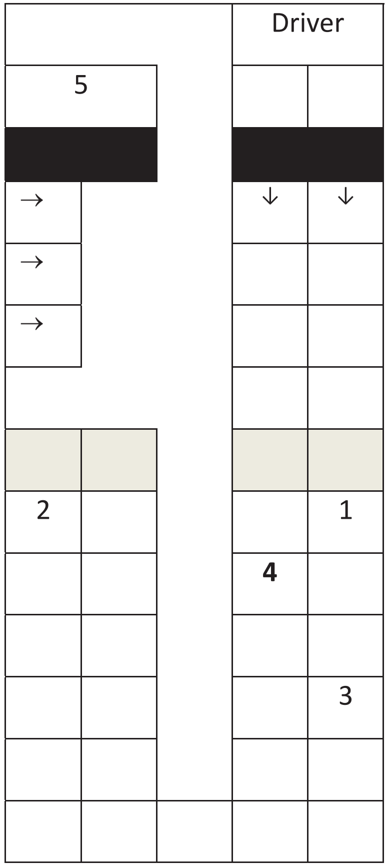




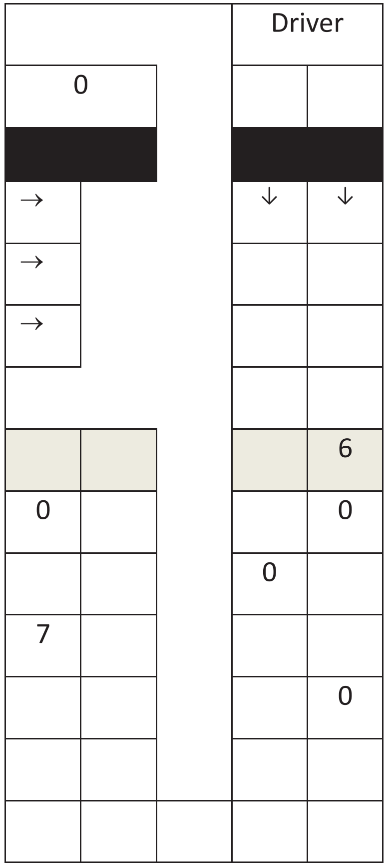


Date **Thursday 23rd August** **Time** **10.15am** **Journey O**

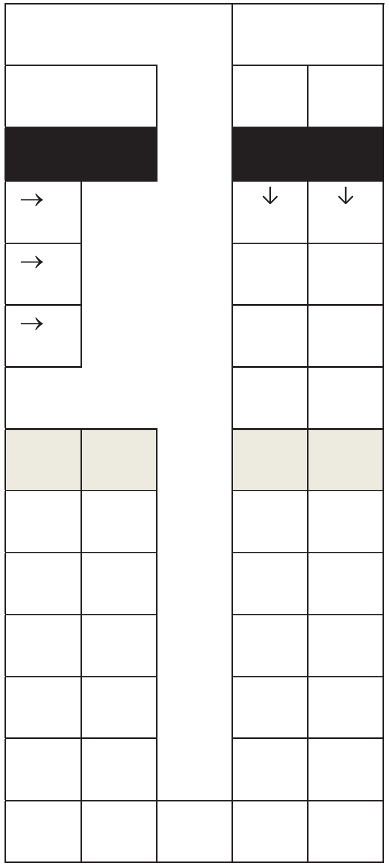
Bus stop # 1
Exit
Board 1 - 5
Change



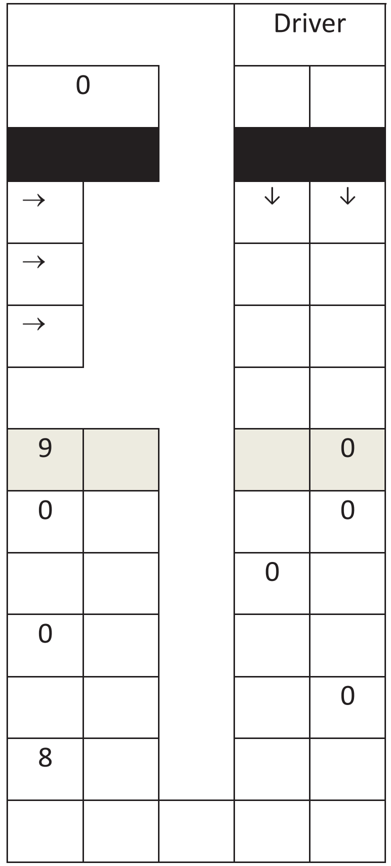
Bus stop # 2
Exit
Board 6 - 7
Change



Bus stop # 3
Exit
Board
Change



Bus stop # 4
Exit
Board 8 - 9
Change



Date Thursday 23rd August **Time 10.15am** **Journey O**

Bus stop # 5
Exit
Board 10 - 11
Change

			Driver	
0				
→			↓	↓
→				
→				
			10	
0				0
0				0
			0	
0			11	
				0
0				

Bus stop # 6
Exit
Board 12
Change

			Driver	
0				
→			↓	↓
→				12
→				
			0	
0				0
0				0
			0	
0			0	
				0
0				

Bus stop # 7
Exit
Board
Change

→			↓	↓
→				
→				

Bus stop # 8
Exit
Board 13 - 20
Change

			Driver	
0			19	18
→			↓	↓
→				0
→15			14	
			0	
0				0
0				0
13			0	
0			0	
	20			0
0				
17				16

Date **Thursday 23rd August** **Time** **10.15am** **Journey O**

Bus stop # 9
Exit
Board
Change

→			↓	↓
→				
→				

Bus stop # 10
Exit
Board 21 - 28
Change 4, 14

			Driver	
0			0	0
→26			↓	↓
→			28	0
→0			0	
			c	14
0	23		27	0
0	21		22	0
0	25		c	4
0			0	
	0			0
0				
0		24		0

Bus stop # 11
Exit
Board 29 - 32
Change 20

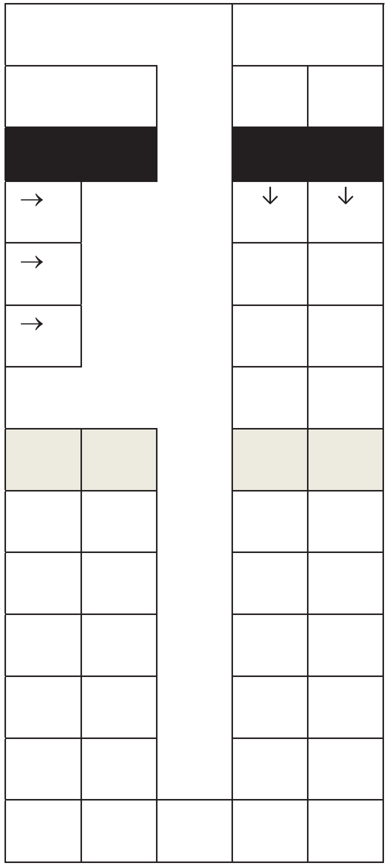
			Driver	
0			0	0
→0			↓	↓ 31
→32			0	0
→0			0	
				0
0	0		0	0
0	0		0	0
0	0		30	0
0			0	
20	c29			0
0				
0		0		0

Bus stop # 12
Exit 14
Board 33 - 37
Change

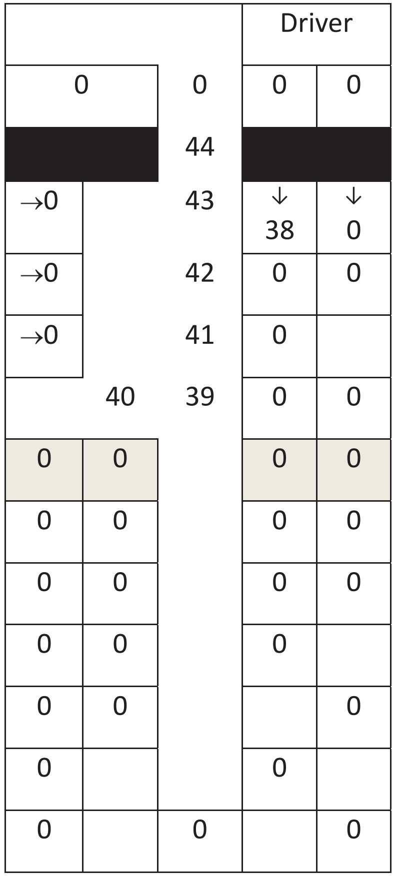
			Driver	
0		37	0	0
→0			↓	↓ 0
→0			0	0
→0			0	
			34	x33
0	0		0	0
0	0		0	0
0	0		0	0
0	35		0	
0	0			0
0			36	
0		0		0

Date **Thursday 23rd August** **Time** **10.15am** **Journey O**

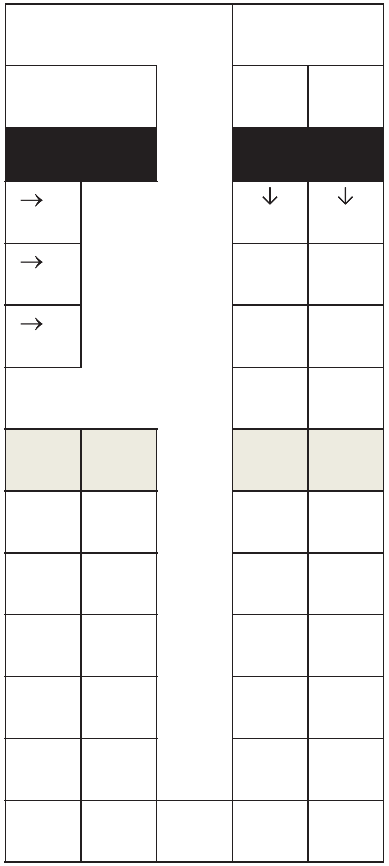
Bus stop # 13
Exit
Board
Change



Bus stop # 14
Exit
Board 38 - 44
Change



Bus stop # 15
Exit
Board
Change



Date **Thursday 23rd August** **Time** **11.15am** **Journey P**

Bus stop # 1
Exit
Board 1 - 5
Change

		Driver	
1			5
→		↓	↓
→			
→			
		3	
2			
4			

Bus stop # 2
Exit
Board 6 - 7
Change

		Driver	
0			0
→		↓	↓
→			
→			7
		0	
0			6
0			

Bus stop # 3
Exit
Board 8
Change

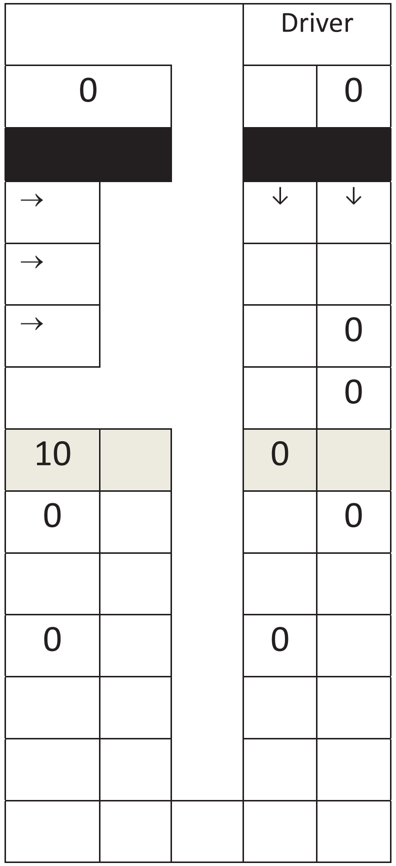
		Driver	
0			0
→		↓	↓
→			
→			0
			8
		0	
0			0
0			

Bus stop # 4
Exit
Board 9
Change

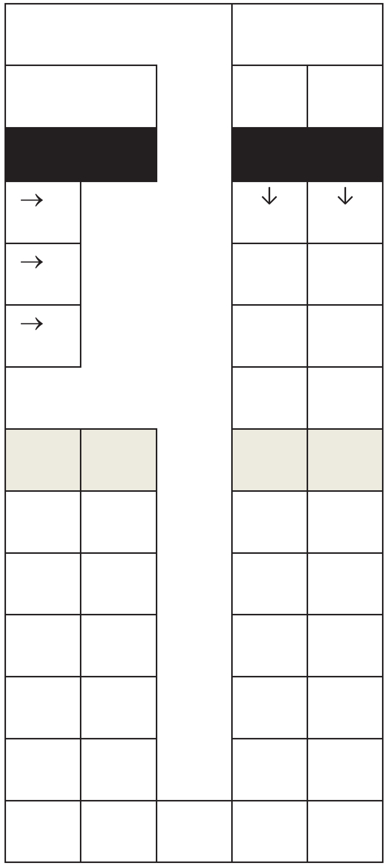
		Driver	
0			0
→		↓	↓
→			
→			0
			0
		0	
0			0
0		9	

Date **Thursday 23rd August** **Time** **11.15am** **Journey P**

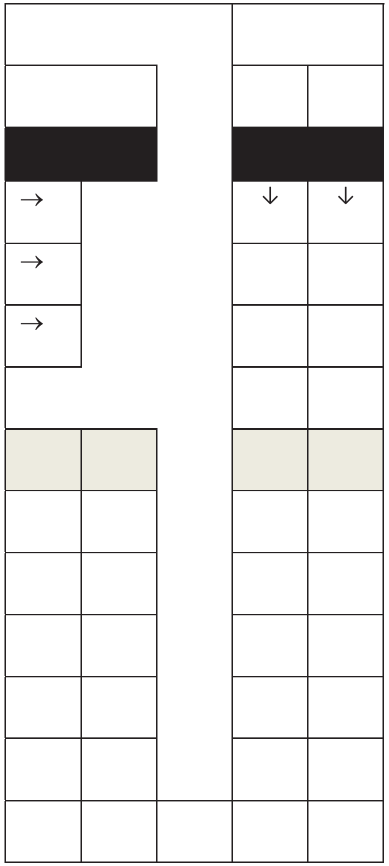
Bus stop # 5
Exit
Board 10
Change



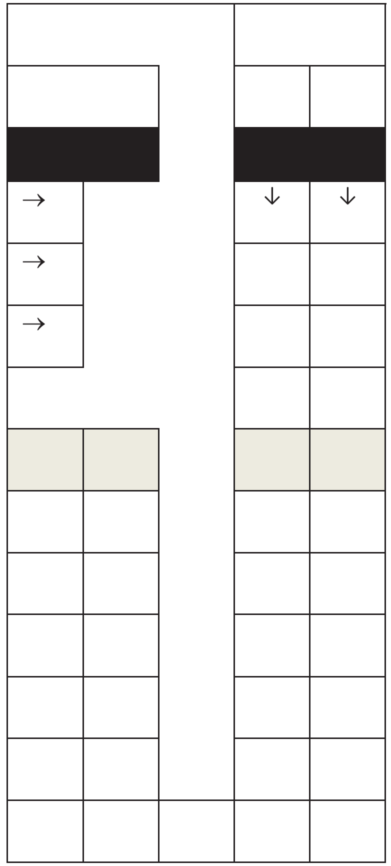
Bus stop # 6
Exit
Board
Change



Bus stop # 7
Exit
Board
Change



Bus stop # 8
Exit
Board
Change



Date **Thursday 23rd August** **Time** **11.15am** **Journey P**

Bus stop # 9
Exit
Board 11 - 14
Change

			Driver	
0				0
→12			↓	↓
→				
→13				0
				0
0			0	
0				0
0			0	
	14			11

Bus stop # 10
Exit
Board 15 - 16
Change

			Driver	
0				0
→0			↓	↓
→			15	
→0				0
				0
0			0	
0				0
				16
0			0	
	0			0

Bus stop # 11
Exit
Board
Change

→			↓	↓
→				
→				

Bus stop # 12
Exit
Board
Change

→			↓	↓
→				
→				

Date **Thursday 23rd August** **Time** **11.15am** **Journey P**

Bus stop # 13
Exit
Board 17
Change

			Driver	
0				0
→0			↓ 17	↓
→			0	
→0				0
				0
0			0	
0				0
				0
0			0	
	0			0

Bus stop # 14
Exit
Board 18 - 19
Change

			Driver	
0				0
→0			↓ 0	↓
→			0	
→0				0
				0
0			0	
0				0
	18			0
0			0	
	0			0
		19		

Bus stop # 15
Exit
Board
Change

→			↓	↓
→				
→				

Date **Thursday 23rd August** **Time** **11.55am** **Journey Q**

Bus stop # 1
Exit
Board 1 - 11
Change

			Driver	
1			8	7
→			↓	↓
→				
→				
				4
5			11	
10				**6**
2				
3				
				9

Bus stop # 2
Exit
Board 12 - 13
Change

			Driver	
0			0	0
→			↓	↓
→				12
→13				
				0
0			0	
0				0
0				
0				
				0

Bus stop # 3
Exit
Board 14
Change

			Driver	
0			0	0
→			↓	↓
→				0
→0				14
				0
0			0	
0				0
0				
0				
				0

Bus stop # 4
Exit
Board 15 - 17
Change

			Driver	
0			0	0
→17			↓	↓
→				0
→0				0
				0
0			0	
0				0
0				15
0				16
				0

Date **Thursday 23rd August** **Time** **11.55am** **Journey Q**

Bus stop # 5
Exit
Board 18 - 19
Change

			Driver	
0			0	0
→0			↓	↓
→				0
→0				0
				0
0			0	
0				0
0				0
0				0
18				0
				19

Bus stop # 6
Exit 7, 8
Board 20 - 21
Change

			Driver	
0			x	x
→0			↓	↓
→				0
→0				0
				0
0	21		0	
0				0
0				0
0				0
0				0
20				0

Bus stop # 7
Exit
Board 22 - 26
Change

			Driver	
0				
→0			↓	↓
→				0
→0			23	0
				0
0	0		0	
0			22	0
0			24	0
0	25			0
0				0
0				0
		26		

Bus stop # 8
Exit
Board 27 - 29
Change

			Driver	
0				
→0			↓	↓ 27
→			28	0
→0			0	0
			29	0
0	0		0	
0			0	0
0			0	0
0	0			0
0				0
0				0
		0		

Date Thursday 23rd August **Time 11.55am** **Journey Q**

Bus stop # 9
Exit
Board 30 - 31
Change

			Driver	
0				30
→0			↓	↓ 0
→			0	0
→0			0	0
			0	0
0	0		0	
0	31		0	0
0			0	0
0	0			0
0				0
0				0
		0		

Bus stop # 10
Exit 1, 21
Board 32 -35 dog
Change

			Driver	
x				0
→0			↓	↓ 0
→33			0	0
→0			0	0
dog	32		0	0
0	x35		0	
0	0		0	0
0			0	0
0	0			0
0				0
0	34			0
		0		

Bus stop # 11
Exit
Board 36 - 38
Change 11

			Driver	
38				0
→0			↓ 37	↓ 0
→0			0	0
→0			0	0
dog	0		0	0
0	0		c	11
0	0		0	0
0			0	0
0	0			0
0	36			0
0	0			0
		0		

Bus stop # 12
Exit
Board
Change

→			↓	↓
→				
→				

Date **Thursday 23rd August** **Time** **11.55am** **Journey Q**

Bus stop # 13
Exit 32, dog
Board 39 - 40
Change

			Driver	
0				0
→0			↓ 0	↓ 0
→0			0	0
→0			0	0
x	x		0	0
0	0		39	0
0	0		0	0
0			0	0
0	0		40	0
0	0			0
0	0			0
		0		

Bus stop # 14
Exit
Board
Change

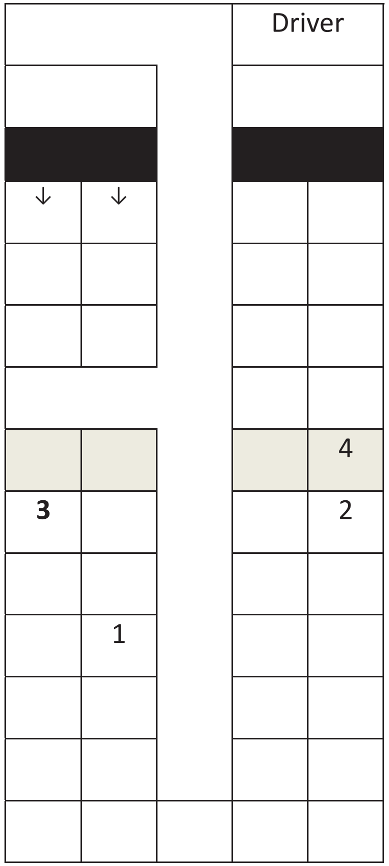
→			↓	↓
→				
→				

Bus stop # 15
Exit
Board
Change

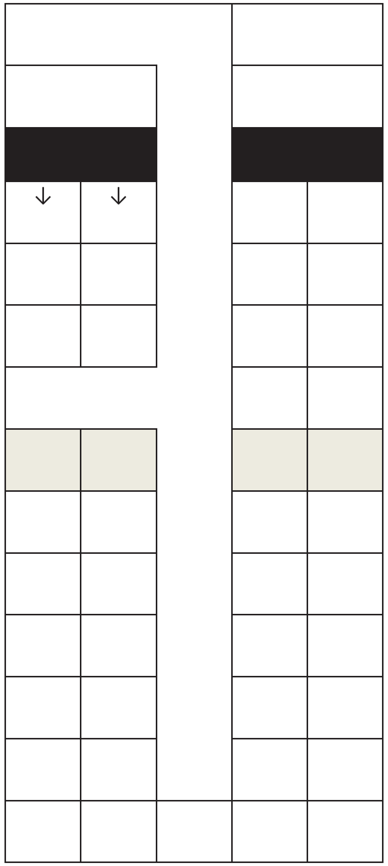
→			↓	↓
→				
→				

Date **Thursday 23rd August** **Time** **12.45pm** **Journey R**

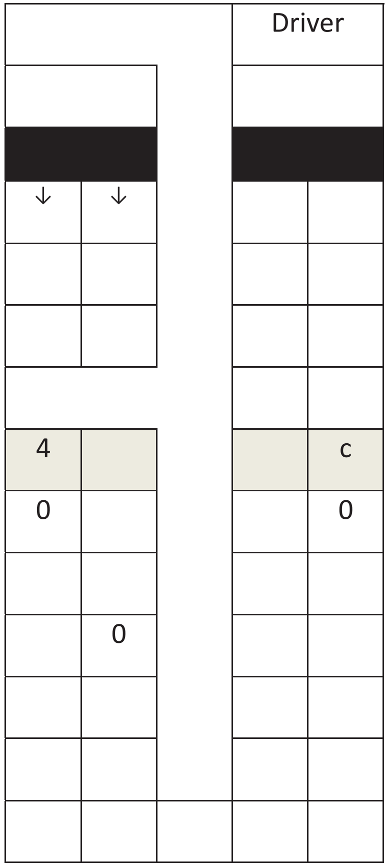
Bus stop # 1
Exit
Board 1 - 4
Change



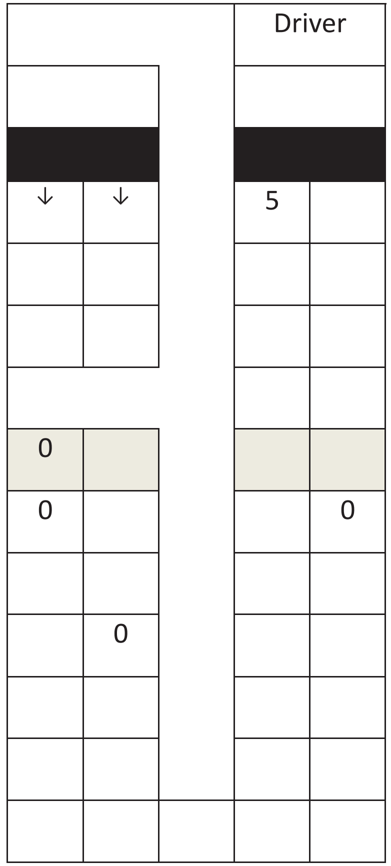
Bus stop # 2
Exit
Board
Change



Bus stop # 3
Exit
Board
Change 4

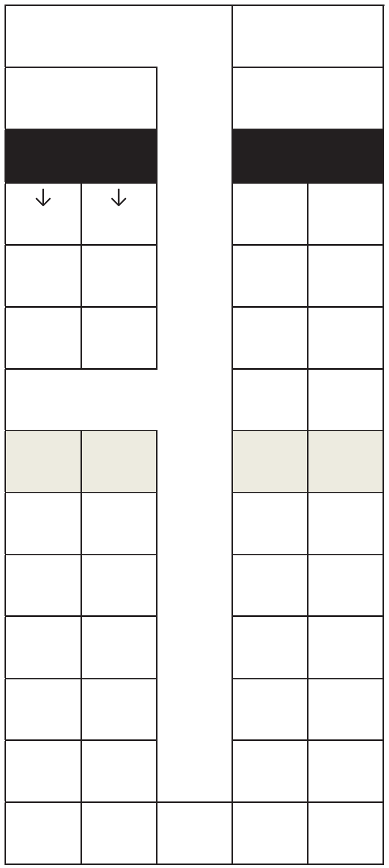


Bus stop # 4
Exit
Board 5
Change

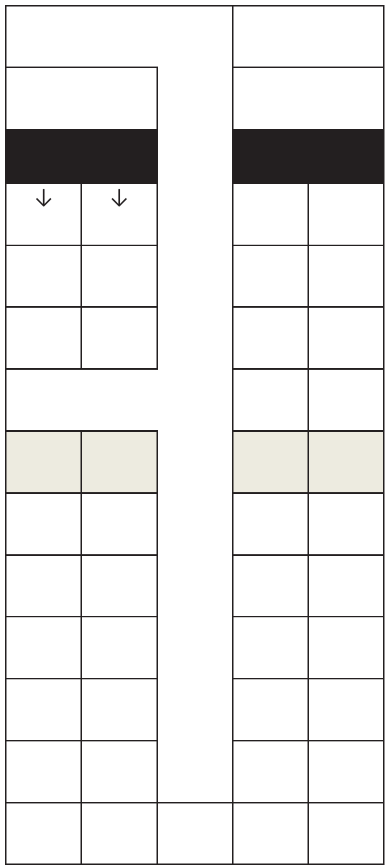


Date **Thursday 23rd August** **Time** **12.45pm** **Journey R**

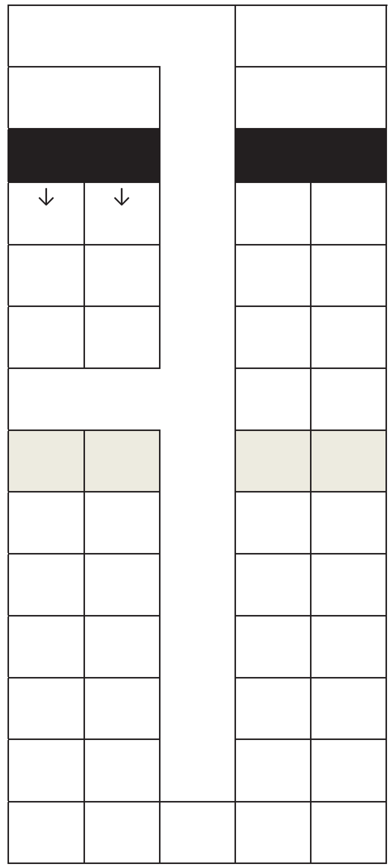
Bus stop # 5
Exit
Board
Change



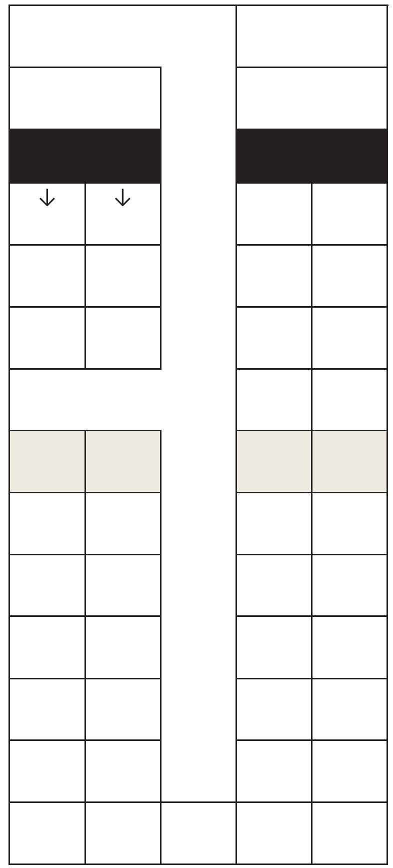
Bus stop # 6
Exit
Board
Change



Bus stop # 7
Exit
Board
Change



Bus stop # 8
Exit
Board
Change



Date Thursday 23rd August **Time 12.45pm** **Journey R**

Bus stop # 9
Exit
Board 6
Change

			Driver	
↓	↓		0	
0				
0				0
	0			
				6

Bus stop # 10
Exit
Board 7 - 9
Change

			Driver	
↓	↓		0	
			7	
				8
0				9
0				0
	0			
				0

Bus stop # 11
Exit
Board
Change

↓	↓			

Bus stop # 12
Exit
Board
Change

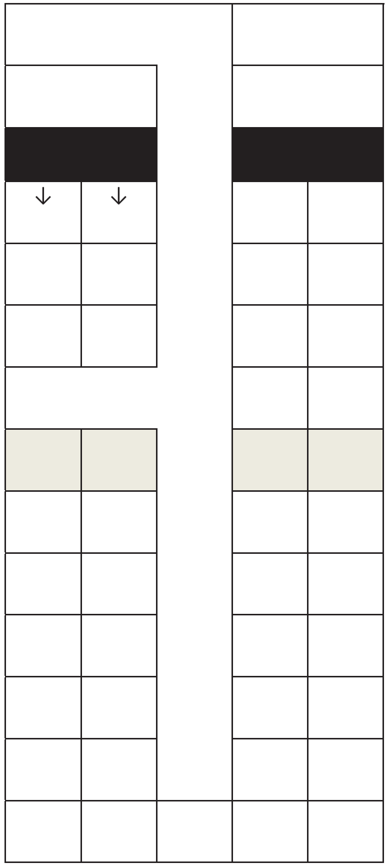
↓	↓			

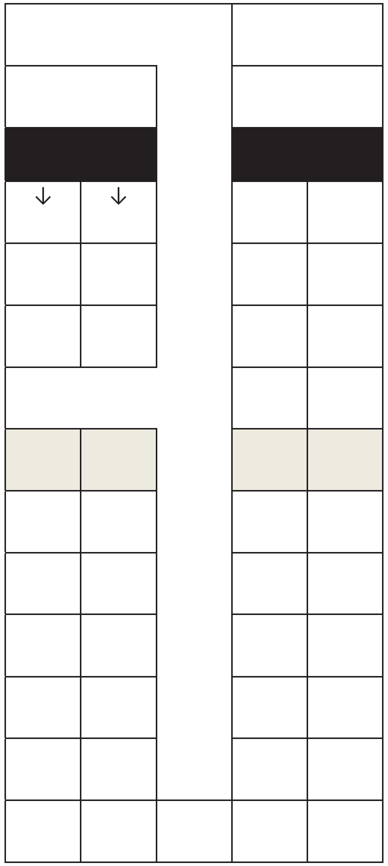
Date **Thursday 23rd August** **Time** **12.45pm** **Journey R**

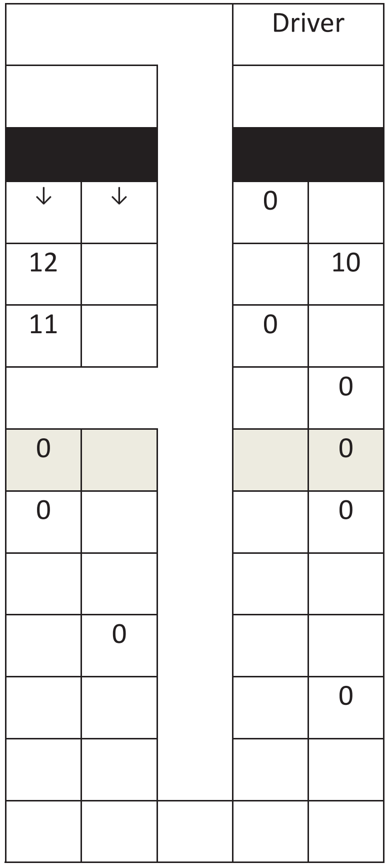
Bus stop # 13
Exit
Board
Change

Bus stop # 14
Exit
Board
Change

Bus stop # 15
Exit
Board 10 - 12
Change







Date **Thursday 23rd August** **Time** **1.25pm** **Journey S**

Bus stop # 1
Exit
Board 1 - 8
Change

			Driver	
3			7	
↓	↓			
			4	
				5
1				6
			8	
				2

Bus stop # 2
Exit
Board 9 - 10
Change

			Driver	
0			0	
↓	↓			
			0	
9				0
0				0
10			0	
				0

Bus stop # 3
Exit
Board 11
Change

			Driver	
0			0	
↓	↓			
			0	
0				0
0				0
0			0	
				0
			11	

Bus stop # 4
Exit
Board 12 - 13
Change

			Driver	
0			0	
↓	↓			
	13			12
			0	
0				0
0				0
0			0	
				0
			0	

Date Thursday 23rd August **Time 1.25pm** **Journey S**

Bus stop # 5
Exit
Board 14 – 16
Change

			Driver	
0			0	
↓	↓			14
15				
	0			0
			0	
0				0
0				0
0			0	
				0
16			0	

Bus stop # 6
Exit
Board
Change

↓	↓			

Bus stop # 7
Exit
Board 17 - 20
Change

			Driver	
0			0	
↓	↓			0
0	20			18
	0			0
			0	
0				0
0	17			0
0			0	
19				0
0			0	

Bus stop # 8
Exit 13
Board
Change

			Driver	
0			0	
↓	↓			0
0	0			0
	x			0
			0	
0				0
0	0			0
0			0	
0				0
0			0	

Date Thursday 23rd August **Time 1.25pm** **Journey S**

Bus stop # 9
Exit
Board 21 - 22
Change

			Driver	
0			0	
↓	↓			0
0	0			0
21				0
			0	
0				0
0	0			0
0			0	
0				0
0			0	
				22

Bus stop # 10
Exit 4, 15, 20
Board 23 - 25
Change

			Driver	
0			0	
↓	↓			0
x	x			0
0				0
			x	25
0				0
0	0			0
0			0	
0				0
0			0	
23				0
	24			

Bus stop # 11
Exit
Board 26 - 27
Change

			Driver	
0			0	
↓	↓			0
27				0
0				0
			26	0
0				0
0	0			0
0			0	
0				0
0			0	
0				0
	0			

Bus stop # 12
Exit
Board
Change

↓	↓			

Date **Thursday 23rd August** **Time** **1.25pm** **Journey S**

Bus stop # 13
Exit
Board
Change

↓	↓			

Bus stop # 14
Exit
Board 28 - 31
Change

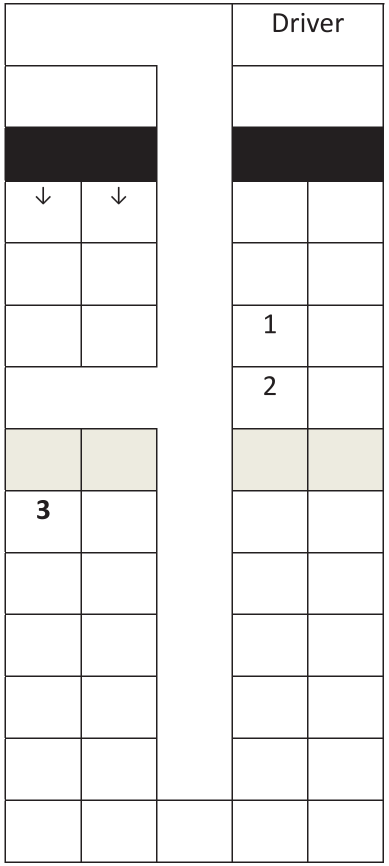
			Driver	
0			0	
↓	↓ 30			0
0			31	0
0			28	0
			0	0
0			29	0
0	0			0
0			0	
0				0
0			0	
0				0
	0			

Bus stop # 15
Exit
Board 32 - 35
Change

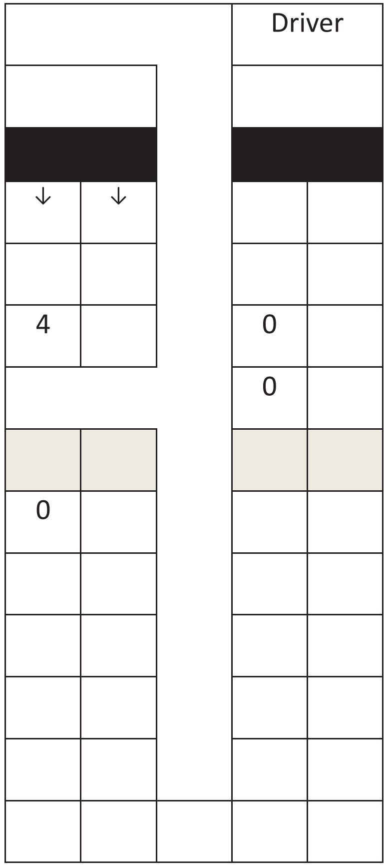
			Driver	
0			0	
↓	↓ 0			0
0	32		0	0
0	33		0	0
			0	0
0	34		0	0
0	0			0
0			0	
0				0
0			0	
0				0
	0			35

Date **Thursday 23rd August** **Time** **2.15pm** **Journey T**

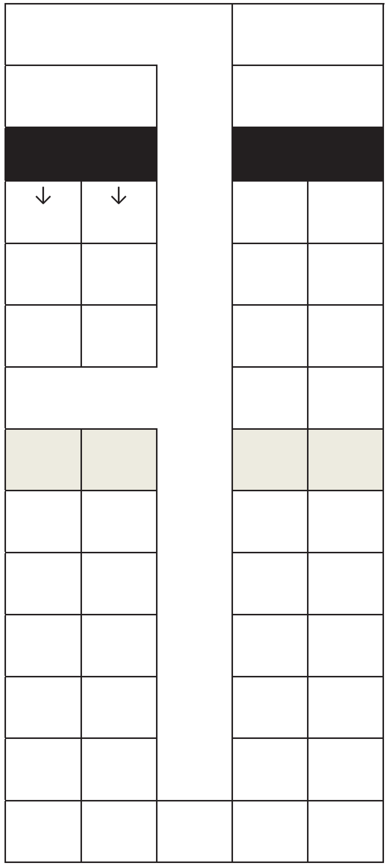
Bus stop	# 1
Exit	
Board	1 - 3
Change	



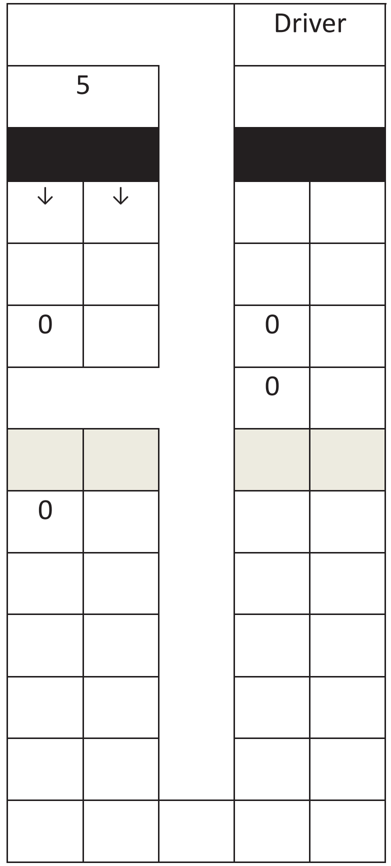
Bus stop	# 2
Exit	
Board	4
Change	



Bus stop	# 3
Exit	
Board	
Change	



Bus stop	# 4
Exit	
Board	5
Change	



Date Thursday 23rd August **Time 2.15pm** **Journey T**

Bus stop # 5
Exit 2
Board
Change

			Driver	
0				
↓	↓			
0			0	
			x	
0				

Bus stop # 6
Exit 1
Board 6 - 9
Change

			Driver	
0				
↓	↓			
			9	
0			x	
				6
				8
0				7

Bus stop # 7
Exit
Board
Change

↓	↓			

Bus stop # 8
Exit
Board 10
Change

			Driver	
0				
↓	↓			
			0	
0				10
				0
				0
0				0

Date **Thursday 23rd August** **Time** **2.15pm** **Journey T**

Bus stop # 9
Exit
Board
Change

Bus stop # 10
Exit
Board 11
Change

			Driver	
0				
↓	↓			
11			0	
0				0
				0
				0
0				0

Bus stop # 11
Exit
Board
Change

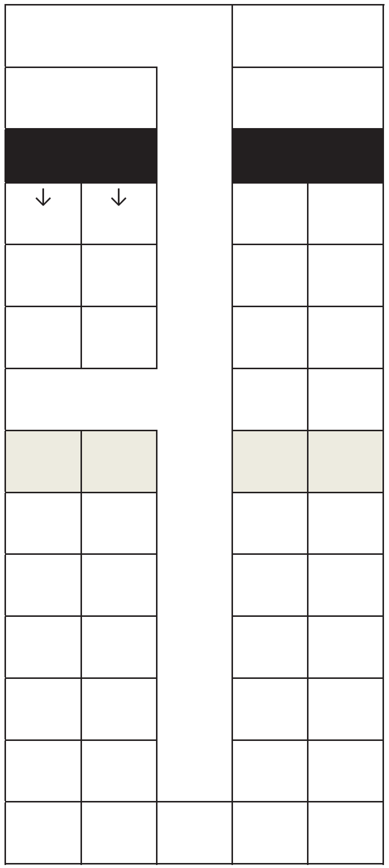
↓	↓			

Bus stop # 12
Exit
Board
Change

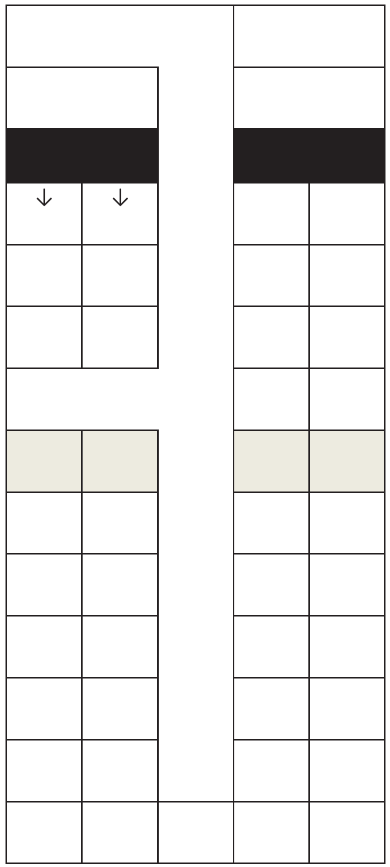
↓	↓			

Date **Thursday 23rd August** **Time** **2.15pm** **Journey T**

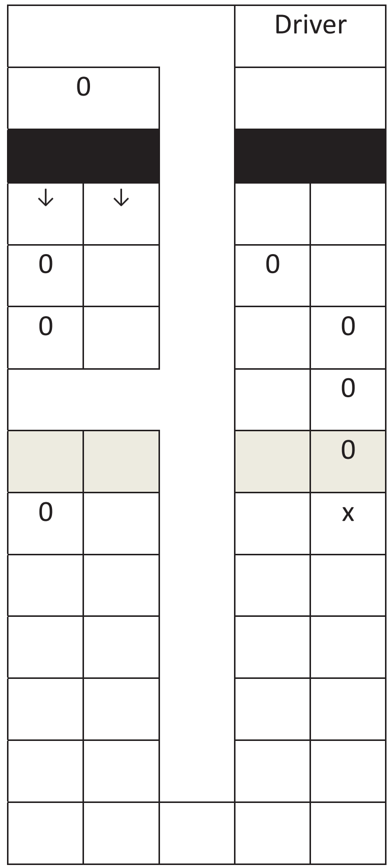
Bus stop # 13
Exit
Board
Change



Bus stop # 14
Exit
Board
Change

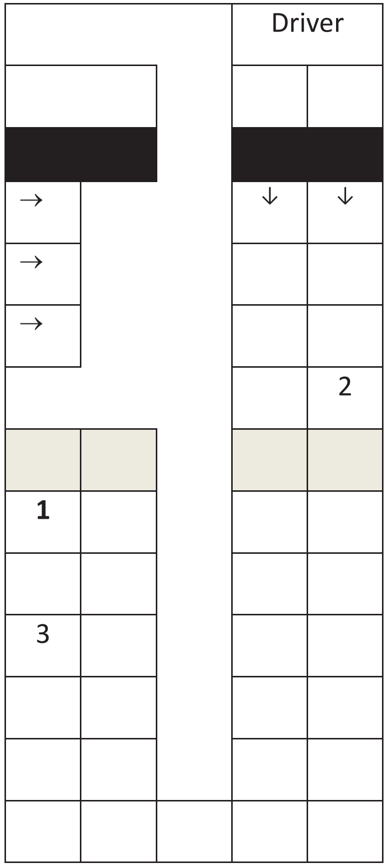


Bus stop # 15
Exit 7
Board
Change

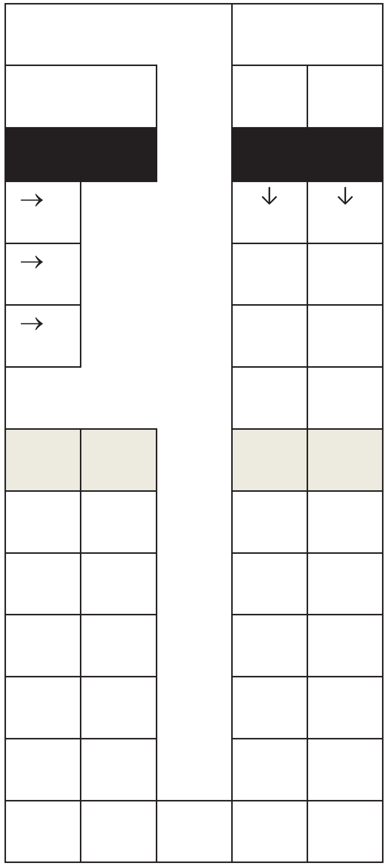


Date Wednesday 05th September **Time 10.45am** **Journey U**

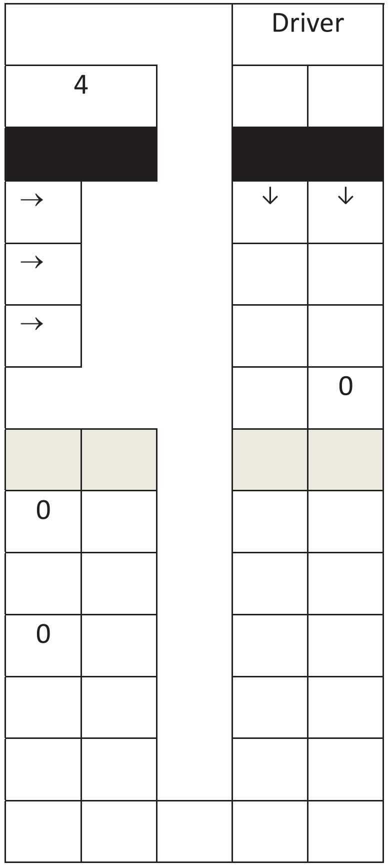
Bus stop # 1
Exit
Board 1 - 3
Change



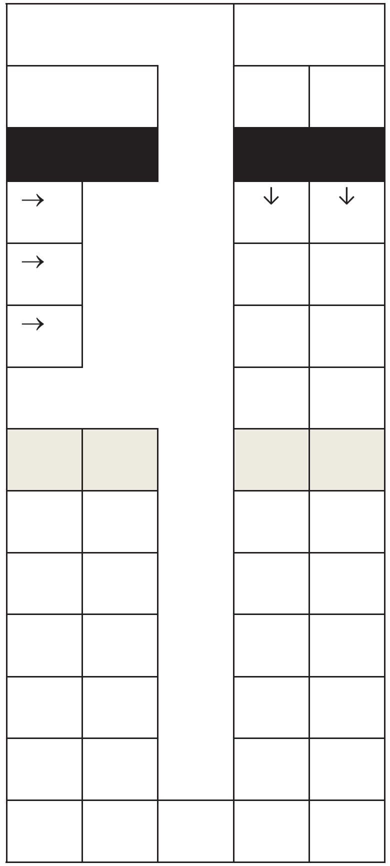
Bus stop # 2
Exit
Board
Change



Bus stop # 3
Exit
Board 4
Change

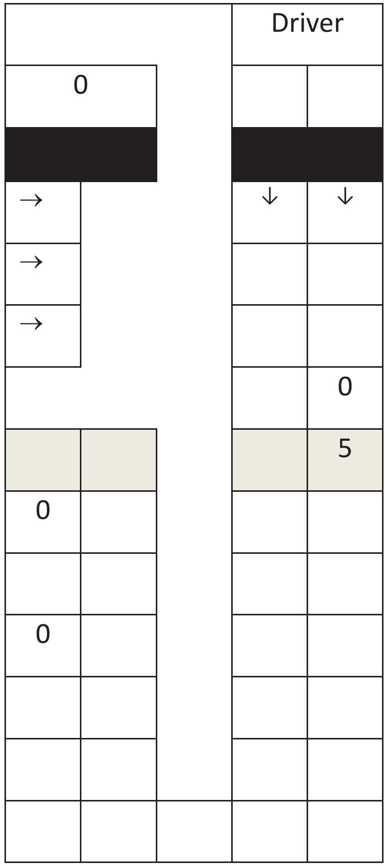


Bus stop # 4
Exit
Board
Change

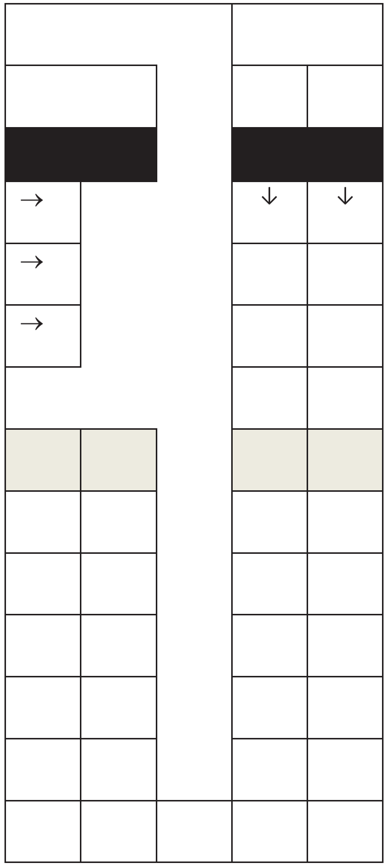


Date **Wednesday 05th September** **Time** **10.45am** **Journey U**

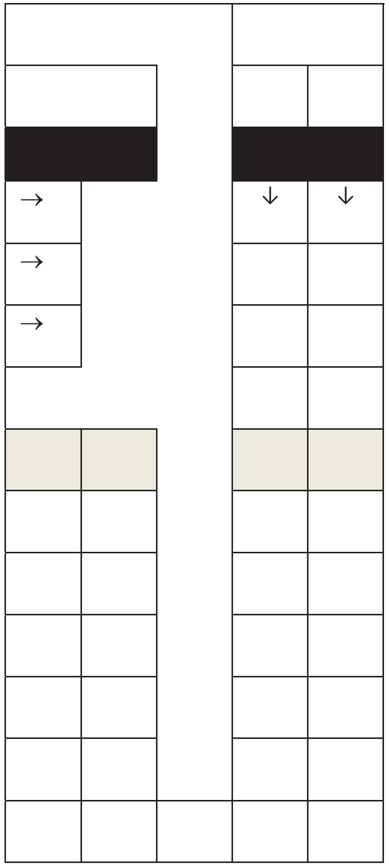
Bus stop # 5
Exit
Board 5
Change



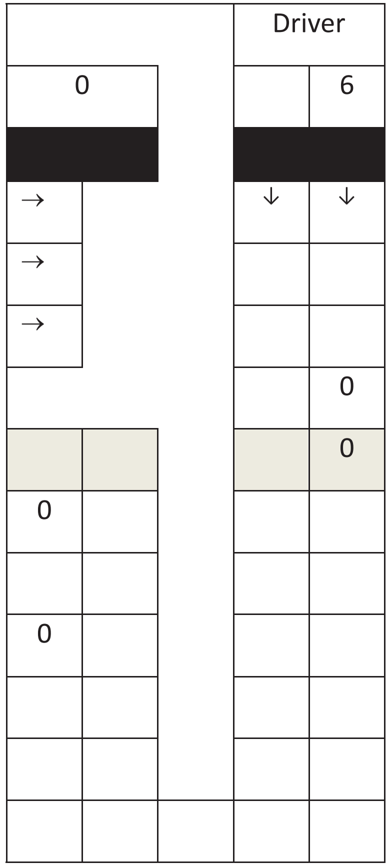
Bus stop # 6
Exit
Board
Change



Bus stop # 7
Exit
Board
Change

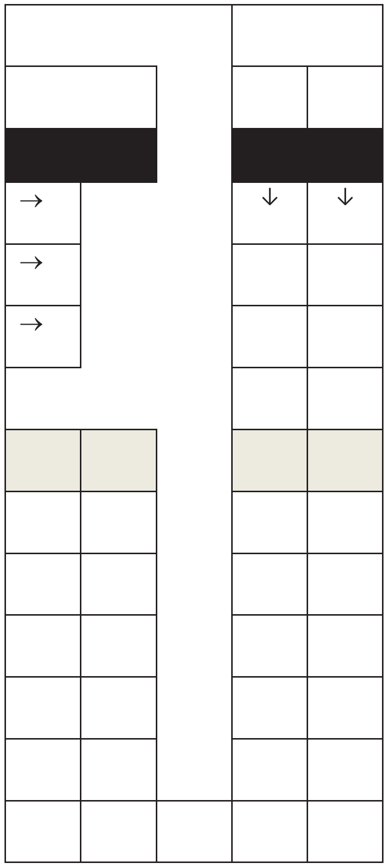


Bus stop # 8
Exit
Board 6
Change

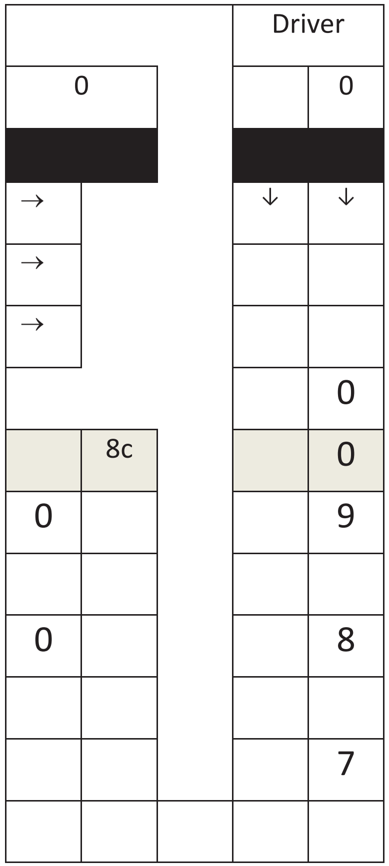


Date Wednesday 05th September **Time 10.45am** **Journey U**

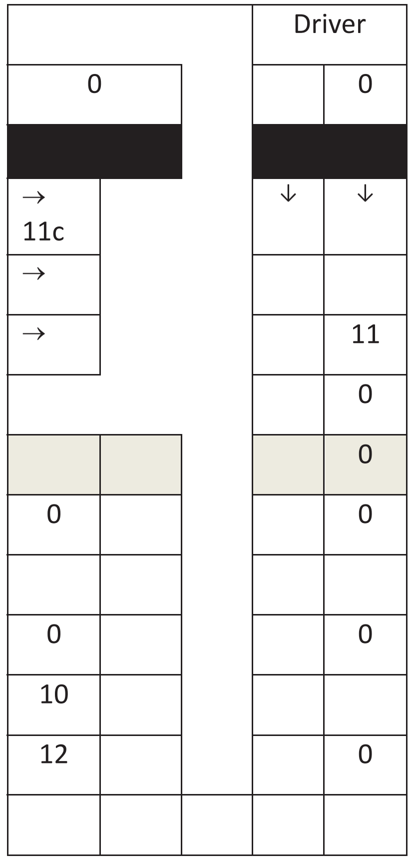
Bus stop # 9
Exit
Board
Change



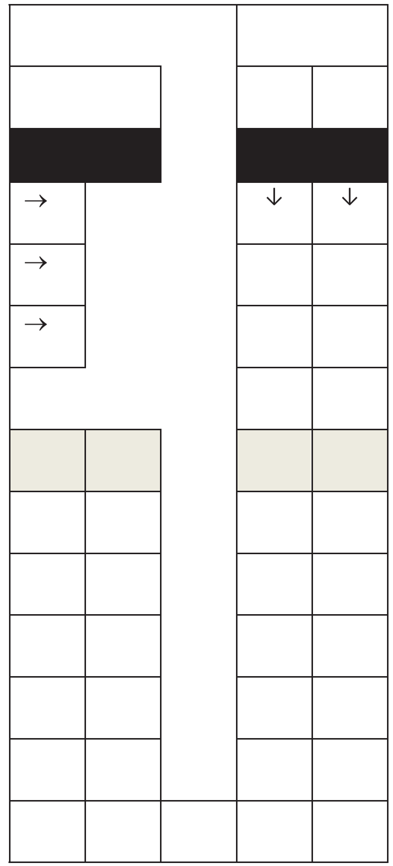
Bus stop # 10
Exit
Board 7 - 9
Change 8 (after)



Bus stop # 11
Exit
Board 10 - 12
Change 11



Bus stop # 12
Exit
Board
Change



Date **Wednesday 05th September** **Time** **10.45am**

Bus stop # 13
Exit
Board
Change

→			↓	↓
→				
→				

Bus stop # 14
Exit
Board 13
Change

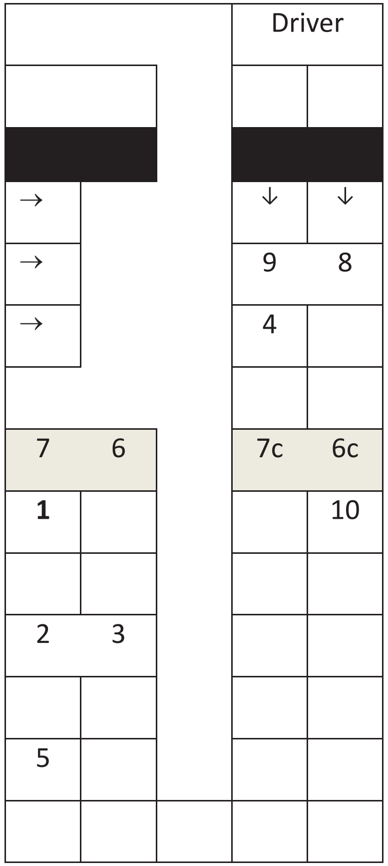
			Driver	
0				0
→			↓	↓
→				
→				0
				0
				0
0				0
13				
0				0
0				
0				0

Bus stop # 15
Exit
Board
Change

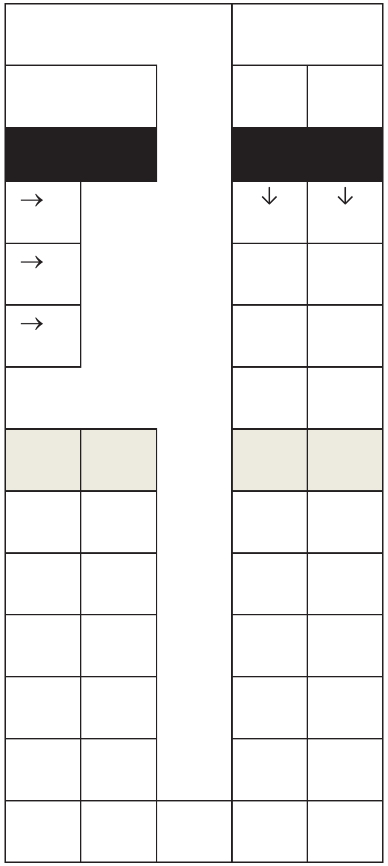
→			↓	↓
→				
→				

Date Wednesday 05th September **Time 11.25am** **Journey V**

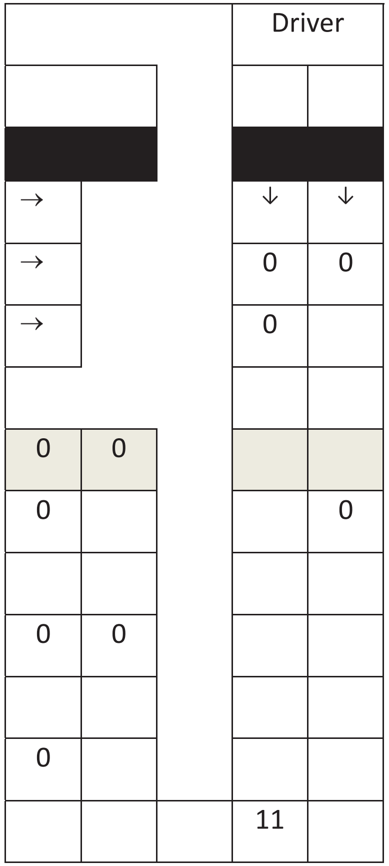
Bus stop # 1
Exit
Board 1 - 10
Change 6, 7 (between 9 and 10)



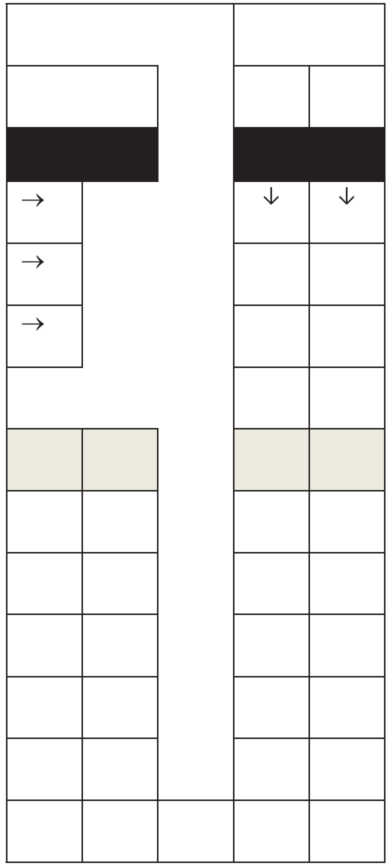
Bus stop # 2
Exit
Board
Change



Bus stop # 3
Exit
Board 11
Change



Bus stop # 4
Exit
Board
Change



Date **Wednesday 05th September** **Time** **11.25am** **Journey V**

Bus stop # 5
Exit
Board 12
Change

			Driver	
→			↓	↓
→			0	0
→			0	
0	0			
0				0
0	0			
				12
0				
			0	

Bus stop # 6
Exit
Board 13
Change

			Driver	
→			↓	↓
→			0	0
→			0	
0	0			
0				0
0	0			13
				0
0				
			0	

Bus stop # 7
Exit
Board 14
Change

			Driver	
→14			↓	↓
→			0	0
→			0	
0	0			
0				0
0	0			0
				0
0				
			0	

Bus stop # 8
Exit 4
Board
Change

			Driver	
→0			↓	↓
→			0	0
→			x	
0	0			
0				0
0	0			0
				0
0				
			0	

Date **Wednesday 05th September** **Time** **11.25am** **Journey V**

Bus stop # 9
Exit 8, 9, 11
Board 15
Change

			Driver	
15				
→0			↓	↓
→			x	x
→				
0	0			
0				0
0	0			0
				0
0				
			x	

Bus stop # 10
Exit 14
Board 16 - 17
Change

			Driver	
0				
→ x			↓	↓
→			17	
→				16
0	0			
0				0
0	0			0
				0
0				

Bus stop # 11
Exit
Board
Change

→			↓	↓
→				
→				

Bus stop # 12
Exit
Board
Change

→			↓	↓
→				
→				

Date **Wednesday 05th September** **Time** **11.25am** **Journey V**

Bus stop	# 13
Exit	
Board	18
Change	

			Driver	
0				18
→			↓	↓
→			0	
→				0
0	0			
0				0
0	0			0
				0
0				

Bus stop	# 14
Exit	
Board	19
Change	

			Driver	
0				0
→			↓	↓
→			0	
→				0
0	0			19
0				0
0	0			0
				0
0				

Bus stop	# 15
Exit	
Board	
Change	

→			↓	↓
→				
→				

Date Wednesday 05th September **Time 11.55am** **Journey W**

Bus stop # 1
Exit
Board 1 - 9
Change

			Driver	
7			8	
↓	↓			1
9				
4				
2				
				3
6				5

Bus stop # 2
Exit
Board 10
Change

			Driver	
0			0	
↓	↓			0
0				
0				
0				
				0
0				0
	10			

Bus stop # 3
Exit 1
Board
Change

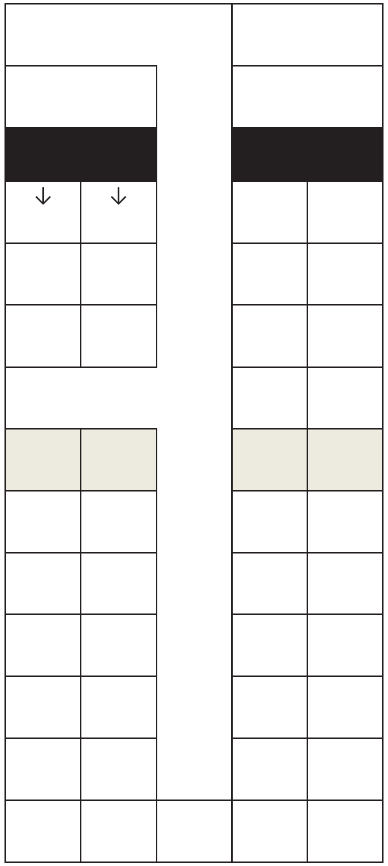
			Driver	
0			0	
↓	↓			x
0				
0				
0				
				0
0				0
	0			

Bus stop # 4
Exit
Board
Change

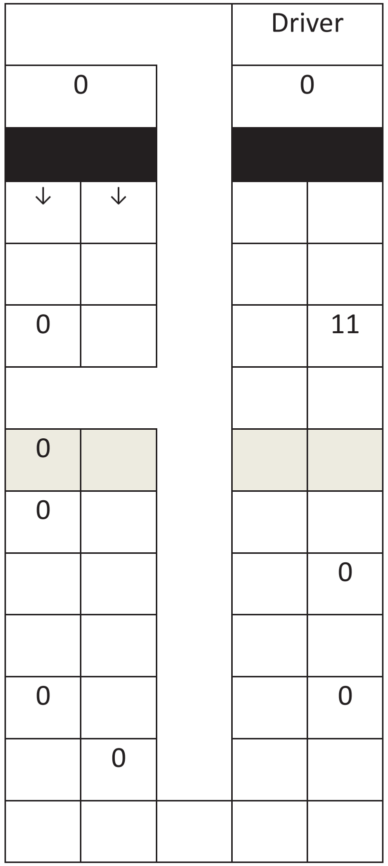
↓	↓			

Date Wednesday 05th September **Time 11.55am** **Journey W**

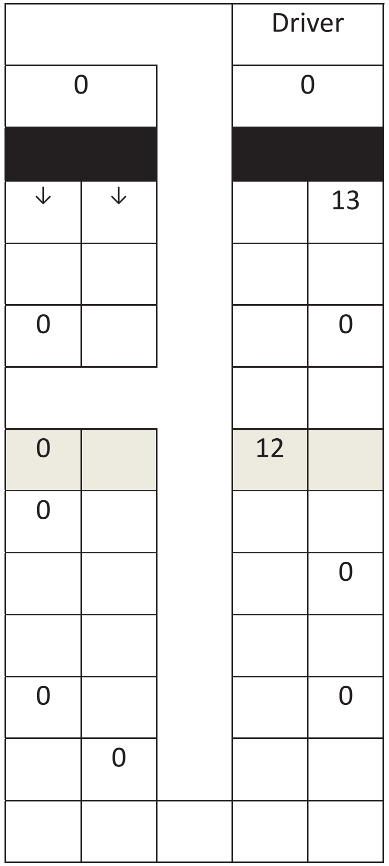
Bus stop # 5
Exit
Board
Change



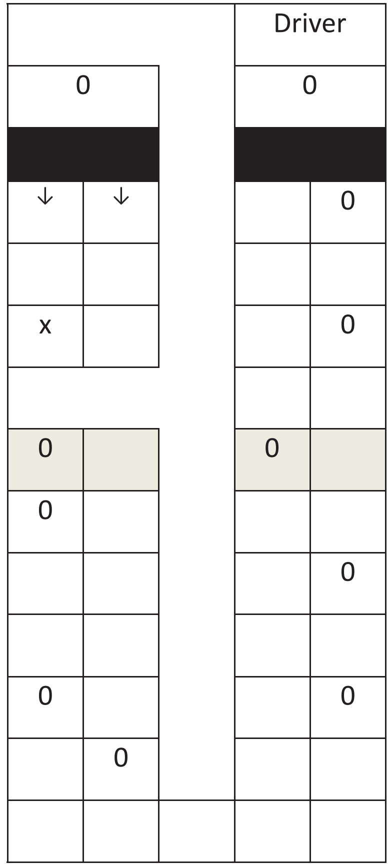
Bus stop # 6
Exit
Board 11
Change



Bus stop # 7
Exit
Board 12 - 13
Change



Bus stop # 8
Exit 9
Board
Change



Date **Wednesday 05th September** **Time** **11.55am** **Journey W**

Bus stop # 9
Exit
Board 14 - 19
Change 11 (before)

			Driver	
0			0	
18+pram				0
	17			
11				c19
				16
0			0	
0				15
14				0
0				0
	0			

Bus stop # 10
Exit
Board 20 - 21
Change

			Driver	
0			0	
pram				0
	0			20
0				0
				0
0			0	
0				0
0				0
				21
0				0
	0			

Bus stop # 11
Exit 7
Board
Change

			Driver	
x			0	
pram				0
	0			0
0				0
				0
0			0	
0				0
0				0
				0
0				0
	0			

Bus stop # 12
Exit
Board
Change

↓	↓			

Date Wednesday 05th September **Time 11.55am** **Journey W**

Bus stop # 13
Exit
Board
Change

↓	↓			

Bus stop # 14
Exit
Board 22 - 24
Change

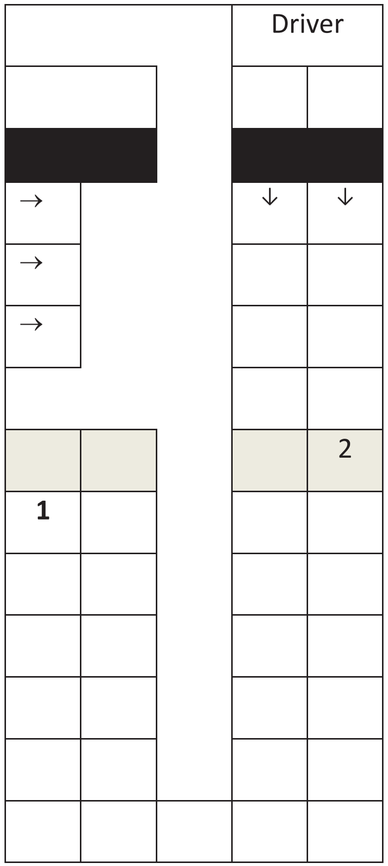
			Driver	
			0	
pram				0
	0			0
0				0
				0
0			0	
0				0
0				0
23	24			0
0				0
	0			22

Bus stop # 15
Exit
Board
Change

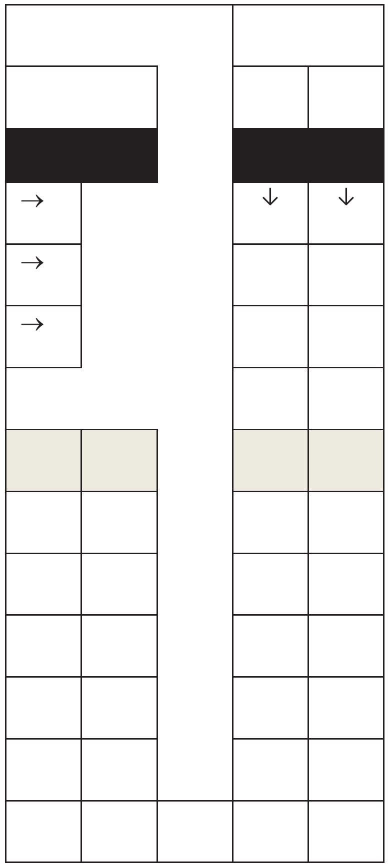
↓	↓			

Date **Wednesday 05th September** **Time** **12.55pm** **Journey X**

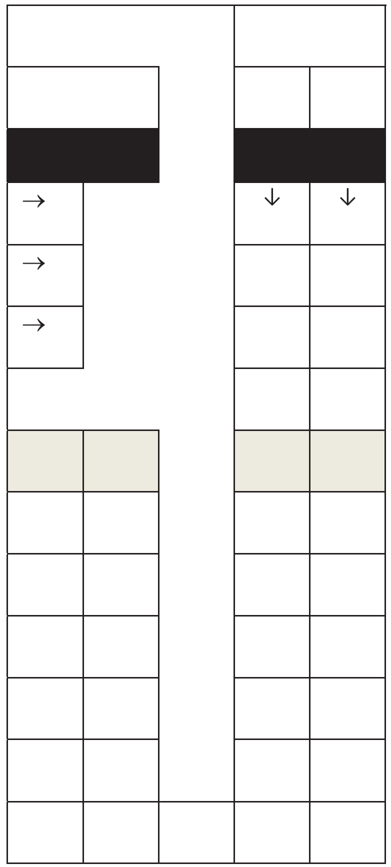
Bus stop # 1
Exit
Board 1 - 2
Change



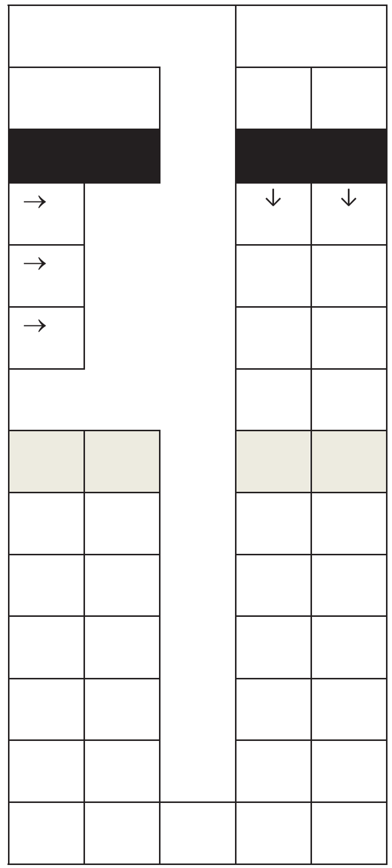
Bus stop # 2
Exit
Board
Change



Bus stop # 3
Exit
Board
Change

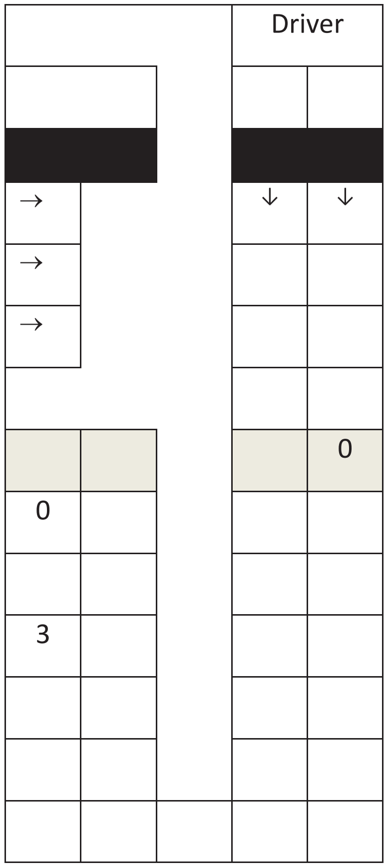


Bus stop # 4
Exit
Board
Change

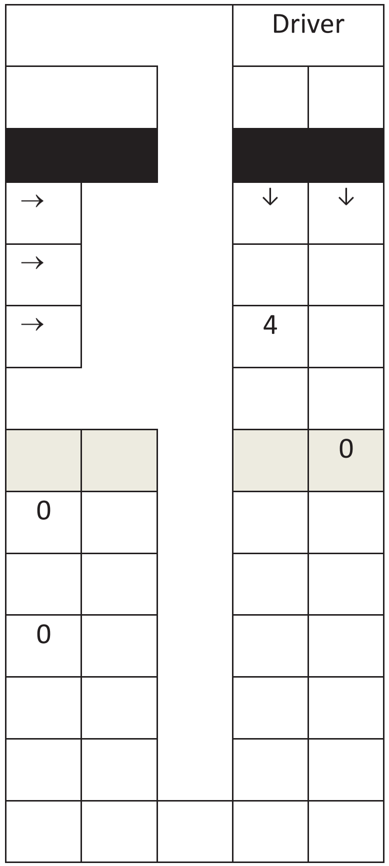


Date **Wednesday 05th September** **Time** **12.55pm** **Journey X**

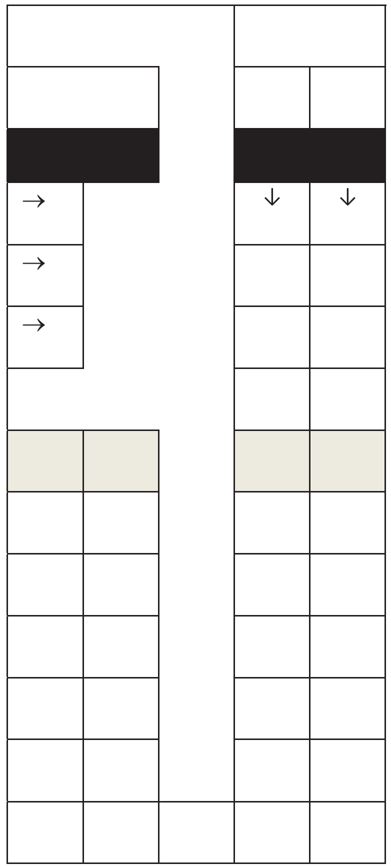
Bus stop # 5
Exit
Board 3
Change



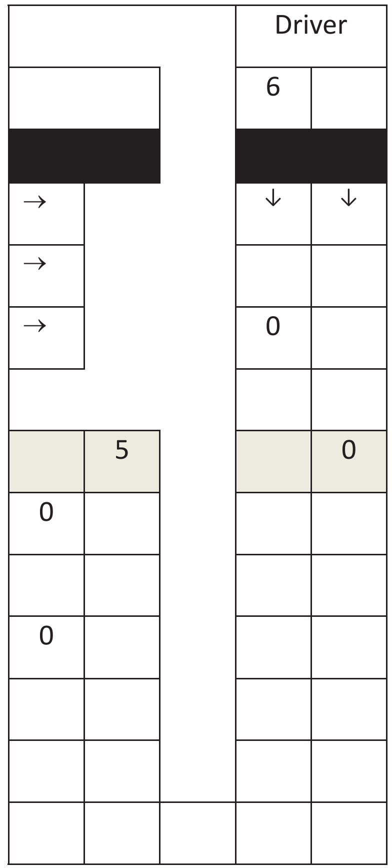
Bus stop # 6
Exit
Board 4
Change



Bus stop # 7
Exit
Board
Change

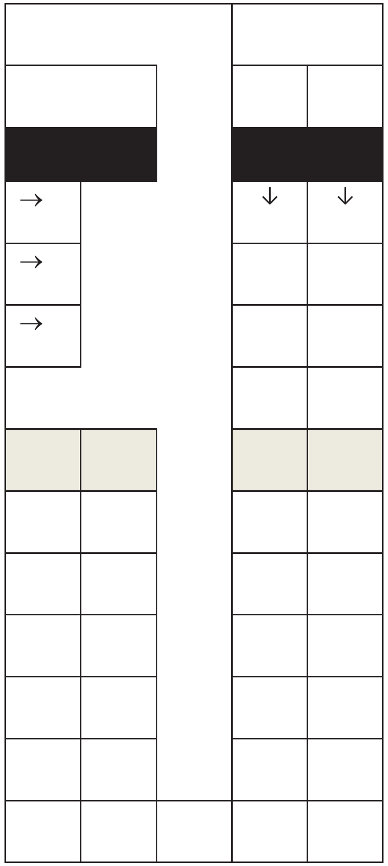


Bus stop # 8
Exit
Board 5 - 6
Change

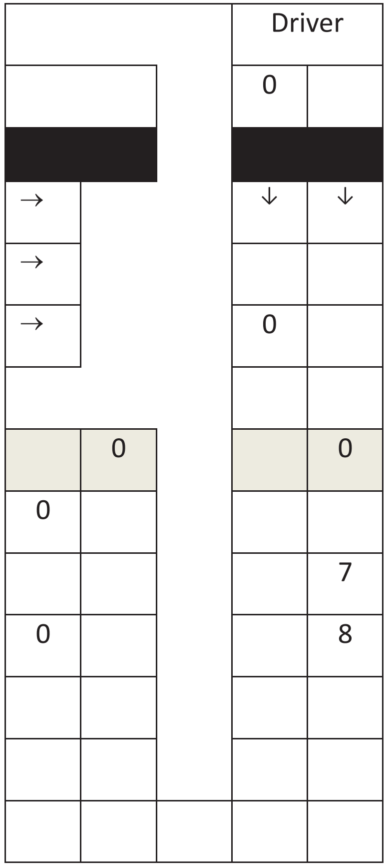


Date **Wednesday 05th September** **Time** **12.55pm** **Journey X**

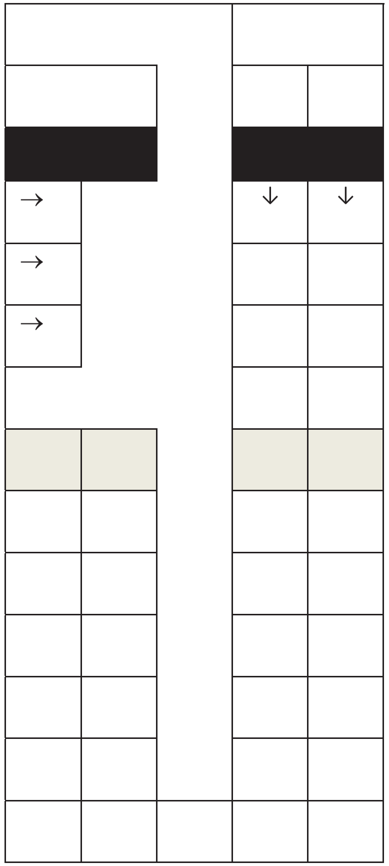
Bus stop # 9
Exit
Board
Change



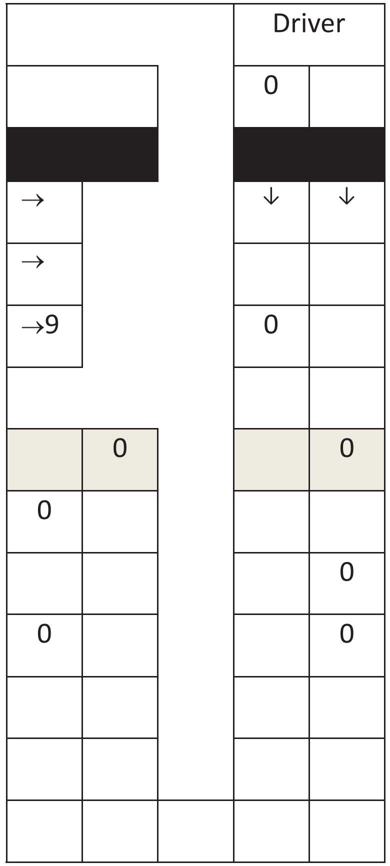
Bus stop # 10
Exit
Board 7 - 8
Change



Bus stop # 11
Exit
Board
Change

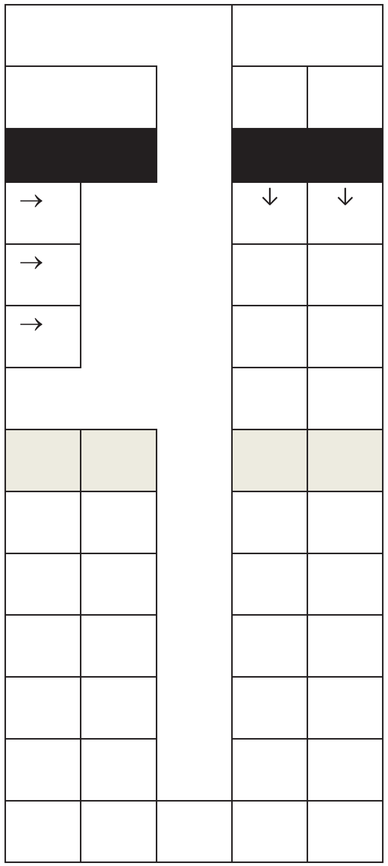


Bus stop # 12
Exit
Board 9
Change

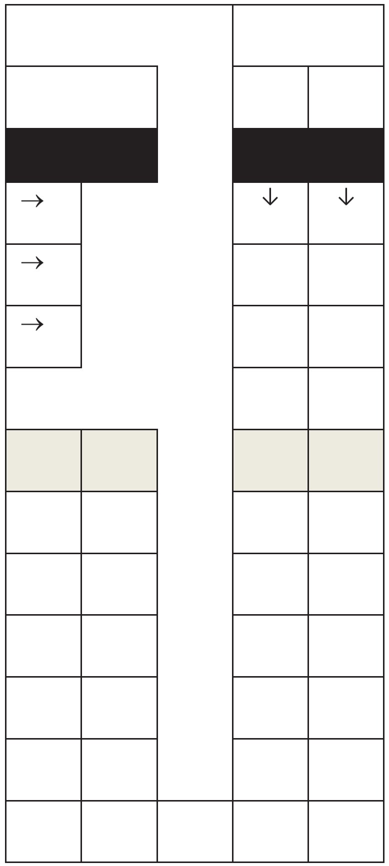


Date Wednesday 05th September **Time 12.55pm** **Journey X**

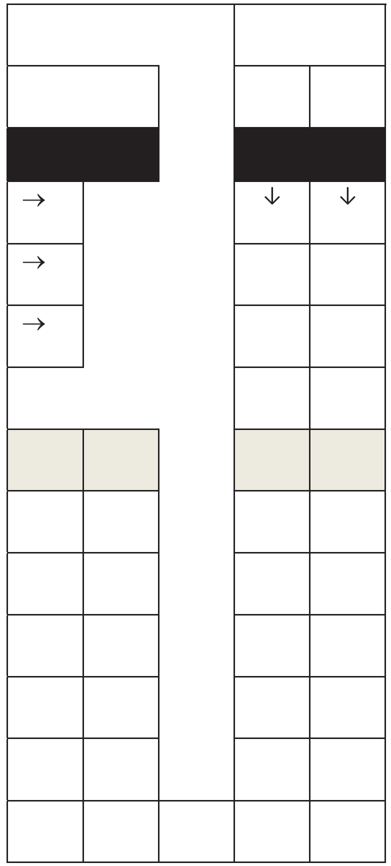
Bus stop # 13
Exit
Board
Change



Bus stop # 14
Exit
Board
Change

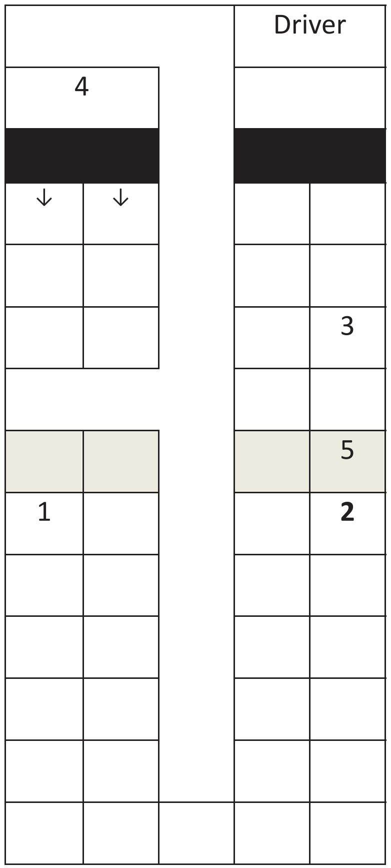


Bus stop # 15
Exit
Board
Change

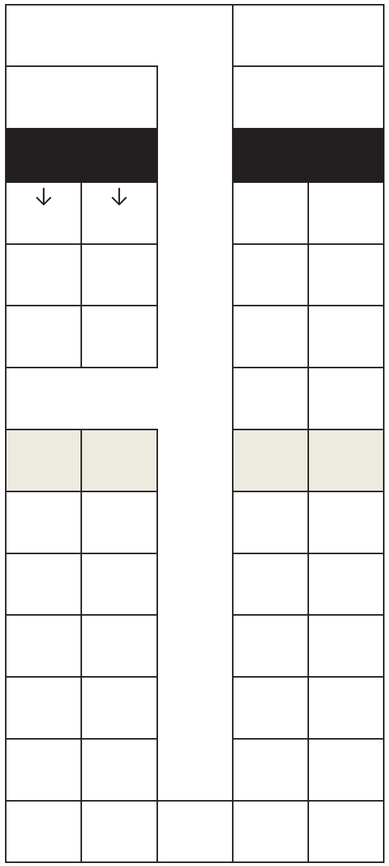


Date **Wednesday 05th September** **Time** **1.25pm** **Journey Y**

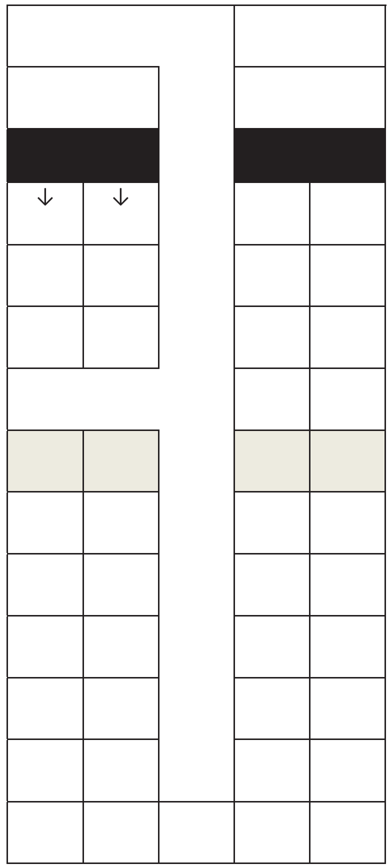
Bus stop # 1
Exit
Board 1 - 5
Change



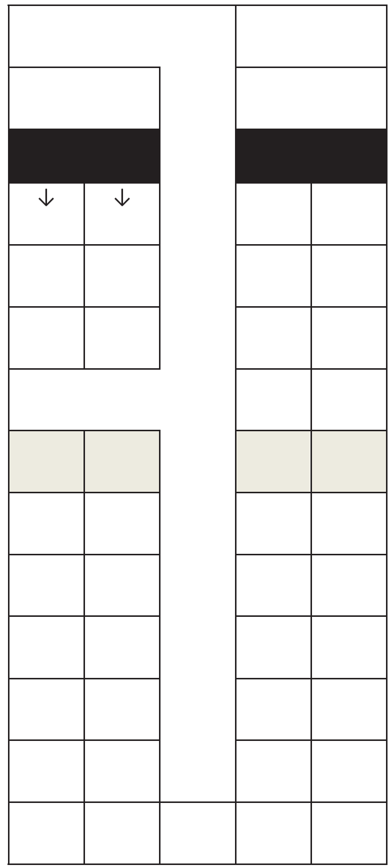
Bus stop # 2
Exit
Board
Change



Bus stop # 3
Exit
Board
Change

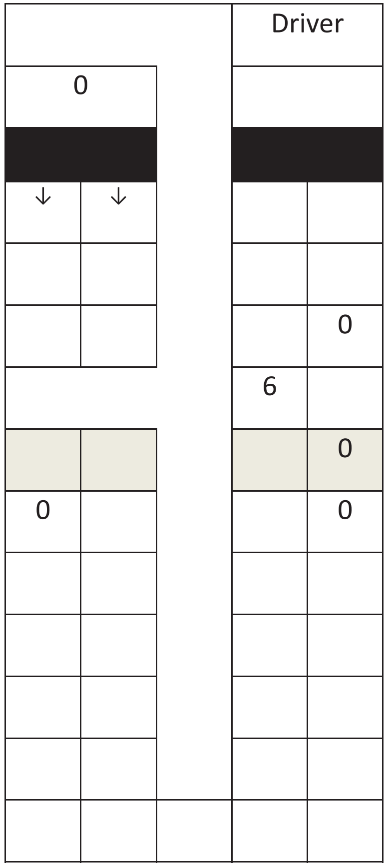


Bus stop # 4
Exit
Board
Change

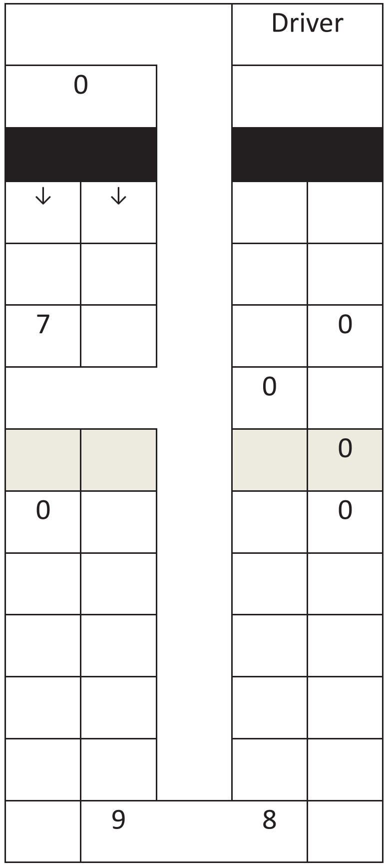


Date **Wednesday 05th September** **Time** **1.25pm** **Journey Y**

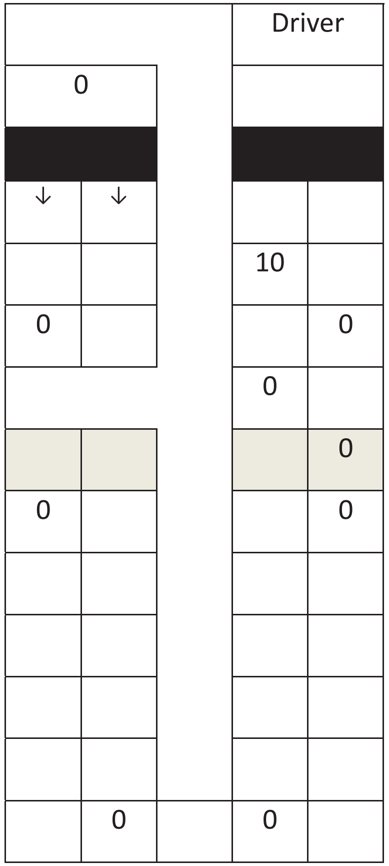
Bus stop # 5
Exit
Board 6
Change



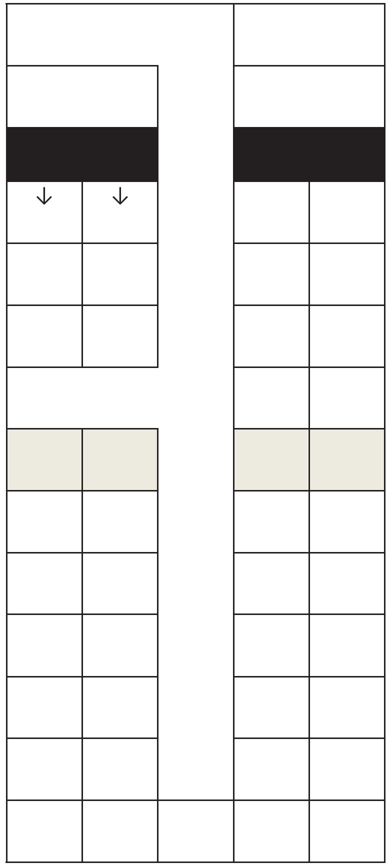
Bus stop # 6
Exit
Board 7 - 9
Change



Bus stop # 7
Exit
Board 10
Change



Bus stop # 8
Exit
Board
Change



Date Wednesday 05th September **Time 1.25pm** **Journey Y**

Bus stop # 9
Exit
Board 11
Change

			Driver	
0				
↓	↓			
11			0	
0				0
			0	
				0
0				0
	0		0	

Bus stop # 10
Exit 6
Board 12 - 14
Change

			Driver	
0				
↓	↓			13
0			0	
0				0
			x	12
	14			0
0				0
	0		0	

Bus stop # 11
Exit
Board
Change

↓	↓			

Bus stop # 12
Exit
Board
Change

↓	↓			

Date **Wednesday 05th September** **Time** **1.25pm** **Journey Y**

Bus stop # 13
Exit
Board
Change

↓	↓			

Bus stop # 14
Exit
Board 15 - 17
Change

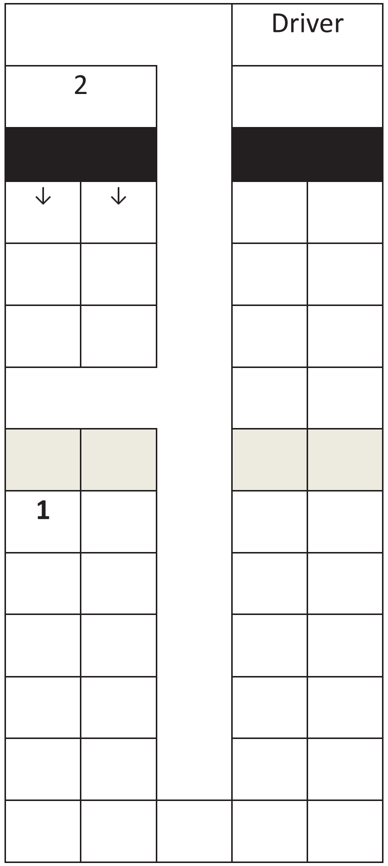
			Driver	
0				
↓	↓			0
0			0	
0				0
				0
	0			0
0				0
16			15	
17				
	0		0	

Bus stop # 15
Exit
Board
Change

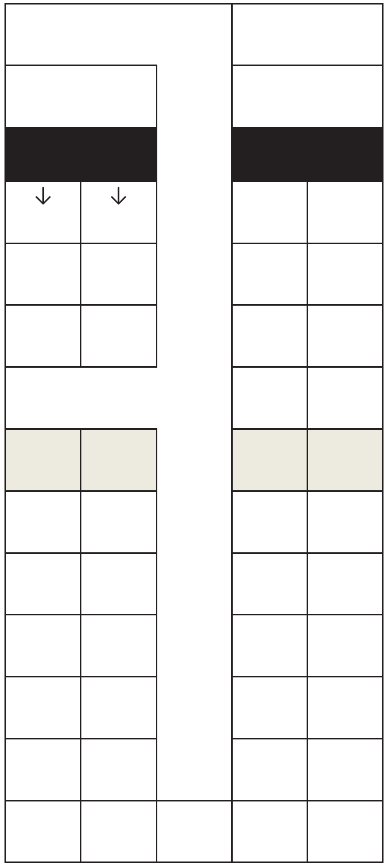
↓	↓			

Date Wednesday 05th September **Time 2.15pm** **Journey Z**

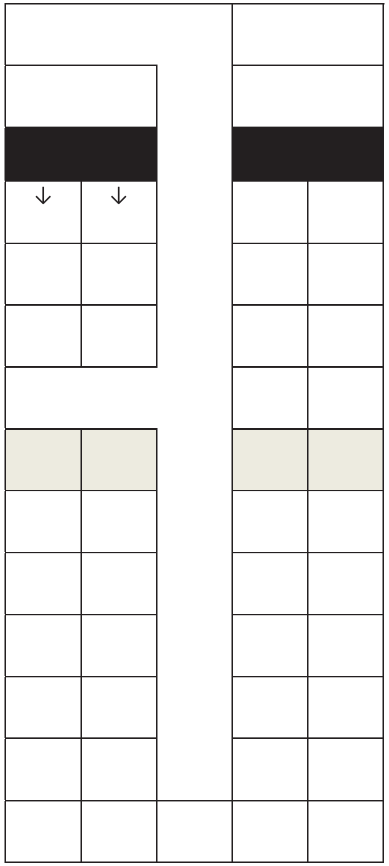
Bus stop # 1
Exit
Board 1 - 2
Change



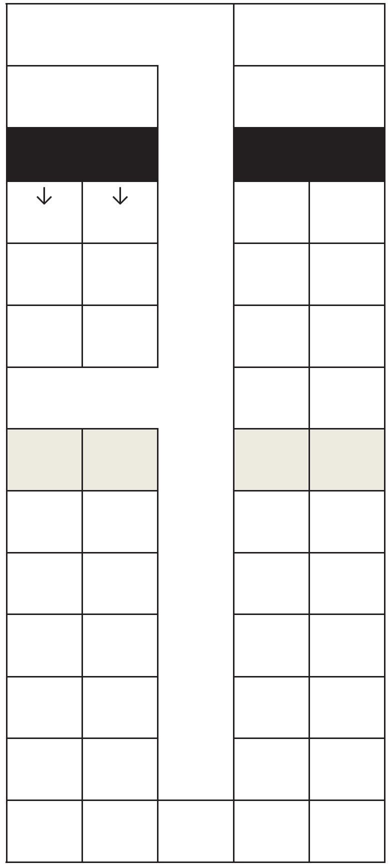
Bus stop # 2
Exit
Board
Change



Bus stop # 3
Exit
Board
Change

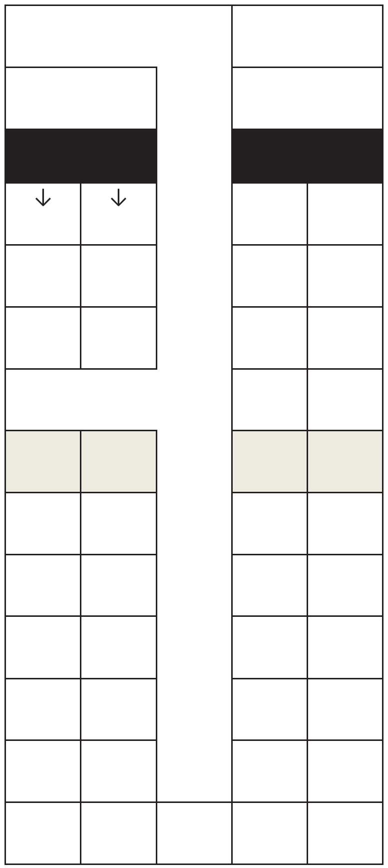


Bus stop # 4
Exit
Board
Change

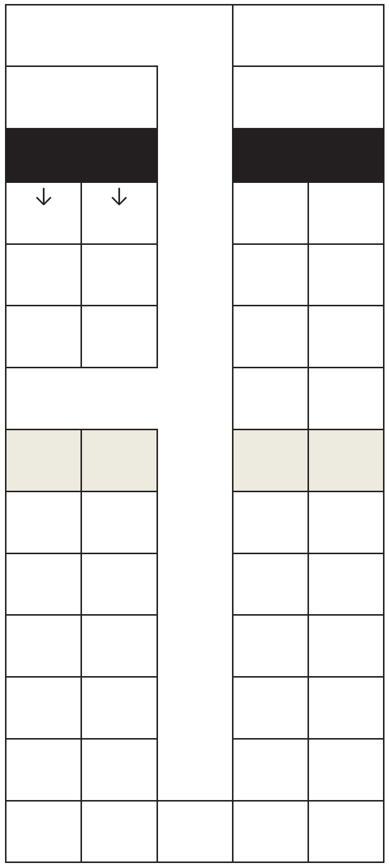


Date **Wednesday 05th September** **Time** **2.15pm** **Journey Z**

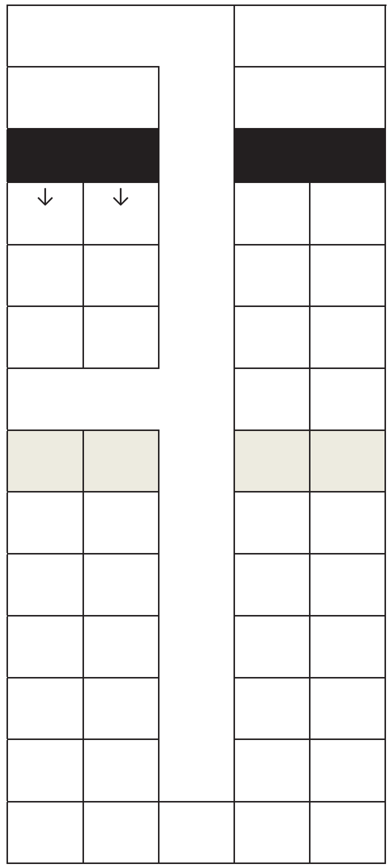
Bus stop # 5
Exit
Board
Change



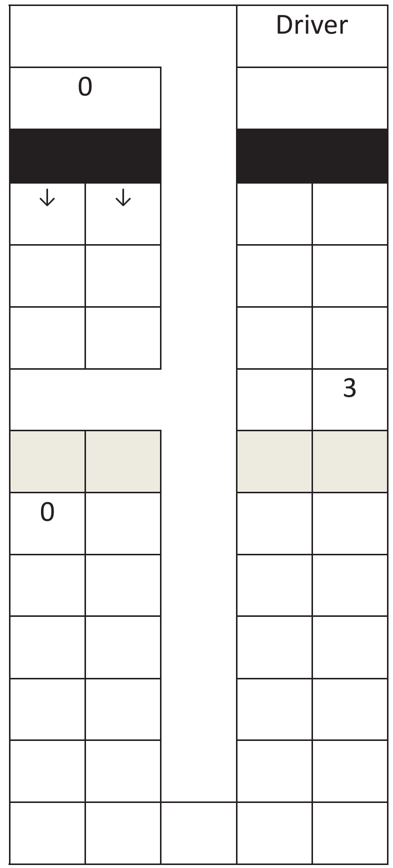
Bus stop # 6
Exit
Board
Change



Bus stop # 7
Exit
Board
Change

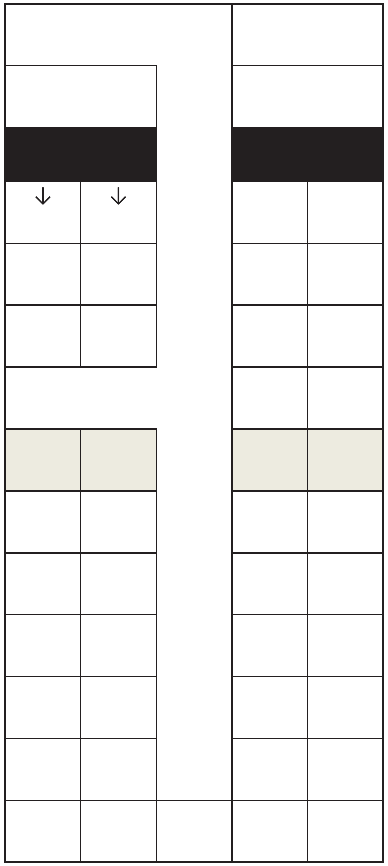


Bus stop # 8
Exit
Board 3
Change

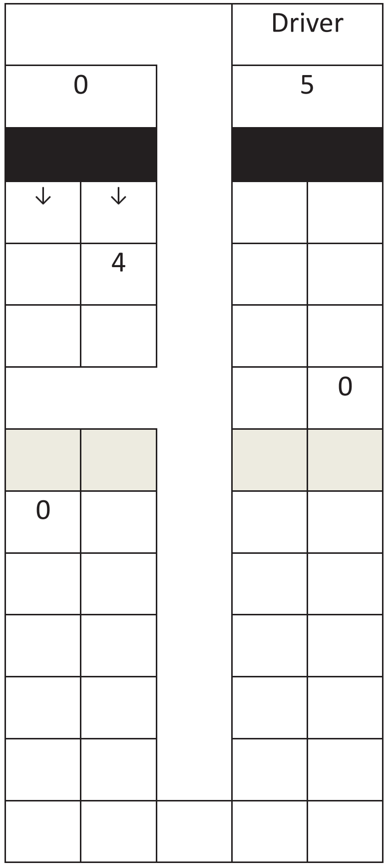


Date **Wednesday 05th September** **Time** **2.15pm** **Journey Z**

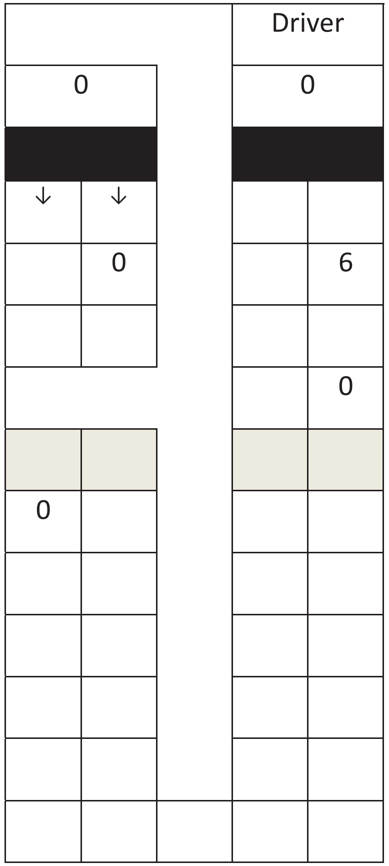
Bus stop # 9
Exit
Board
Change



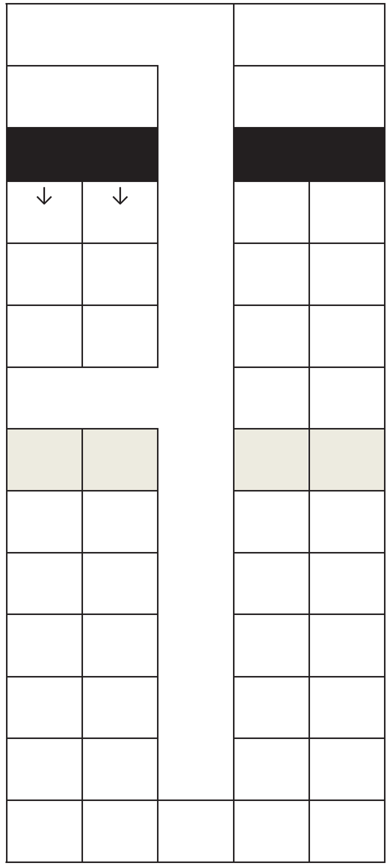
Bus stop # 10
Exit
Board 4 - 5
Change



Bus stop # 11
Exit
Board 6
Change

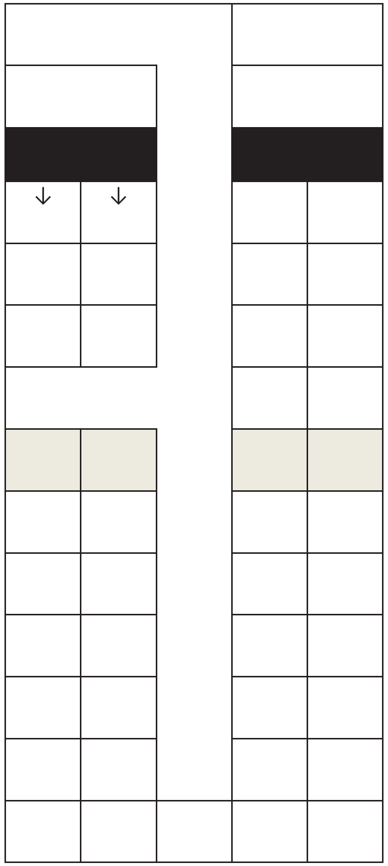


Bus stop # 12
Exit
Board
Change

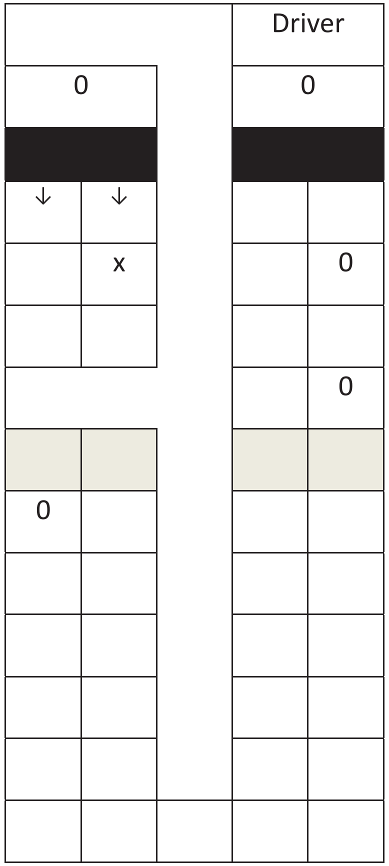


Date Wednesday 05th September **Time 2.15pm** **Journey Z**

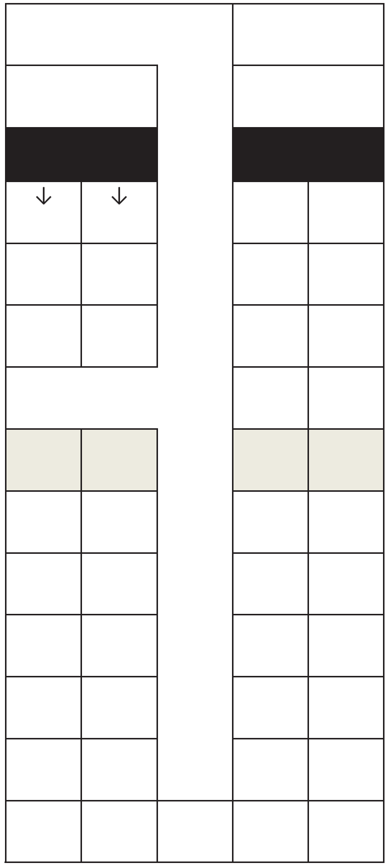
Bus stop # 13
Exit
Board
Change



Bus stop # 14
Exit 4
Board
Change



Bus stop # 15
Exit
Board
Change



Appendix C

Letter dated 09 August, 2012, acknowledging that Low Risk Notification for the present study has been received and recorded on the Massey University Human Ethics Committee's Low Risk Database.

FILE

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA

9 August 2012

Kirsten Phillips
6 Churches Avenue
Mount Roskill
AUCKLAND 1041

Dear Kirsten

Re: Choice of Bus Seat as an Indicator of Human Sensitivity to the Environment: A Naturalistic Observation

Thank you for your Low Risk Notification which was received on 24 July 2012.

Your project has been recorded on the Low Risk Database which is reported in the Annual Report of the Massey University Human Ethics Committees.

The low risk notification for this project is valid for a maximum of three years.

Please notify me if situations subsequently occur which cause you to reconsider your initial ethical analysis that it is safe to proceed without approval by one of the University's Human Ethics Committees.

Please note that travel undertaken by students must be approved by the supervisor and the relevant Pro Vice-Chancellor and be in accordance with the Policy and Procedures for Course-Related Student Travel Overseas. In addition, the supervisor must advise the University's Insurance Officer.

A reminder to include the following statement on all public documents:

> *"This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research.*
>
> *If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor John O'Neill, Director (Research Ethics), telephone 06 350 5249, e-mail humanethics@massey.ac.nz".*

Please note that if a sponsoring organisation, funding authority or a journal in which you wish to publish requires evidence of committee approval (with an approval number), you will have to provide a full application to one of the University's Human Ethics Committees. You should also note that such an approval can only be provided prior to the commencement of the research.

Yours sincerely

J O'Neill

John G O'Neill (Professor)
Chair, Human Ethics Chairs' Committee and Director (Research Ethics)

cc: Dr Linda Jones
School of Psychology
Wellington

Assoc Prof Mandy Morgan, HoS
School of Psychology
PN320

Massey University Human Ethics Committee
Accredited by the Health Research Council

Research Ethics Office, Massey University, Private Bag 11222, Palmerston North 4442, New Zealand
T +64 6 350 5573 +64 6 350 5575 F +64 6 350 5622
E humanethics@massey.ac.nz animalethics@massey.ac.nz gtc@massey.ac.nz
www.massey.ac.nz