Co-operation and Complicity Voices, Robots, and Tricksters in the Digital Marketplace

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We advocate the theme of complicity, ahead of co-operation, as a means of understanding complex, interactive digital systems. Our case study of a market precinct known as the Barras, about one mile from the centre of the city of Glasgow, foregrounds the notion of complicity. Marketplaces are characterized not only by co-operation in rule-governed environments, but complicity between actors as a means of breaking rules, working at the boundaries of formal frameworks, avoiding other actors, such as law enforcers, and even working with them in tacitly agreed evasion strategies. We present the human voice (as exercised in the case of market stall holders drawing attention to their wares) as a major medium of complicity. In our application of these ideas we deploy Lego MindstormsTM RCX robot processing to explore interactions between a mobile sensing robot and simple environmental controls: movements of sliding screens in response to an autonomous mobile sensor. As well as their benign characteristics as co-operating agents, we argue for a consideration of robots as quintessential tricksters, plotting and scheming strategies of survival, evasion and opportunism. Traits that can be employed in the development of useful augmented environments.

1. Introduction

Much research has been conducted into the properties of organisations, human and automated, in which the overall system behaves in a way that cannot easily be predicted from the characteristics of the individual components [1, 2, 3]. Free markets are often put forward as such complex adaptive systems. According to classical theories, the performance of the economy is a product of so many individuals or actors (buyers and sellers) seeking to maximize their individual gain [4]. The aims of various actors generally conflict, requiring negotiation to maintain or improve the common welfare [5, 6]. *Co-operation* is the operative term, implying that actors work together within a common framework or rule base to meet mutually agreed ends. We would like to skew this tendency for co-operation towards *complicity*, which implies actors working with or against one another to break the rules, or at least to operate at the edges of their frames of reference and rules bases.

2. The marketplace

The study of markets is instructive in understanding co-operation and complicity. E-commerce on the Internet has been likened to a bazaar: chaotic, dynamic, and opportunistic in its organization [7, 8]. As rich, sensory environments, local markets are also instructive on the interaction between the senses of vision, sound, smell, touch, taste, and movement. Sound is very important in marketplaces. To bring some of these characteristics of the market into sharp relief we report on our study of the market area in Glasgow known as the Barras. The name "Barras," short for "barrowlands," refers to the environment in which sellers would gather with their barrows and call out to draw attention to their wares. The barrows are now replaced by market stalls, but this sonic quality persists. The voices of the Barras compete for attention.

The Barras was established around 1920, and has a well-documented history and folk lore [9]. It is a destination for tourists to Glasgow, and as yet has resisted gentrification. The increase in fashionable new housing in the area suggests that the market environment will change, but such marketplaces persist in spite of advances in electronic commerce and online shopping. We visited the site on numerous occasions as part of our research, taking photographs and sound recordings, and conducting focus groups of researchers with expertise in sound, music, anthropology and architecture to help analyze data from the site. We have also made comparisons with data from other noisy public sites, such as auction houses, Camden Market in London, railway stations, football fields, and department stores in Japan.

Like many traditional, anachronistic environments, the Barras is not untouched by digital media. Like many local and regional sites the market is caught up in reconfigurations of the local and the global that involve

communications networks. There is information about the Barras on the Internet. It features in tourist guides. It makes use of the global import economy. It is an example of local enterprise that is invigorated by globalisation, amplifying local and national identity [10]. The Barras are managed using digital technologies. Store-holders succumb to processes similar to those attributed to the micro-entrepreneur, whose business acumen is abetted by mobile phone networks [11]. The environment is patrolled by police who use mobile communications. The Barras also submits to analysis using digital media. Google Earth provides a clear image of the market on a busy summer day. People take pictures of the market with digital cameras, and we recorded sounds using binaural in-ear microphones that look like iPod earphones enabling inconspicuous, high quality recording. We also deploy our own online system for storing and logging research data. Though it appears to belong to a bygone era, the functioning and experience of the market is abetted, mediated and amplified by the presence of digital technologies.

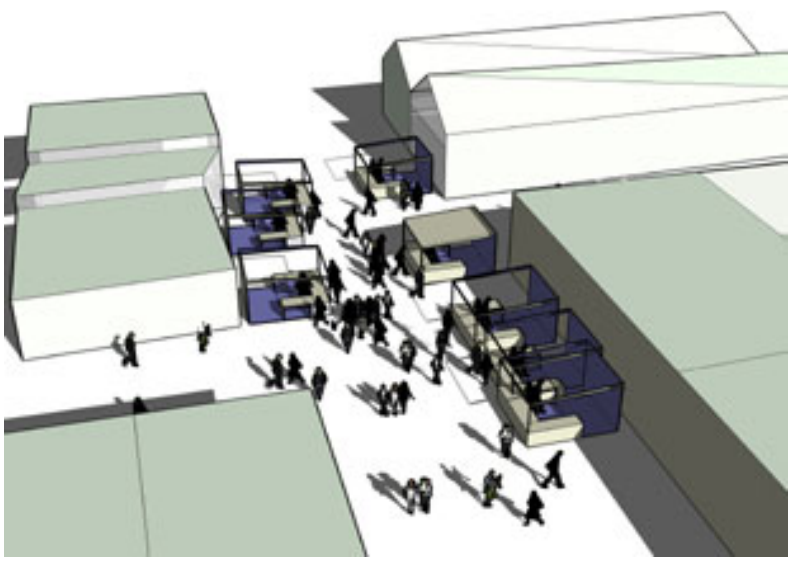
Our investigations of the Barras drew us inevitably to the main junction at the centre of the Barras, the asymmetrical crossing of the market's two major axes. People are drawn to the crossing, and researchers on the team identified independently the same setting as affording the most interesting sound recordings. A typical visit reveals a series of prominent stalls at the four corners of the crossing, which encroach on the roadway. There is a stall offering packets of confectionary at "three for a pound." There is a CD seller, and a towel merchant draws a crowd with interactive repartee. The stall holders and their entourages seem also to sustain a loud, familial banter inviting shoppers to eavesdrop on local affairs. Sellers at the junction use vocal calls to attract attention and to define their areas of trade. We are studying the use of the voice as an architectural element in such spaces.

2.1. Markets and multimodality

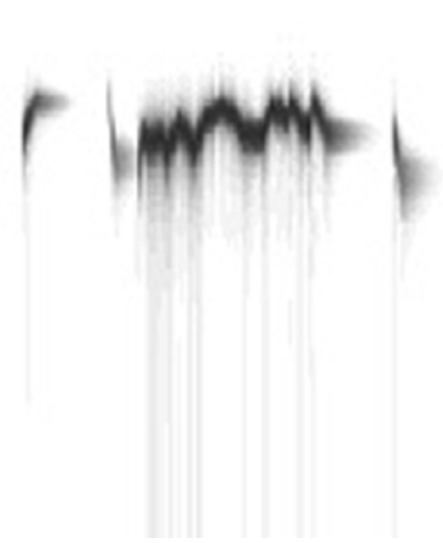
The spatial experience of a market involves all the senses. We also deploy different sensory modes in the representation of the Barras: static photographs, sound recordings, aerial photography, PDA on-site sketches, 3d models (Figure 1), and sound processing imagery (Figure 2). No single mode reveals all that the site has to offer, particularly as so much of the site's character is revealed through sound and the use of the human voice. Our study therefore confirms the immediate observation that visual apparatus are insufficient to reveal the character and functionality of rich, multi-sensory environments like the Barras.

Sight plays an obvious role in the arrangement of the Barras. Objects have to be clear to view, and sellers attempt to catch the eye of a potential customer. There are needs for visual privacy. Sound is also important, in terms of the acoustic quality of spaces. But our study indicates that the voice is not only supplemental, but could be said to be a major determinant

in the spatial definition of the market, its ambience or atmosphere, its functioning, the temporal organisation and the layout of objects (stalls), the transient architecture of the space. As a material consideration in the configuration of the spaces, the voice is more time-dependent and mobile than the devices of vision, but is palpable in its own way, independently of what is actually being said.



► Figure 1: Sketch model of the Barras.



► Figure 2: Melograph, visual representation of vocal inflection (ie the rise and fall of the tone of the voice), a further representation of the Barras. The phrase represented is "three for a pound here."

2.2. Markets and repetition

Stalls in the Barras are laid out in repetitive patterns. But the voice also features prominently as a repetitive element. The obvious means of defining space through the voice are volume, pitch, intonation, inflection, and the ambience created by voices overlaying and interacting with each other. As well as using the voice to communicate, people deploy the voice to manipulate their immediate environment. There are also emergent features of the voice outwith the control of any individual and that have a collective effect. In fact, in keeping with other observations of how people use music and sounds [12], we are not entirely willing agents in the use of the voice. In keeping with certain characterisations of language [13], the voice, or at least the incessant babble of voices, could be said to manipulate us. This is most obvious in the use of banal repetitions. Street sellers call out, almost in spite of themselves, and repeat their utterances to sustain their claims on space. Callers were observed to break away from normal conversation to assert their territorial claims. This repetition was precise, hitting the same pitch and inflection each time with very little variation.

2.3. Markets and competition

We are interested in the competitive element of the marketplace, or, more specifically, its *agonistic* aspects, that is, the way stall holders negotiate with one another their different claims on space. Repetition is an obvious means of staking out a claim, a major device in the territorial behaviour of animals, both human and non-human [14]. Stall holders are also involved in an agonistic play with potential customers, and with the law enforcers. Ardrey describes such communities as "held together by mutual animosity" (p.167), a characterization that parallels the agonistic functions of play in human communities [15, 16] and is also attributed to the character of oral communities. The claims associating voice with 'violence' are strong amongst those who study the relationship between visual and aural cultures. Ong notes that "violence in oral art forms is also connected with the structure of orality itself." He observes that when communication relies on direct word of mouth, involving "the give-and-take dynamics of sound, interpersonal relations are kept high — both attractions, and even more, antagonisms" [17, p.45]. The 'violence' of the voice is not necessarily of the kind that draws blood, but competes, disrupts, breaks through, demands attention and protests.

Market stall holders set up a rhythm amongst themselves. Their positioning is determined by the size of the stalls, but also the reach and influence of the voice. The towel merchant has an assistant who echoes the key components of the merchant's utterances. Intentional and accidental vocal co-operation produces cycles and patterns of aural ambience. It is also a determiner of where customers and browsers go and how they move around.

We conducted a series of experiments to test how listeners negotiate the spatial aspects of competing voices. We set up a room involving three sound stations, each with a loud speaker connected to a digital sound system emitting a repetitive call as an abstract representation of the market setting. We could have used recordings from the Barras, but the scenario seemed contrived and inadequate in a small interior space. Instead, we used recordings of a voice calling out the FTSE100 stock listing, an auctioneer and a telephone train booking transaction. In fact we thought the content of the repetitive calls less important than the rhythms and inflections they deployed. Twenty subjects were invited to occupy the space (in succession) and carry out a series of paper-based tasks designed to elicit spatial responses. When interrogated about the spatial character of the repeated calls people referred to the "hypnotic effect" of the repetitions, and some were able to draw spatialisations of the sonic environment. We were not looking for direct spatial correlations, but simple confirmation of the territorial nature of the competing voice. Needless to say, subjects were quick to point out the annoying aspects of the competing voices of the space, and attempted diagrams to represent this and their resistance to the irritation. The second phase of the experiment was to provide moveable sound sources (voices) in a gallery space, and to invite subjects to move the sound sources around. We then talked to them about their experience, and what they were trying to achieve. Mobility is a vital part of one's experience of the voice: being able to move away from or closer to the voices that surround us. Being able to exercise spatial control over a vocal source is also important, as in telling a noisy child to leave the room, or encouraging someone to turn away when on the phone. Positioning voices on the basis of criteria other than sound nuisance is more difficult, but turns out to be an art that can be cultivated. Like arranging plant materials in an ikebana display, subjects were capable of organizing the parameters of a vocal 'display' to invoke contrasts, ameliorate discord, excite interest, construct meaning, and to provide a focal point for talking about the spatiality of the voice.

The way the voice is deployed in marketplaces, particularly by stallholders, displays a similar artistry in negotiating the agonistic space between irritation and seduction, taking account of the competing voices of other stallholders and the mobility of potential customers.

2.4. Markets and the trickster function

The agonistic character of the voice draws attention to play. The Barras is a leisure site, with other entertainments, including a ballroom, built into the fabric of the market. People attend the market recreationally, and to be entertained. It is a place to enjoy local dialects, and boasts a particular brand of "Scottishness." Not least in this appeal is the Barras as a site of the trickster function.

According to some theorists, as part of its agonistic function, the voice is tricky in any case. The ability of people to deceive with words has been observed since Homer, and Plato opined on the trickiness of speech. The trickster function is a popular theme in literary studies. According to Lewis Hyde the crossroads are where commerce springs up, and is the habitat of the Jungian archetype of the trickster: "He is the spirit of the doorway leading out, and of the crossroad at the edge of town (the one where a little market springs up). He is the spirit of the road at dusk, the one that runs from one town to another and belongs to neither" [18, p.7]. The trickster is the middleman, and a confuser of distinctions: "Trickster is the mythic embodiment of ambiguity and ambivalence, doubleness and duplicity, contradiction and paradox" (p.7). Needless to say, the cross-roads constitute the main arena of the Barras.

The workings of the trickster resonate with certain characterizations of the contemporary designer. The designer as trickster plays with the space between the strange and the familiar, or at least uses strange juxtapositions and unusual encounters as a stimulus to design [19]. According to Tschumi: "the ultimate pleasure of architecture lies in the most forbidden parts of the architectural act; where limits are perverted, and prohibitions are *transgressed*. The starting point of architecture is distortion." [20, p.91] It is consistent with our design orientation to the problematic of the Barras to celebrate its trickster functioning.

The co-operation and complicity amongst market participants is tricky. Classical economics assumes that market conditions tend towards stable conditions, abetted by sufficient information for rational decision-making [21]. Our observations of the marketplace indicate the role of instability, tarrying at the edge of legality. This is the 'reality' of much market activity. The Barras is notorious as a site of hustling, mischief and illegal trading that attracts both bargain hunters and spectators. On more than one visit we observed a familiar scenario involving the sale of bootlegged CDs. A seller positioned himself on the road at the crossing with a card table covered with a tablecloth scarcely concealed by a small crowd of potential buyers. Before long a lookout signalled a warning. The produce (CDs) were scooped into the table cloth and carried away. The table was speedily carried off the street, and the sellers and crowd continued as if nothing had happened. A few minutes later two police personnel strolled along the street on their customary patrol. To the extent that the Barras participate in the "black market" environment it participates in the tricky off-beat economics popularised by the economist Steven Levitt, and characterised as *Freakonomics* [22]. The trickiness of the environment is perpetrated in no small part by the voice. The lookout signals a warning of the police approach via the voice. The perpetuation of such complicit practices belongs firmly within Ong's characterization of aural cultures. Were guidelines for such practices, names of the actors, lists of produce and advertisements to

appear in print then traces would be laid for ready detection. The game would move into a different arena, of evidence, action and reaction by regulatory agencies. So market sellers co-operate (conspire) with one another, especially in the case of illicit goods, where the sellers operate as look-outs for one another, and openly share anecdotes about their encounters with the regulators. Successfully evading the authorities serves their common interest, even where sellers are in direct competition, a practice also identified in Japanese retail by Matsushita [23, p.243] and termed 'co-opetition.'

Movements advocating free access to, and the appropriation of, wireless networks participate in a kind of co-operative trickster culture (eg Wireless London). Sound is also complicit in various forms of activism in art. One of our team reported a recent experience in Austria where artist Peter Kutin had made a sound piece that read out the names of psychiatric patients who were apparently assassinated by the order of the City Council during World War II [24]. Officials attempted repeatedly to turn the sound piece off and remove visual signage that drew attention to it. Whereas a commemorative plaque drawing attention to the events can be removed from a building, sound creeps around the walls of a building and is harder to eradicate, further evidence of the complicity of sound in the trickster function, and further indication of the 'cat and mouse' game that sustains trickster practices.

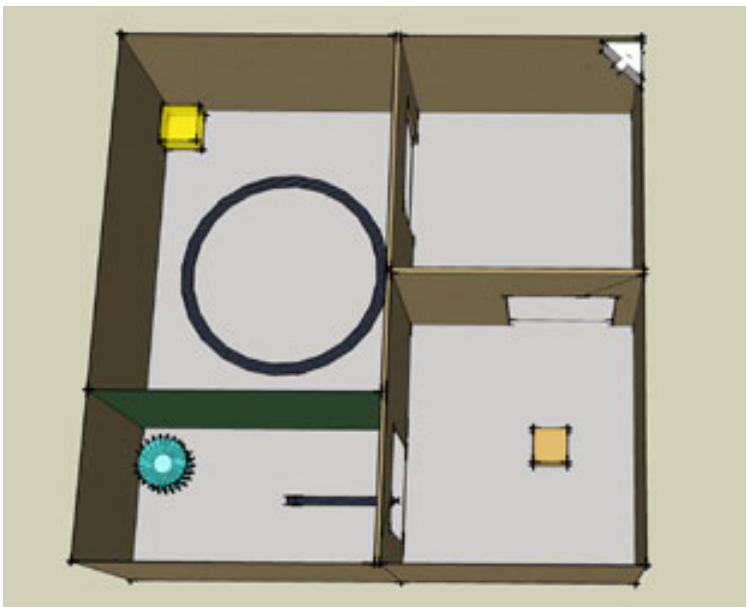
3. Multi-agent automata

It may seem a large jump to proceed from nefarious market practices to robotics, but prominent amongst the wares of the market are eye-catching gadgets and toys, cheap miniature automata that light up, run about, and emit noises. These are the contemporary, mass-produced progeny of the puppets, dolls and mechanical oddities of traditional fairs and amusement arcades, and of the kind that populate the home of Sebastian in Ridley Scott's science fiction film, *BladeRunner*. (Freud draws attention to such automata in his characterization of the uncanny.) Cute, uncanny, and mischievous robots are never far from our conceptions of the marketplace.

There has been much research into co-operative systems in which automated agents work together to solve some problem or carry out a task [25]. So-called intelligent environments rely on sensor technologies for making adjustments to the environment: eg configuring sun controls, lighting, and natural and artificial ventilation [26]. The field of research extends to all building systems, and even those that reconfigure the shapes of spaces. Weather and environmental control is an obvious issue in open-air markets. One could imagine an elaborate, augmented marketplace in which awnings are extended automatically, screens appear and disappear, sound masking or augmentation is activated as needed, and CCTV devices play an instrumental and automated role in site management. Such control arguably works

against the operations of the marketplace, and is more in accord with the commercial shopping mall. Digital augmentation is a means of enhanced policing, requiring further resourcefulness on the part of complicit actors.

To test the possibilities of multi-agent environmental control, we created a physical model of cardboard, pulleys and robotic controls: a model with moveable partition elements controlled by a Lego Mindstorms™ RCX processor and motors (Figures 3 and 4). A second RCX robot (Figure 5) acts as a mobile sensor that moves around on wheels, avoids obstacles, takes readings from its environment and passes these by infrared (IR) communications to a stationary laptop computer. [We note experiments with robotics in architecture by others, notably [27], [28] and [29].] Ostensibly, the justification for using mobile sensors over static sensors is the economic advantage that might ensue in using a roving sensing device that sends signals to static control mechanisms. There could be several such co-operating mobile devices in any space, which operate discretely when no one is around. Multiple agency is often dealt with as a marketplace of co-operating agents. We are not yet ready to model the Barras as an intelligent environment. But there are lessons from our Barras case study.



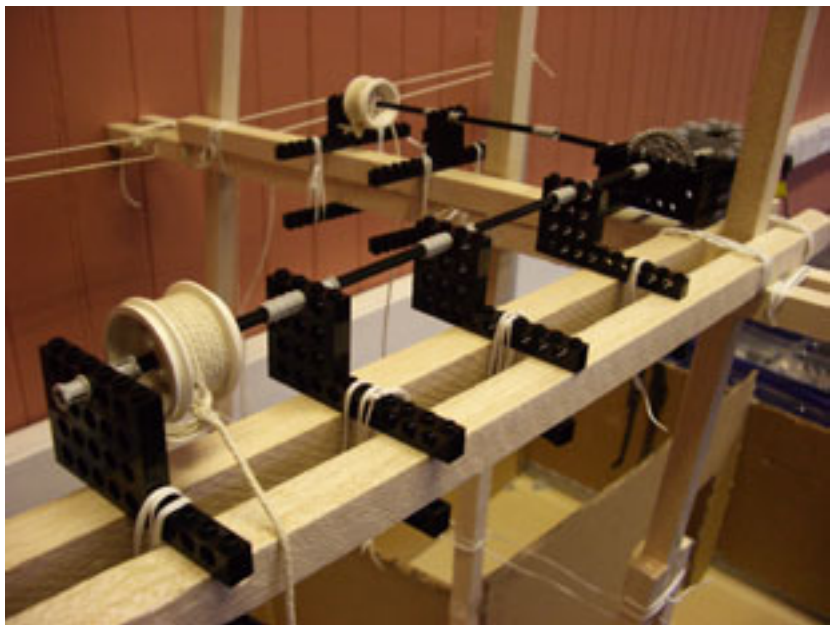
◀ Figure 3: Computer model of the augmented environment: a series of rooms with simple tasks, obstacles and sensory stimulations. The mobile sensor robot signals to the environment to raise the screen to enable it to complete a circuit.

3.1. Robots and multimodality

Our embryonic augmented environment uses the various sensor technologies available in robotics, and in particular the Lego Mindstorms™ kit. The main modalities are sight (light) and touch (pressure), with the release of colour and ultra-sonic distance sensors (which can also detect movement) with the subsequent generation of NXT robots. Sound, and particularly voice, is an obvious modality in intelligent environmental

control, and the NXT processor will facilitate voice-activated processes. It can also provide temperature and compass data. The current state of our experiment deploys IR communication between two RCX processors: one that controls the environment, raising and lowering screens in a physical model to permit passage for a mobile RCX robot. So the agents in intelligent environments can use multiple modalities to communicate with one another and with environmental controls. The environment is also treated as a multi-sensory space. The imagination jumps readily to the prospect of mobile robots of various shapes and sizes modifying the comfort, ambience, functioning and security of the local market, or, in even more fanciful scenarios, conducting business.

► Figure 4: Mechanism for raising and lowering screens as a simple simulation of environmental control.

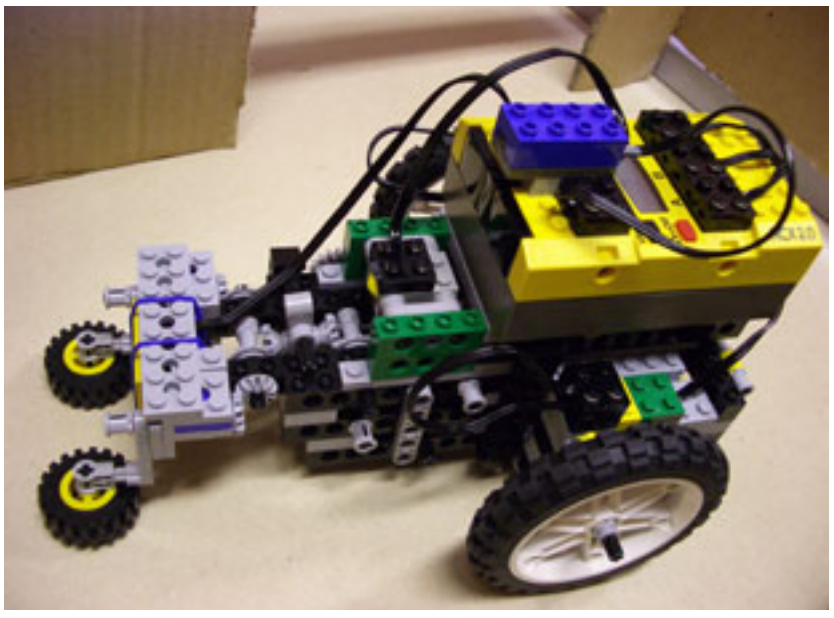


3.2. Robots and repetition

The repetitions of the Barras are important in defining spaces and territories. Our mobile robot performs repetitive operations to command space. It is programmed to undertake a circular journey around a kind of obstacle course of sensor stimulations to test responses and test the extent to which the robot can influence its environment. There is a rhythmic response to light and dark as these are easy to process, but we will extend the sensing technology to sound, temperature and humidity. With ultrasonic sensors, the system will define its spaces by emitting periodic signals to determine distances from target objects. Our studies into inflection will also play a role in augmented commands (Figure 2).

3.3. Robots and co-operation

Our system shows a rudimentary presentation of a multi-agent system [26], in this case with just two agents: the RCX that controls the surfaces in the environment, and the mobile sensor robot that moves about and signals changes in the fabric of the environment (raising and lowering screens). The mobile robot carries out information collection and simple tasks. In an augmented marketplace one might expect modification and control of various parameters, including sound, to enhance comfort and ambience.



◀ Figure 5: Mobile sensing robot.

3.4. Robots and the trickster function

The Lego Mindstorms™ kits are between a toy and a serious research tool. The environmental controls concentrate on threshold conditions, transitions between states in the environment. In keeping with behaviour-based robotics [30], the mobile RCX behaves locally, a trickster function of sorts, with no regard for goals or a grand plan. As we have seen, many agents operating in their own interest are thought to produce an emergent global effect, as in the case of termites constructing elaborate structures [31, 32]. By a slightly different reading, the trickster function draws attention to the rogue robot, who upsets the operations of the swarm. In our imperfect study it is easy to observe unusual, amusing and uncontrolled behaviour in the mobile RCX. We tried mounting a wireless camera to the robot. This introduces "sneaky" behaviour to its repertoire. The robot also required us to modify the environment in response to its limitations. For example, the simple navigation algorithm deployed meant that the robot would easily get caught in futile repetitive back and forth movements if it

encountered a wall head-on. So it would get stuck if it missed a doorway. We modified the environment by angling walls in the horizontal plane towards their openings. This produced a funnelling effect that enabled the robot to find its way through an opening with fewer iterations.

How can trickster complicity constitute a strategy for multi-agent systems that modify the environment? We have already alluded to the desirability of discrete and obsequious robot behaviour, traits often associated with service, and even servitude, necessitated also by co-occupancy with human actors. Retinues of mobile sensors must operate to avoid human and animal inhabitants of spaces (for reasons that include the health and safety of the human occupants), much as market racketeers conspire to evade the police. The control of automata must therefore accommodate actions that are discrete, covert and vigilant. Their operations need not be limited to the floor space, but can include the walls, ducts, and interstices of the building fabric. Under the trickster function, it is also worth examining how automata may flaunt the rules, change the rules, be complicit with the regulators, and infiltrate their operations. Flaunt, conspire, infiltrate: these are the themes of complicit computing.

4. Conclusion

Were we to follow through with these investigations and design a fully augmented marketplace then it would no doubt have a different character to the Barras. Substantial resources are rarely injected into such environments without turning them into entertainments or themed shopping malls. But thinking about augmented marketplaces provides insights into intelligent environments in general. Our studies confirm the importance of all the senses, and their availability for stimulation through augmentation technologies. We suggest that sound, the voice, and repetition, are important spatial determinants, open to digital augmentation and manipulation. What would it be like to inhabit spaces where the movement of people and processes is under the control of carefully modulated and responsive sounds? Mobile sound masking is one important area of opportunity. Our experimentation with RCX robotics provides an environment populated with mobile sensors that manipulate screens. The process will soon be abetted by sound sensing and generation. But the environment could also be configured sonically. Not only can robots be controlled by sound, but, as attested by various digital installations [33], they can be complicit in creating sonic environments for human habitation and pleasure. There is scope for applications of obsequious mobile sensor technologies that deploy and modify sound in the environment. We have posited complicity as the operative metaphor, a theme that runs through many digital projects, ranging across the digital marketplace, digital activism, complex adaptive systems, multi-agent systems, architecture and robotics.

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