ACTIONS, ARTEFACTS AND COGNITION: AN ETHNOGRAPHY OF COOKING

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Abstract: This paper details a number of observations from an ethnographic study of ten people preparing a meal in their own kitchens. The focus of the study was on how people cope with the cognitive demands of a familiar task such as cooking.

The observations of the study are grouped under three headings. One section describes a few ways in which some of the participants handled timing constraints, as well as some perhaps surprising observations of clock use. The next section recounts some ways in which the spatial layout of objects was used to encode information (cf. Kirsh, 1995), and also some examples of preparation and maintenance of the work space, that arguably benefit cognition. The final section concerns how the working environment and tools are both adapted and adopted. One segment of data shows how the use of an already present artefact can be extended, other data points to cognitively beneficial structures that are generated almost as a by-product of the repeated performance of cooking.

INTRODUCTION

In the last ten years or so, a number of etnographically inspired studies have ably demonstrated the deep contextual nature of cognition. Studies of grocery shopping (Lave, 1988), ship navigation (Hutchins, 1995a), the piloting of aircraft (Hutchins, 1995b; Hutchins & Klausen, 1996), commercial trawling (Hazlehurst, 1994), the use of office technology (Suchman, 1987), and dairy workers assembling product orders (Scribner, 1986), all show various ways in which cognition can lean on the physical and social surroundings.

It has been shown, for instance, that people can make use of the world to remember things (Hutchins, 1995b; Beach, 1988; Norman, 1988), to simplify choice, perception and internal computation (Kirsh, 1995b; Clark, 1997), and to transform tasks to make them less cognitively taxing (Hutchins, 1990, 1995a; Norman, 1991; de Léon, 2002).

Cognition as it is portrayed in this body of work is heavily reliant on, or even partially constituted by, external artefacts and social interactions. Whether the external world is viewed more as scaffolding for individual cognition (see e.g. Salomon, 1993), or as a near equal partner in a distributed cognitive process (e.g. Hutchins, 1995a), all would agree that the material and social context must figure in a satisfying explanation of human activity.

The fieldwork cited in the first paragraph (with the exception of Lave, 1988) has been conducted in settings were groups of people work together. One of the advantages of studying people in groups is that the communication between individual members are observable. Since much of human work and activity occurs in groups this choice of focus is also natural.

Another common characteristic of the domains above is that they involve work of a mathematical or computational nature. Lave's grocery shoppers (1988) compute best buys, Hutchins' navigators collaborate in computing their ship's position, Scribner's dairy-workers assemble and total the sum of orders. These kinds of tasks are ideal for study as they are usually more tractable than such tasks as the production of goods (say, weaving or pottery).

Many of the tasks commonly studied also involve external representations, like maps, diagrams, texts and computer displays. Work centred around external representations is a central part of much of human activity and, again, provide the methodological advantage of more observable phenomena.

For these combined reasons little work has been conducted on single individuals engaged in productive tool-use. Keller and Keller's work on artisan blacksmiths (Keller & Keller, 1993, 1996) is an exception that deals with both single actors and tool use. The main cognitive factors that their work focuses on are the roles of imagery, and how knowledge is used in the preparation for, as well as the engagement in, productive tool-use.

Kirsh's paper (1995b), on the intelligent use of space, also focuses on single users and on the manipulation of objects. The paper contains several interesting ways in which the spatial arrangements of objects can be used to simplify choice, perception and internal computation.

THE STUDY

Inspired by the examples given in Kirsh's paper, I conducted an ethnographic study of ten people cooking. One objective was to collect further examples of actions, strategies and artefact use, that contribute to making a task more "cognitively congenial" (Kirsh, 1996), and perhaps to validate previous findings (such as those in Kirsh, 1995). I was also interested in observing how people cope and co-ordinate with the various demands placed on them whilst cooking.

A related aim was to try to catch something of the processes by which tools are adapted by people in ways that ease the burdens of task performance (cognitive and otherwise). Cooking takes place in a highly structured environment and involves a number of tools and implements. Since it is a recurring activity and many of the constituent parts of cooking are often repeated, the kitchen promised to be a good place to find special solutions tailored to problems and tasks that are frequently encountered.

METHOD

The participants recruited for the study were all people who volunteered to take part and were not compensated for doing so. During recruitment the participants were informed that I wanted to study them in order to better understand how they worked when they cooked in their kitchens.

Ten people took part: five men and five women. With the exception of one participant (a man in his mid fifties) all were around thirty years of age (see table 1 for the exact ages of the participants and for a summary of other personal characteristics). The sessions all took place in the participants' own kitchens. They all cooked alone, with the exception of two sessions in which the participants' children where present.

The participants were asked ahead of time to cook something that they would ordinarily cook on the day on which I visited them (though some clearly made slightly more elaborate efforts than usual). In half the sessions the meal prepared was a lunch time meal, the other sessions were all dinners.

Each session was video filmed with a small hand held video camera at medium range and lasted for about an hour; the duration of the sessions was dictated by the time it took for each subject to prepare the meal. The participants were asked to think-aloud as they cooked and I would also occasionally ask for clarifications. All but one of the participants spoke Swedish (one spoke Danish) and all transcripts have been translated into English (by the author). Back translations, for the purpose of validating the translations, have not been conducted.

After the sessions the participants were interviewed about their cooking histories. All were prompted to talk about how they began to cook and about when and how the implements in their kitchens were acquired. The interviews were not filmed. Instead written notes were taken. The format of the interviews was informal and different kinds of ground were sometimes covered with different participants.

In the post-cooking session I asked to be given a quick tour through the cupboards and drawers of the kitchen. The tour was also video taped. On a couple of occasions brief pencil sketches of the layout of the kitchen were made to help me later when reviewing the tapes.

In one case, which contained an extremely rich material on the build-up of supportive structures, a number of supplementary interviews were made after the initial session, and additional digital still pictures taken (see de Léon, 2003).

The rest of the paper presents a collection of observations taken from the data. These have been loosely grouped into three main themes. The first one concerns some ways in which time can be handled in a session of cooking, specifically how people cope with misalignments in timing. This is followed by a collection of strategies that all utilise the visible grouping of objects (or the removal of visible distractors) for their effect. Included here are strategies that make use of spatial placement (and orientation) of objects to encode task relevant information. The third and final section of the paper deals with some different ways in which the physical structures in a kitchen change over time, as well as how people can expand the uses of artefacts that do not change.

TIME AND TIMING

A number of observed behaviours can be collected under the rubric of time and timing. Time is important in almost any activity and cooking is no exception – this is no doubt confirmed by the reader's own experiences in the kitchen. Not only do various parts of a task *take* time, but different parts often have to be

co-ordinated with each other (for instance, the timing of one part may be dependent on that of other parts). In addition, there are sometimes deadlines set by factors that are extraneous to the activity itself, as in the case of a meal that has to be ready by the time guests arrive or a particular TV show begins.

One way to meet these various demands on time and timing is to plan the activity in some detail before it takes place. Though people surely do plan at least some of their activities (or parts thereof), other kinds of strategies also seem to be at work. Next I will recount an episode which shows how an activity can be set up so as to allow room for improvisation, thus obviating the need for detailed planning. This section will be followed by one in which some ways of coping with misalignments in timing are outlined.

Preparing to Improvise

One of the participants, Belinda, had chosen to cook a stew that she hadn't prepared before, but had eaten at friends. She began her session by cutting up pork and some spicy sausages. She reasoned as follows:

Belinda [Cutting up some thin sausages into small segments]

I'll wait with the rest of the ingredients and fry these up first. I think I can just put the rest in the stew, not much cutting to do

Moments later she added the following:

Belinda I'm doing this

[Moves to stand by the stove]

before, because I think the rest can cook whilst the rice is going

What Belinda did was to reason that most of the necessary preparations could be done whilst the rice cooked. There were some parts of the meal, however, that she felt were more time consuming, and so she did these first (i.e. cutting up some sausages and pork and frying them). With these preparations out of the way she felt confident that she would be able to improvise through the rest of the session (or, at least, that she would have time to handle any eventualities that might arise).

Benny too made a decision much like this one, comparing the time that would be required to prepare some rice with that required to prepare a chicken:

Benny It doesn't take very long to prepare the rice so we'll do the chicken first

Clearly Belinda and Benny are both engaging in a form of planning, in the broadest sense of the word: both assess certain future actions to be taken and decide on an order in which to perform them. However, the 'plans' created are very general and specify broad aspects of the activity, and not the fine details. By identifying more time consuming processes of their activities, and engaging in these early on, Belinda and Benny increase the likelihood that improvisation will be a viable strategy.

Strategies That Compensate for Imperfect Timing

Just because a person chooses to improvise doesn't mean that the constraints inherent in an activity disappear. Even if an activity has been planned down to the smallest details there will still be situations in which a particular task is completed either too early or too late.

When cooking at home there is usually no need to be maximally efficient (though cooking for a large dinner party may be a different matter), imperfect temporal alignment of various activities are tolerated and adjusted to. Nevertheless, there are tasks for which timing does matter or end results will suffer. In John's session, potatoes that had been set to boil were ready too soon, well before the rest of the meal. Allowing the potatoes to continue boiling would result in potatoes that end up too soft. Taking them out of the pot early would allow them too cool. Instead John utilises a simple compensatory strategy:

John [Looks about, then reaches for an oven potholder. Lifts the lid off the pot containing the potatoes and pokes the potatoes with a fork]

The potatoes are soon done here. I think. I think they are

[Puts the lid back on the pot]

What you then do is to turn off that hot plate

[turns off the hot plate]

It's not quite done yet the potatoes, but almost. It can stand there until they're ready

The potatoes are almost ready, but are not in phase with the rest of the meal. By taking them off early and leaving them in the hot water the process of cooking is slowed down to allow the rest of the meal to "catch

up.“ John need not pay them any further attention until the end of the session. Taking them off a little early reduces the risk that they will be over-cooked. Belinda does something similar partway into her session:

Belinda [Is standing by the stove, then moves to the work bench]

And I'll do some foil over the meat

[Opens a drawer and takes out some aluminium foil]

should have done that before

[Pulls off a sheet, returns the packet of foil to the drawer, then moves back to the stove and covers the meat dish with the foil]

Author Because

Belinda So they don't loose too much heat and they can lie here and cook a bit more kind of slowly kind of

This general strategy (or strategies) of preparing something in advance, or preparing something partway, is so pervasive that it is often factored in at the beginning (i.e. planned for).[1]

In the examples above a preparation is completed too early and has to wait for the rest of the activity to "catch up," as it were. Another possible strategy is to try to catch up with event that are about to pass one by. An example follows taken from Robert's session:

Robert [Sprays some oil into the bottom of the pan. Picks up the small ceramic bowl with spices and tips them into the pan. Places the bowl back on the cutting board. Picks up a wooden spoon lying next to the stove, drops it, and picks up one lying next to it. He stirs the spices into the oil and sprays more oil into the pan. He returns to stand by the cutting board and moves the empty bowl out of the way. (The spices can be heard crackling loudly in the simmering oil.) Working quickly he splits the onion in two with a kitchen knife and puts the knife to the side. He picks up a cleaver and continues to chop the onion-half, first one way, then the other, and finally the bit remaining at the tips of his fingers. The bits of the chopped onion are scraped to the top edge of the board]

They can't be allowed to burn that is why I'm hurrying a little

[Robert cuts the second half of the onion. First one way, then the other, and then chops the last piece]

I'm getting a little stressed, I see it is smoking from here

[Robert takes the cutting board and holds it over the pan, scraping the bits of onion off the board and into the pan. He stirs onion and oil with a wooden spoon]

In this example the problem was that one activity (the chopping of an onion) was not completed in time (before the oil began to simmer). Robert's solution was to speed up that activity. Some other possibilities might have been to take the oil off the hot stove, until theonion was ready, or to settle for the quantity of onion that had already been chopped at that point. These are other possible solutions and we can't know for sure why he chose as he did. We can note, however, that the action actually chosen was one that allowed the activity to retain a certain flow and momentum.

A combination of the two main strategies outlined above seems to be at work in an episode in Marcus' session. Marcus too is boiling potatoes and decides, as the potatoes are almost done cooking, that he needs the hot plate they are standing on for something else. Apparently one of the stove's other hot plates works less well and Marcus wanted to move a pot of peas to the efficiently functioning plate the potatoes were on:

Marcus [Lifts the pot with potatoes off the stove and places them on the work bench. He puts the pot of peas on the hot plate the potatoes were standing on]

Shall we try them just in case

[Takes the lid off the potatoes and prods four of the potatoes with the cake tester]

Yes they are soft, they can stand there and keep warm

Moving the potatoes to the side and making room for the pot of peas is a means of catching up: of reducing the delay in the preparation of the peas. But the potatoes are ready and Marcus lets them stand in the hot water of the pot to keep warm, just as John did. Since

[1]The microwave oven might be mentioned here, not as a fast and convenient way of heating food, but as a device that allows one to compensate for misalignments in timing when cooking.

the potatoes are already done, a downside to this strategy is that the potatoes may end up slightly overcooked. John, who utilised a similar strategy, took the potatoes off the stove a little before they were completely done.

CLOCK TIME

Above were some strategies that compensate for imperfect timing. Let me underline that strict timing is only important some of the time: for much of cooking there is a great deal of flexibility as to how and when things are done, and the goals of cooking may even, on occasion, be renegotiated.

But more precise timing can be a desirable thing, which is part of the reason why clocks and egg timers are such prevalent artefacts in kitchens. It is therefore interesting to note that in the ten sessions recorded neither timers, clocks nor watches were extensively used. Six of the participants made use of them (Belinda, Elisabeth, Lisa, Marcus, Henry and Benny), three did not, and one case is uncertain due to a break in the taping of the session. In those cases where a timer, clock or watch (and in one case, a mobile telephone) was in fact used it was sometimes employed otherwise than expected.

For a task like cooking rice or boiling potatoes we might expect a watch or clock to be consulted and an end time calculated. We might, furthermore, expect the person to periodically consult his or her watch until the calculated end time drew near. However, two of the sessions (Belinda's and Marcus') contain episodes in which clocks were studiously consulted to begin with, but nevertheless failed to figure in determining the end points of the tasks engaged in.

I will begin by giving you a number of consecutive segments from Belinda's session. In this case (and the next) I have included the starting time for each segment:

00:00 [Standing by the stove she pours a carton of cream into the pot]

Whilst that's simmering we'll start the rice as well

02:20 [Stirs the pot]

We'll start the rice

[Bends down, pulls out a drawer, takes out a pot and a lid]

04:50 [Pours water from the tap into a one litre measuring cup]

Six decilitres of water but I put in some extra

[Holds the cup near eye level and looks at the scale. Walks over to the stove. Tips the water into the pot were the rice has been frying for a while in oil]

08:35 [Walks over and grabs the kitchen roll. Glances towards the rice as she walks back to the work bench. Starts pulling paper off the roll and holds her arm up to look at her wrist watch]

I want to have some idea of the rice. It's a quarter to

[Starts to wipe down the cutting board with the kitchen paper held in her hand]

about another quarter of an hour

13:58 [Takes the lid off the rice, puts it back on]

It's coming along just right

16:35 [She is standing by the stove. A possible glance over at the rice]

20:30 [Standing by the stove, glances over at the rice. Picks up an oven potholder. Lifts up the lid and looks inside. Puts the lid back on]

23:30 [Starts walking towards the stove]

So now I have to check the rice which I think is about to

[Hesitates, turns around, looks down at a drawer, opens it and takes out a fork. Walks over to the stove. Picks up the oven potholder and takes the lid off the pot in which the rice is cooking. Accidentally drops the fork, picks it up again. Tastes some of the rice, puts the lid back on the pot. Takes the lid off again]

Mmmm

[Tilts the pot, looks inside, puts the pot down. Places the lid on the stove. Picks up a one litre measuring cup. Starts walking to the sink]

Too much

[Fills the measuring cup at the tap. Returns to the stove and pours some water on the rice. Replaces the lid]

30:40 [Screws the cap back on the bottle of olive oil held in her hands. Reaches over to the stove and turns the burner off]

I'm turning off the rice now, I think it's done

The above is a fair length of transcript, all to make the following rather simple observation. Belinda consults her watch and works out when the rice ought to be ready, but then proceeds to check the rice three times, at roughly five minute intervals, until she decides that it is ready, all without consulting her watch ever again. So why did she look at her watch and calculate an end time to begin with? I'll return to this question shortly after having first related a similar (and similarly lengthy) sequence of segments off Marcus' tape, an episode in which he is boiling potatoes:

00:00 [Looks at the clock]

Twelve past twelve, usually needs about twenty five minutes

08:12 Hasn't quite started to boil properly

[Turns the knob. Checks on the potatoes. Looks over at the wall clock]

It's twenty past. Needs at least another twenty minutes

10:32 Now they're coming along nicely

[Turns down the heat]

12:37 [Lifts the lid of the pot of potatoes]

Potatoes are cooking good

19:02 [Takes the lid off the pot and puts it on the stove whilst looking at the potatoes]

Try them a bit

[Opens a drawer, locates a cake tester, brings it out and skewers one of the potatoes: lifts it up then lets it slide off the cake tester. Prods two more in the same manner and puts the cake tester down]

Probably need, six seven minutes something will be right

[Puts the lid back on the pot, but leaving a small gap]

23:08 I think I'll check on the potatoes again

[Takes the lid off with his left hand, picks up the cake tester with the right hand and prods four potatoes]

It's actually getting there

[Puts the lid back and puts the cake tester down on the bench]

a minute or two until I turn off the hot plate

24:06 [Touches the pot containing the potatoes and adjusts its position on the hot plate]

24:25 [Takes the lid off the potatoes and looks at the boiling water. Puts the lid back. Turns the heat down]

27:20 I'm checking the peas

[Takes the lid off the pot of peas]

It's not very good this hot plate so it takes a long time to bring the water to a boil

[Puts the lid back on]

What I usually do then is to swap with the potatoes since they're done now

[Lifts the potatoes off the stove and places them on the sink. Puts the pot of peas on the hot plate the potatoes were standing on earlier]

Shall we test them just to be sure

[Takes the lid off the potatoes, picks up the cake tester and prods four of the potatoes]

Yes they are soft they can stand there and keep warm

In the first segment Marcus looks at his wall clock and establishes the starting time for his potatoes. He also reasons about how long the potatoes will need to cook. About eight minutes later he checks on the potatoes and discovers that they haven't started to boil, he then looks at the clock again and decides on a

new end time. This is the last time that he looks at the clock. Much like Belinda, he then proceeds to check on the progress of his potatoes at fairly regular intervals.

I find these two sequences interesting in their own right, but will indulge the reader and proffer some speculations about what might be going on. One possible interpretation of their behaviours is that they initially set out to use the clock, to help them determine when the rice and potatoes were going to be ready, but then forgot to do so or were side-tracked. Though possible, I find little to support this interpretation (though note that warrants for *any* interpretation are hard to establish). Neither of them mentions their failure to keep track of clock time, which might be expected (and was also commented on by both Henry and Annabel when this was the case for them). Both also embark on close and regular monitoring of the rice and potatoes almost immediately.

Perhaps looking at the clock and reasoning about the end time, as both did, served some other function than marking the time at which rice and potatoes would be ready? Looking at a watch or clock may be a way of taking stock, of reflecting on what one has just been doing, and on what might be done during the interval specified. By thinking about the activity in terms of time, one shifts to a more abstract perspective that might allow other kinds of reasoning than a more episodic conception of the activity would. Thinking about boiling rice or potatoes as something that takes a fixed number of minutes is a succinct way of representing that activity and of reasoning about what might be done in that time slot. In addition, by looking at the clock it is also possible to further abstract the activity and to reason about time spatially. Various tasks can then become spatial segments of the clock face that can be superimposed, combined and rearranged on the face of the clock (see Hutchins, 2002, on conceptual anchors).

Perhaps the instances of clock use recounted above are carried over from other cases of clock use in the same setting. When cooking pasta or eggs precise timing may be more appropriate, and even necessary, than when one is boiling potatoes. Looking at the clock may simply be a habit, something which seems reasonable to do, and which incurs little cost, but which then plays no real part in shaping the activity.

The suggestions above are speculative, but do suggest that ethnographic study of the *actual* use of clocks, watches and timers might be productive. The suggestions given here are all possible hypothesis that could be investigated.

VISIBILITY

A number of observations have been collected under the rubric of "visibility ", as they hinge, in some way or other, on the construction of visible groups of objects (or the removal of visible distractors).

SPATIAL CODING OF INFORMATION

Kirsh's seminal paper from 1995 describes, among other things, some ways in which people use space to encode various aspects of a task (also see Beach, 1988; Scribner, 1986). The placement of objects can, for example, encode a person's location in a task, as well as what action to take next. Several of the examples given in that paper (Kirsh, 1995) are taken from a similar study of cooking. Some of the same behaviours can be foundin my own data. The next two examples, for instance, show how space can be used to encode category membership. The first of these shows spatial location being used to keep track of which knives have been sharpened and which are still to be done. In the second example both location and orientation of mushrooms are used to distinguish rinsed mushrooms from unrinsed ones:

Robert [In front of Robert is a work bench and a cutting board. On the right hand side lie three kitchen knifes and a potato peeler. A cotton place mat is also lying on top of the knives. To the right side of the board is a whetstone. Robert picks up the place mat and tosses it aside and then moves a can of beer out of the way. He picks up the whetstone with his right hand and transfers it to his left. The right hand then picks up the rightmost knife. He sharpens the knife and then places it to the right of the cutting board. He picks up the next knife, sharpens it and places this one to the right of the knife already put aside. He picks up the last knife, sharpens it and places it to the right of the board and to the left of the previous two knifes. He then picks up the potato peeler and moves as if to sharpen it, then puts it down to the left of the cutting board. The whetstone is put away in a drawer near the work bench.][2]

Marcus [There are eight large mushrooms in a loose pile on the cutting board. He picks up the rightmost mushroom and rinses it under the tap. The mushroom is returned to the board and placed upside down at the same time as the next

[2]At the same time as he is sharpening the three knives Robert is also conversing with his wife. The conversation has been omitted for reasons of clarity.

one is picked up. The second mushroom is rinsed and replaced upside down next to the first, just as the third one is being picked up. This one is rinsed and replaced upside down. The procedure is repeated with a fourth mushroom. As the fourth isbeing returned to the cutting board the other hand picks up the fifth and sixth mushrooms together and then rinses them. They are replaced upside down simultaneously as the seventh and eight are picked up together in one hand, rinsed and then replaced upside down]

That Marcus works two-handedly contributes to the efficiency with which the task is carried out, but also helps to ensure that rinsed mushrooms are kept separate from unrinsed ones. The two handed action, the fact that Marcus picks mushrooms from the right side of the board and works his way leftwards, and that rinsed mushrooms are replaced on the board upside down all provide cues to their rinsed or unrinsed state. Another reason for placing them upside down is that this also makes it easier when they are later cut into quarters.

Here it is difficult to separate out the cognitive motivation for some action, or actions, from other requirements of the task. It is unlikely, however that actions are (as perhaps implied by the distinction in Kirsh and Maglio, 1994) either "pragmatic" (i.e. done to bring an agent closer to some end state) or "epistemic" (i.e. done for cognitive reasons). Actions may serve both of these functions simultaneously.

In the episodes recounted, spatial grouping obviate the need for the participants to remember which knife has been sharpened, or which mushrooms have been rinsed. This information about the objects is instead given by their spatial location and, in the case of the mushrooms, also their orientation. Another example in which spatial location indicates identity is found in Benny's kitchen:

Benny [Backs away from the sink where he's working]

Salt

[Turns and looks down at the cook book]

maybe /inaudible/ how much salt there should be

[Reads the recipe. Returns to the sink and picks up a small metal tin, removes the lid. Puts the lid back and then replaces the tin. Picks up an identical metal tin next to it]

I have the same tins

[Takes the lid off the tin]

That isn't so smart, especially if you have sea salt since that looks like sugar

[Displays the contents of the tin]

Author How do you know what's what then

Benny I have the sugar there

[Points to the table behind him. Laughs. Pours some salt into a mortar]

It took me quite a while before I thought of it

Author Having them in different places

Benny They will get mixed up otherwise too. But otherwise it's simple to see the difference between salt and sugar but sea salt gets so, the same lustre kind of

Keeping salt and sugar separate would seem to be a relatively simple problem. And of course it is. However, it is not the only problem facing Benny when he cooks, but one of many things he must keep track of. Add to this the potentially quite unpleasant consequence of mistaking salt for sugar and it is clear that this kind of spatial coding serves him well.

Another participant, Henry, kept his spices in a number of small clear plastic bags inside a cupboard. There weren't many of these bags to keep track of, but during the tour of Henry's kitchen I asked him how he could tell the spices apart:

Author How do you know which spices are which. Do you recognise them

Henry Often … I will recognise

[Lifts a bag to eye level]

I can see this one is thyme for example

[Puts the bag back inside the cupboard]

But then there is a problem if I have to decide between saffron and curry, then you have to taste

Author And you do

Henry Yes and if I'm lucky it's saffron

Author [laughs]

Clearly, even a few spice jars (or bags) are enough to keep track of. It is therefore perhaps no great surprise that the enormous collection of spice jars found in Robert's kitchen is so extensively structured (see de Léon, 2003).

PREPARING AND MAINTAINING THE WORK SPACE

The strategies delineated above work best if there are no distractors present, no superfluous objects competing for attention. Clearing stuff away at the beginning of the session (as Amanda, Annabel and Benny all did), or during breaks in the flow of the activity (as did Annabel, Benny and Lisa) improves the cognitive congeniality of the work space. As Benny told me:

Benny I always try to keep it clean. You know, free surfaces in some way so you know what you're doing

And as Amanda put it:

Amanda I can't do this if there are too many things /out/

As well as removing possible distractors, clearing away clutter may also be performed in an effort to be tidy, to keep the workspace clean, or simply to provide space to work in. Perhaps it is this mixture of factors – cognitive and pragmatic – that motivates Annabel:

Annabel I like to wash up kind of bit by bit, I find it difficult when everything is out

Author Difficult how

Annabel Here it's mostly that there is no work surface, I don't know, there is something, it's sort of cluttered and difficult

Preparing and maintaining the workspace by removing distractors and ensuring that all visible objects are relevant to the task at hand is one way of simplifying the cognitive work of cooking. Another strategy employed by some of the participants was to start their sessions by bringing out all the ingredients they would be using. As Marcus explained:

Marcus Then I usually bring out most of what I'll be using, so I kinda have an idea, this gives me a certain overview of what order I'm going to do things

If we take Marcus at his word, then it seems as if the physical presence of the ingredients to be used assist him in preparing or planning for the task facing him. And surely, with the ingredients visibly present he doesn't need to remember what they are and they can prompt his memory as he reviews the coming task.

That the mere presence of the ingredients play some such role for Marcus is supported by the following occurrence in which Marcus is confronted with some extra vegetables that were brought out by mistake at the beginning of his session. These vegetables had been purchased at the same time as the other ingredients for the meal, but were not part of the meal being prepared:

Marcus [Looks down at the cook book and reads]

Eh

[Looks up at the two peppers and the leek placed in front of the book, then back at the book again]

These weren't for this recipe, but for another one

[He picks up the two peppers and the leek and goes to the fridge and puts them inside]

that we also bought stuff for when we were shopping

If Marcus was not relying on the purposeful presence of the ingredients about him, then why should he be momentarily thrown by the presence of an additional leek and some peppers? To deem them irrelevant he had to consult the recipe.

Bringing stuff out before it is to be used is a strategy that can also be combined with some of the spatial strategies discussed in a previous section. The following is an example from Amanda's session in which the ingredients for a spaghetti sauce that she is making are grouped on one of her cutting boards before being put to use:

Amanda [Picks up the plastic cutting board resting on top of the wooden one and puts it into the sink. Walks past the sink to the cupboard. Takes out a bottle of ketchup and a bottle of wine. She holds these objects under an arm and opens the refrigerator, which is placed inside a cupboard) and takes out a tube of tomato purée. She closes the cupboard door, walks back to the wooden cutting board and places the three items on it. Walks to a hanging cupboard, opens it, moves a packet of

crisp bread aside. Takes out a small packet of stock.]

Meat stock

[Tips out a cube from the packet. Puts the small cardboard packet back in the cupboard and closes the door. Walks with the cube of stock to the wooden cutting board and opens the wrapper against the surface of the board. Opens a drawer under the work surface. Takes out a garlic press and closes the drawer. Picks up a clove of garlic and puts it into the press, then places the press on the board]

Bringing out all ingredients (as well as tools and other items) at the beginning of the session is a way of delegating some aspects of remembering to the world, but it is also simultaneously a way of ensuring, before the task is fully underway, that everything that will be needed will be available. Like Marcus, Benny too starts by bringing out the items that he'll be using:

Benny [Places cook book by window]

It's a small kitchen so you have to arrange things quite a bit to

[Goes to fetch the bag of groceries standing by the door to the kitchen. Places bag on kitchen table]

I'm otherwise relatively structured when I cook

[Takes two packets of risotto rice and places them on the table]

Author Is that because the kitchen is small

Benny Yes, no, I also think it's because I think… I usually take everything out that I'll be using

Benny then continues to remove items from the bag, naming each one as it is put down. And at the end he notices that something is missing:

Benny I actually forgot the rosemary

So, preparing the work space in this way – clearing away superfluous items and bringing out everything that will be used – allows objects and implements to serve as reminders of things to be done. Furthermore, they can also be arranged in the kinds of ways described in the previous section. Provided that things are also cleared away during the course of cooking, the absence of ingredients will assist the judgement that the task is complete.

Development of Supportive Structures and Strategies

An assumption underlying the present study was that the physical environment and available materials are often intimately involved in the processes of cognition. A number of ways in which tools and strategies can support the cognitive work of cooking have already been presented, as well as some other features of action and activity, but the question of how materials come to have the shape and use that they do, and how strategies are acquired, has so far been left unaddressed. This is the topic of the present section of the paper.

Sometimes new structures are made or introduced into the kitchen, sometimes old ones are modified, sometimes structures change through use, and sometimes it is a change in the way in which something is employed that permits it to shoulder some of the cognitive burden of cooking. Though the introduction of new structures, or modification of ones already present, is often outside the time frame of a single session of cooking, there were some clear instances that will be related below.

Lets begin with an episode in which an already present structure was co-opted by the participant and transformed into a cognitive resource.

Appropriating Already Present Structures

In the example to be given bellow one of the participants, called Lisa, found a new way of using one of her kitchen implements. Having settled on this new use for the object, and having even established its appropriateness, the artefact in question will simplify certain tasks for her in the future. The example is thus given as a case in which a material resource is appropriated, in a way that allows it to improve the cognitive congeniality of a certain type of task.

When I visited Lisa she had decided to bake a cake to top off the meal she was about to make. At one point in making the cake the recipe specified a certain quantity of coconut flakes. The quantity was given in grams in the recipe, but Lisa's kitchen was without either scales or conversion tables. What she did have was an old glass measuring cup marked down the side with scales for the weight equivalencies of rice, sugar and porridge oats, in addition to markings for metric volume. The cup is a material resource that enables weight to volume conversion to be carried out, for a

number of common ingredients, using some rather simple physical manipulations.[3] In the example given below Lisa uses the cup to solve an immediate problem facing her, but in so doing expands her future use of this particular material resource:

Lisa Coconut flakes

[Looks at the bag in her hand. Turns her head towards her son, who is sitting on her hip, and speaks to him in a falsetto voice]

120 grams

[Looks at the work bench]

the scissors

[Lifts a kitchen towel lying on the bench]

where are the scissors

[Looks around]

there

[Picks the scissors up and cuts off the corner of the packet of coconut flakes. Picks up the measuring cup, looks at it whilst turning it. Continues to look at it. Glances at the packet in her hand. Puts the measuring cup down, glancing at it as she does so. She takes some coconut flakes from the bag and gives her son to taste. Picks up the measuring cup. Looks at it and turns it in her hand]

Then we have the next problem. Can't measure coconut flakes

[Puts the measuring cup down on the bench]

So

[Holds up the bag. Looks down at the measuring cup]

We'll say that they weigh, weigh like porridge oats maybe

[Turns the bag in her hand]

Yes that'll do

[Bends down and pours coconut flakes from the bag into the measuring cup]

they weigh like porridge oats

[Moves to put the bag down, but then lifts it up to eye level. Turns it over in her hand]

200 grams. We should be using half the bag

[Pours a few more coconut flakes into the cup and then empties the cup into a pan. She then pours out more flakes and empties the cup again]

It is clear, both from what Lisa says, and from her uncertainty in how to proceed, that Lisa has no predetermined strategy for dealing with the problem at hand. There is an artefact available that is clearly made for the job (or, at least, for jobs like it), but it doesn't quite fit her needs. What Lisa does first is to make a judgement regarding the similarity of the density of coconut flakes and the available alternatives. Having done so she then checks the soundness of her decision, of equating the density of oat and coconut-flakes, by using the material resources at hand. The bag is printed with the weight equivalence of almost twice the quantity of coconut flakes specified by the recipe and by seeing that the bag was half empty Lisa was able to conclude that she had achieved an acceptable approximation using the cup.

Of course, had it occurred her, she could have employed this particular strategy – of using half the bag's contents – to begin with, without having to bring the measuring cup into play. But having established the approximate equivalence of porridge oats and coconut flakes, as she did, she not only solved the immediate problem, but also expanded her future use of this particular material resource.

Supportive Structures Generated Through Use

In the above example the artefact in question was already present in the working environment and remained unchanged throughout the encounter. The key transformation, in this case, was in Lisa's understanding and use of the measuring cup. Next, I would like to give some examples in which it is the world that changes (in ways that, arguably, improve the cognitive congeniality of the environment), but where no concomitant conceptual change is supposed or required.

The chief organisational mechanism I wish to bring to the fore is one in which the repeated performance of an activity shapes the surrounding environment in ways that later supports more of the same activity (cf. Barker, 1968). As examples, think of the footpath kept clear through use, or the discolorations caused by tools and implements hanging on the walls of a workshop that facilitate their correct replacement.

[3] A neat feature of the cup is that volume to weight conversion is carried out simultaneously and instantaneously with the act of measuring out a desired quantity.

In the present study it is not wear and tear, as such, that generates supportive structure, but rather the spatial redistribution of artefacts and other objects as they are handled in various ways. Take the following example from the very beginning of Henry's session:

Henry [The door to the fridge is open]

Author Let me see your fridge

Henry Okay [laughs]

Author Do you have a special, system

Henry In my fridge? Hmmm, everything that is old and gross is at the back

Author [Laughs]

Henry The further out you go the newer it is

Author Is that so

Henry It is. It's not so long ago that I had a fridge…

[Picks up a plastic bag from the bottom shelf with some cheese inside]

here is an example of, we can throw it away right away

[Henry turns to the sink, opens the door under the sink and throws the cheese in the trash]

The conversation quoted above is light and humorous, and it is quite possible that Henry is partly joking. For one, there is obviously more order to the items stored in his fridge than he himself allows. One of the shelves on the inside of the fridge door, for instance, houses a row of standard sized milk containers and three glass bottles of ketchup, the shelf above it holds some smaller glass bottles, and the topmost shelf inside the fridge contains items that are visibly taller than the other items in the fridge. So contrary to Henry's claim, there is some order, order that is imposed by the size of items and the various spaces that are available. The remaining contents of the fridge, however, do seem to lack any readily apprehensible order. At the end of the session Henry confirms the account he gave above:

Henry [Opens the fridge door]

So it's a lot like I said… yes… Hmmmm

[He reaches into the fridge and touches a plastic bag of potatoes on the middle shelf]

that one I wouldn't want to swear on how old it is for example

[Touches a packet of bacon, then a bag of potatoes on the bottom shelf]

old potatoes and

Author So the old stuff is at the back, or

Henry [Takes out a small plastic box containing cherry tomatoes, turns it at an angle, looks at it, puts it back]

since I push it in after awhile

[Makes a few pushing gesture with the flat of his left hand]

In addition to the order imposed by the sizes and shapes of various food items, as well as the different storage spaces of the fridge, items are also arrayed roughly in accordance with when they were purchased and/or last used. Provided that Henry knows when something was bought, or last used, this emergent order will help him in locating sought for items. The acts of placing, removing and replacing food in the refrigerator thus result in an unintended order that supports the process of locating specific items.

The shelves of Henry's cupboards were also organised according to frequency of use (as were Benny's and Belinda's): items that were most often used were, according to him, placed low in the high hanging cupboards of his kitchen, and thus more easily accessible. Though the data doesn't reveal how his cupboards came to have the organisation that they do, sorting through use is a possible mechanism.[4]

Another emergent form of sorting can be found in several of the participants' use of their plate racks. Implements that are routinely required are likely to have been recently used and cleaned. The plate rack is therefore a probable place to find commonly used items, such as measuring cups and knives. Four of the participants in the study (Lisa, Annabel, Amanda and Robert) made frequent trips to the plate rack to fetch objects that were then used during preparation and cooking of their meals (Henry's and Belinda's kitchens lacked plate racks, whilst Benny, Elisabeth, John and Marcus didn't use theirs in the sessions filmed). Amanda had this to say about her use of the rack:

Amanda Those things that I use every day like cereal bowls for example and, the cup or the glass you drink juice from in the

4 The cupboards and drawers of Belinda's kitchen were similarly organised, with frequently accessed items stored at the bottom of high hanging cupboards (and at the top of lower storage space), and common items in drawers stored towards the front, and less frequently used items towards the back. In Belinda's case, she and her husband purposefully arranged their kitchen in this way when they first moved in. However, the organisational scheme was, they told me, a carry over from their previous kitchen and the question remains how that scheme originated.

morning, everything, it's there so you don't have to, like the cutlery, the things you use most all stand there

The plate rack is also conveniently placed in most kitchens. The processes of using and cleaning kitchen implements, therefore, sorts out, and makes readily available the most frequently used implements, making them easy to find and use.

Taking items from the rack also conserves effort. As items are taken down, less items remain to be put away when the rack is emptied; the rack is cleared partly as a by-product of the activity of cooking. Some items may never be put away, but lead an existence either in use or drying on the rack. This was the case, for instance, with the less expensive of Amanda's kitchen knives.

Amanda They work and they are always standing there, in the plate rack. Doesn't matter if you dry them or not (which was apparently an issue with her more expensive knives)

Another advantage of the plate rack is that its contents, unlike those of the items still in drawers and kitchen cupboards, are visible and easily identifiable. Visibility is many times a desirable property as it can often replace the need to recall the location of some object (cf. Norman, 1988). Elisabeth, for instance, bought a magnetic strip to hang her kitchen knives on:

Elisabeth They (i.e. the knives) come in one of those blocks. Actually it's better to have them like this because then you can actually see what kind of knife it is

The strip was fixed to the wall and carried five evenly spaced knives and a knife grinder. Placed in the wooden block that they came in, only the handles were visible. As the handles all looked pretty much the same, with only minimal variations in shape and size, they were hard to tell apart without actually withdrawing a knife from the block.

Most of the other participants stored their knives in a drawer, except for Amanda (who kept her cheap knives on the dish rack), and the two participants who had their children present during the session (John and Lisa), who kept theirs in pots on their work benches. As both John and Lisa explained:

John [Turns to the pot on the work bench containing knives and other implements]

Since we have kids

[Grabs a knife with two fingers and jiggles it in the pot]

all sharp things are here. So that's thought through, it should be here. Stuff that's dangerous for the kids

Lisa [Gestures to the pot on her work bench]

I have all the dangerous stuff here, away from my son

Regardless of what might be optimal, from a cognitive perspective, other considerations will sometimes take precedence over how things are stored. In the two cases above the issue of safety governed storage of certain items. Below is another kind of example, taken from Amanda's session:

Amanda [Takes a wooden pepper mill from the shelf above her stove and gives it a couple of twists over the sauce]

And salt

[Walks over to a cupboard. Opens cupboard and takes out a fairly large plastic brand name salt cellar]

It's so ugly it has to be kept here

Rather than letting an unattractive plastic saltcellar ruin an otherwise pastoral shelf placed above her stove (which contained other condiments), Amanda had relegated the saltcellar to the inside of a cupboard. For her, as for most of us, aesthetic preferences are sometimes more important than matters of usability. The kitchen is also a place with it's own aesthetic, something that several people showed a sensitivity to. Henry, for example, had a ceramic jar next to the stove with mostly wooden implements, as well as a plastic and steel potato masher. When I asked him about it he told me:

Henry All the things of wood

[Picks up a potato masher]

This shouldn't really be here, for aesthetic reasons. It's really meant for wood things because they look nice

[Touches a wooden spoon with the tips of two fingers]

but next to the microwave and my filthy stove it doesn't look so good anyway, so I don't care

[Replaces the potatoes masher]

For the same reason I like to hide things back here

[Wags a finger by the side of the microwave oven near the wall]

CONCLUSION

The observations presented in this paper are a selection of all the things that I though myself see when I was filming the participants cooking, or when I analysed the video data collected. There were many things that did not make it into the present paper. Observations which I have omitted are ones where there were too many competing explanations for what I observed happening. Providing sufficient warrants for interpretations of data of this nature is hard. There will be interpretations that I have provided that the studious reader will find doubtful or unconvincing. For this reason I have tried to include as much transcript as necessary to make it possible for another person to reach a different conclusion to mine. In some cases the result is a long transcript and a minor point made. However, I prefer to sacrifice some style and give my reader a fair chance of reaching different conclusions. That being said, I hope that the reader will subscribe to at least some of my proffered interpretations.

This study has but skimmed the surface and I think there is much more that could be investigated. The present study has raised a number of issues that would be worthwhile to explore further. One such issue is the use of clocks in a session of cooking. I have suggested that clocks may be consulted and used for purposes other than the that of "taking time" and I also offered a number of alternative hypotheses that could be tested. An explorative study that focuses on time and clock use would be a suitable starting point.

Furthermore, since cooking is such a frequently recurring activity there is time and incentive for people to hit upon, learn or invent new tricks and techniques, and to change the organisation of their kitchens. The kitchen promises to be a good place tofind special solutions tailored to problems and tasks that are frequently encountered. In the present study I visited each participant and filmed them cooking only once. It would be interesting to revisit the same group of people to observe them cooking on several occasions, to observe them cooking familiar recipes as well as novel ones, and to see them cooking various kinds of meals.

Cooking is a rich domain: it takes place in a highly structured environment and involves a number of tools and implements; there are complexities of timing and co-ordination, but at the same time there is a great deal of flexibility in how constraints are handled. We may be tempted to think of cooking as a simple activity, but that is an illusion born of our familiarity and prolonged experience with cooking and food preparation: from having stood by the stove as children, watching our parents make pancakes, to whipping up soufflés and other marvels as adults.

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Name	Gender	Age	Occupation	Meal	Familiar w. preparations	Recipe used
Amanda	F	31	Book editor	Dinner for 4	Yes	Yes
Annabel	F	34	Librarian	Dinner for 6	Yes	Yes
Belinda	F	32	Lawyer	Dinner for 4	No	Yes
Benny	M	28	PhD Student	Dinner for 4	No	Yes
Elisabeth	F	25	Secretary	Dinner for 3	Yes	No
Henry	M	30	PhD student	Lunch for 2	Yes	Yes
John	M	35	School teacher	Lunch for 4	Yes	No
Lisa	F	33	PhD student	Lunch for 2	Yes	Yes, for dessert
Marcus	M	29	School teacher	Lunch for 3	Yes	Yes
Robert	M	55	Social worker	Lunch for 3	Yes	Yes

Table 1: A summary of the pseudonyms used, other personal characteristics of the participants, and the conditions for each session.