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Activity Scenario Modelling: an emerging method for examining human-artefact interaction

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Abstract: Everyday activities are jointly shaped by people and artefacts. This points to the need for tools that designers can use to examine the joint agency of people and artefacts. This paper reports progress in developing Activity Scenario Modelling (ASM), a design approach that can be used for such purpose. ASM combines techniques of video analysis, discourse analysis and social network analysis. The paper provides an overview of the theoretical foundations of ASM and illustrates it by modelling an activity scenario from an online tutorial on tea-making. The paper also describes a research agenda to apply ASM in design for sustainability efforts.

Keywords: design, agency; activity scenario modelling, sustainability.

1. Introduction

Everyday activities are jointly shaped by people and artefacts (Bennett, 2010). The ‘toasting’ of a slice of bread varies due to the way people set up the toaster, the toaster’s features, the amount of sugar and protein in the slice of bread, etc. (Jopson, 2015). Given the above, sustainability (in design) is currently considered a property of sociotechnical systems (Ceschin & Gaziulusoy, 2016). This points to a need for tools that designers can use to examine how sustainability arises from human-artefact interaction. Activity Scenario Modelling (ASM) is a method we have conceived for such purpose. ASM is a method in development. This paper reports both the achievements and the subsequent steps in the development of ASM.

The most important achievements in our research so far are two. The first one is the conceptual framework that we have formulated to examine the joint agency of people and artefacts. Such framework considers five types of roles that people and artefacts can play. These roles are articulatory, kinetic, sensory, regulatory and symbolic roles. Each of these roles accounts for a mode of interaction between people and artefacts (Norris, 2004). Namely,



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physical coupling, joint mobilisation, sensory exchange, co-regulation and world-viewing. In section 2, we describe in detail the aforementioned roles and modes of interaction and the process by which we defined them.

Our second achievement, is the method for modelling activity scenarios. This method combines techniques of video analysis (Korkut & Eren, 2019), discourse analysis (Phillips & Hardy, 2002) and social network analysis (Cherven, 2015). The combination of these techniques enables the assessment of interdependencies between the roles that people and artefacts play. To illustrate the method, in sections 3 and 4 we model and analyse an activity scenario (AS) from an online video tutorial on ‘how to make a cup of tea using a tea bag’. The video tutorial is available at: <https://tinyurl.com/yc5swwkx>.

In section 5, we describe the next steps in our research agenda. Through these steps, we seek to shore up ASM so that it can be used to design for sustainability. The term sustainability refers here to fostering ways of proceeding in which nature is cherish, not dominated (Bannon, 2016; Gaard, 1993; Haraway, 2016). In section 5, we explain how ASM could assist designers not only in identifying different expressions of human domination over nature, but also in challenging, reducing and/or suppressing such expressions.

2. Theoretical foundations of activity scenario modelling

People and artefacts can interact in various ways as everyday activities unfold. Because of this, everyday activities can be deemed as multimodal events (Norris, 2004). By tilting a kettle, people may set in motion the water contained in it. This manoeuvre involves not only the physical coupling, but also the joint mobilisation of the human body, the kettle and the water (Giard, 1998; Kröschlová, 2000).

A sensory exchange is also at place in the situation above. When pouring water, people may be somewhat aware of things like the weight of the kettle, the sound of the running water, etc. (Dickens, 2017; Rodaway, 2002). Sensory exchange can lead to adjustments in physical coupling and mobilisation (Krippendorff, 2005). For example, people can vary the pouring angle as the water outflows the kettle and the weight of the kettle decreases.

Adjustments are not given by human capacities only. Artefacts’ capacities can also regulate how an activity is carried out (Illies & Meijers, 2014; Latour, 1992, 2005). For instance, the rate at which people modify the pouring angle can vary given the size of the kettle, the shape of its spout, etc. In other words, everyday activities are co-regulated by people and artefacts.

Human and nonhuman capacities integrate in people's worldviews (Halliday & Matthiessen, 2013). Worldviews are composed by the assumptions, notions, beliefs, etc. that people rely on to make sense of everyday situations. Worldviews are expressed in everyday speech (Forlano et al., 2016). Consider the following phrase: “So, as the water is coming now to a rolling boil, we’ll turn the kettle off so again, it doesn’t over boil and lose all the oxygen...”. In this phrase, the speaker explains what is going on by referring to his capacity to turn off the kettle, the water’s capacity to boil, the kettle’s capacity to display its content, etc.

Physical coupling, joint mobilisation, sensory exchange, co-regulation and world-viewing are some of the modes of human-artefact interaction that can take place in everyday activities. Roles in this study were specified from this non-comprehensive list of interaction modes. The types of roles considered in this study are shown in Table 1. These types are articulatory, kinetic, sensory, regulatory and symbolic roles.

Table 1 Correspondence between interaction modes and role types.

Interaction mode	Role type
Physical coupling	Articulatory roles are performed by participants who come into physical contact.
Joint mobilisation	Kinetic roles are performed by participants that mobilise or are mobilised.
Sensory exchange	Sensory roles are performed by participants that interchange data of some kind.
Co-regulation	Regulatory roles are performed by participants whose capacities modulate the deployment of an activity.
World-viewing	Symbolic roles are performed by participants that are referred in people's accounts of everyday activities.

2.1 Principles for role clustering

In activity scenario modelling (ASM), roles connect via internal and external links (DeLanda, 2019). Internal links bring together the roles that a participant plays in an activity. In principle, all the roles performed by a participant should interconnect. This is because the roles that a participant play are all afforded by its design (Nelson & Stolterman, 2012). Clusters of roles produced by internal links can be considered depictions of participants' design. These depictions are referred here as internal clusters (ICs).

External links, on the other hand, connect roles performed by different participants. Clusters produced from external links are called external clusters (ECs). ECs are depictions of the processes that make up an activity (Kaptelinin & Nardi, 2006). In ECs, connections are established only among roles of the same type. This is because the clustering of each type of roles accounts for a specific mode of interaction between participants.

Activity scenarios (AS) result from the tie-in of ICs and ECs. These additions occur when a participant performs roles in more than one process. An example of this is illustrated in Figure 1. EC1 depicts the process of 'boiling water' and EC2 that of 'pouring boiling water'. IC1 depicts the design of a kettle. As Figure 1 shows, EC1 and EC2 bond via IC1 because the kettle plays a role in both processes. The kettle's roles in EC1 and EC2 (i.e. R3 and R8) constitute 'cutting points' (Prell, 2012). This is because without R3 and R8, EC1 and EC2 would remain disjointed.

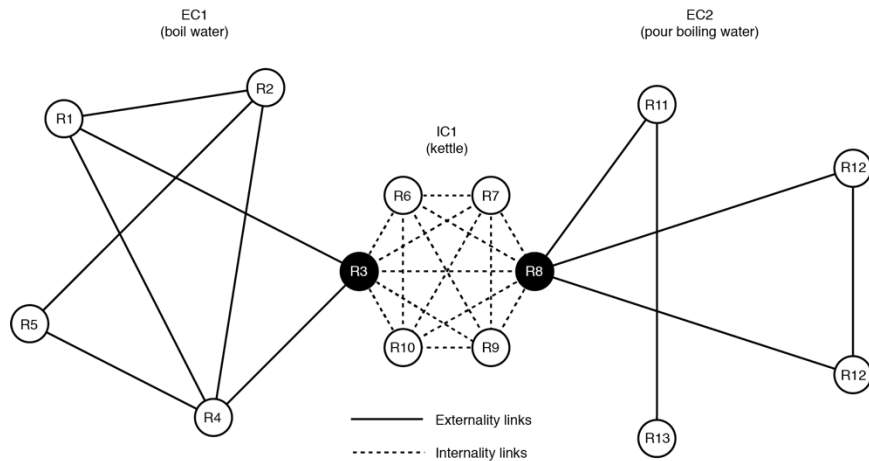


Figure 1. EC1 and EC2 respectively depict the processes of 'boil water' and 'pour boiling water'. EC1 and EC2 bond via IC1 because the kettle performs a role in both processes (R3 and R8 respectively).

In ASM cutting points are considered more central than roles that are not. Centrality in ASM is a measure of influence (Caldarelli & Catanzaro, 2012). As everyday activities unfold, some processes may affect how others are conducted. For instance, the strength of tea may influence people's decisions on how much sugar to add. In other words, the way tea is brewed can influence the way tea is sweetened. The above suggests that role-playing is interdependent (Juez, 2002). Role interdependencies are local when they occur within an ego-network (Prell, 2012). Ego-networks consist of a focal role ("ego") and the roles to whom ego directly connects.

Role interdependencies can also be remote. That is, a role can exhibit interdependencies with roles outside its ego-network. This is because roles that compose an ego-network have ego-networks on their own. In view of this, the effects of interdependencies can propagate among ego-networks. The links through which effects propagate are called here 'interdependence routes'. Given their position within an AS, a role can be part of a variable number of interdependence routes (Prell, 2012). The higher the number of routes to which a role belongs, the greater its potential to influence or be influenced by other roles and thus, the more central it is said to be (Bennett, 2010).

3. A method for modelling activity scenarios

In this section, we describe a method for modelling activity scenarios (AS). The method is called activity scenario modelling (ASM). ASM combines techniques of video analysis, discourse analysis and social network analysis. We illustrate the method by modelling an AS from an online video tutorial on 'how to make a cup of tea using a teabag'. The tutorial (available at <https://tinyurl.com/yc5swwx>) shows a person making a cup of tea with no sugar, milk or any other accompaniments added. The tutorial is part of a set of online videos that informed our initial explorations on how to represent and assess activity scenarios i.e.

networks of human and nonhuman roles. The steps that comprise ASM are described in the following subsections.



Figure 2. Screenshot of the video tutorial used to exemplify the modelling of activity scenarios.

We decided to work with video tutorials on tea-making for several reasons. Firstly, tea-making is a widely practised activity. Secondly, online video tutorials are public, easily accessible and are created by people with different backgrounds, levels of expertise, etc. (Quinton & Reynolds, 2018) Third, in video tutorials people tend to comment on their actions as they perform them. Therefore, video tutorials can provide insights not only on people's ways of proceeding, but also on the concerns, beliefs, etc. that guide their actions (Pink et al., 2015). Fourth, ASM is a method under development. Thus, before working with users, designers, etc., we wanted to develop a sound understanding of how data collection can be done ethically and efficiently. The steps that comprise the method are described in the following subsections.

3.1 Activity subdivision and participant allocation

Everyday activities can be decomposed into processes (Kaptelinin & Nardi, 2006). For instance, toasting a slice of bread can be partitioned in processes such as 'get the slice', 'brown the slice with heat', etc. Thus, the first step is to subdivide the tea-making method shown in the video tutorial. This can be based on a definition of process categories (Braun et al., 2019). The categories we work with are two. These categories are 'transportation processes' and 'transformation processes'.

Transportation processes are given by the circulation of commodities (e.g. water, sugar, etc.) in an activity. Two commodities whose circulation is observed in the video tutorial are tea

leaves and water. Correspondingly, two transportation processes were considered. These processes are tea leaves flow (p1) and water flow (p2).

Transformation processes are those that produce changes in the physical characteristics of commodities. Three transformation processes that can be observed in the video tutorial are boiling, brewing and mixing. In what follows, these processes are respectively referred as p3, p4, and p5.

The second step in ASM is to elucidate the participants of each process. This can be done one process at a time (Norris, 2004). This means that the tutorial is analysed repeatedly. Each time, designers can look at a specific process. Table 2 shows a non-comprehensive list of participants for p1...p5. Notice that some participants appear in more than one list. This is because they participate in more than one process. The cup for example, performs as container of both tea leaves and water. Additionally, the cup performs as a brewing and mixing vessel. Therefore, the cup is part of p1, p2, p4 and p5.

Table 2 Allocation of participants by process.

Process	Participants
p1 (tea leaves flow)	Human, cup, water, teabag wrap, teabag, saucer, tea leaves, spoon.
p2 (water flow)	Human, kettle, cup, water, teabag, saucer, tea leaves
p3 (boiling)	Human, kettle, water.
p4 (brewing)	Human, cup, water, teabag, saucer, tea leaves, spoon.
p5 (mixing)	Human, cup, water, teabag, saucer, tea leaves, spoon.

3.2 Role assessment

The next step is to examine participants' roles in each process. That is, assess what roles are participants performing in p1...p5. Participants can perform roles of the same type in more than one process. For instance, the tutorial's host performs articulatory roles in p1, p2, p3, p4 and p5. This is because he manipulates artefacts and/or commodities in all these processes.

Role assessment can also be done one process at a time (Norris, 2004). That is, a process is analysed repeatedly. Each time, designers can look at a specific type of role. Examination of articulatory and kinetic roles can be done visually. The reason for this is that physical coupling and joint movement are observable events.

When it comes to regulatory and sensory roles, visual assessment may not suffice. This is because data exchange and co-regulation can involve non-observable acts (e.g. perception, decision making, etc.) (Nevile, 2005). One way to deal with this is by deeming what people say about a process. To clarify, let's review a phrase from the tutorial: "So, as the water is coming now to a rolling boil, we'll turn the kettle off so again, it doesn't over boil and lose all the oxygen... (01:00)"

The phrase above is indicative of a sensory exchange between the human participant, the kettle and the water. Likewise, the phrase reveals the deployment of at least two human

capacities. Namely, ‘acknowledging when the water is boiling’ and ‘turning off the kettle’. The phrase also provides insights on the deployment of nonhuman capacities i.e. the kettle’s capacity to ‘display its content’, the water’s capacity to ‘boil’, the water’s capacity to ‘lose oxygen’, etc.

The importance of people’s discourse is even greater in the appraisal of symbolic roles. This is because the way people make sense of the ongoing situation may not always be explicit. That is, making sense of what is going on can be a partially or exclusively cognitive act (Phillips & Hardy, 2002). Consequently, the inquiry of symbolic roles was grounded on systemic functional linguistic theory (SFL) (Halliday & Matthiessen, 2013).

SFL is a language theory that focuses on the functions of language (that is, what language does and how it does it), rather than on the structure of language. In this theoretical framework, for example, verb selection is considered a mechanism that produces certain coherent worldviews (Janks, 1997). We selected this approach because it admits inputs from the other modes of interaction we consider in this study.

Designers can use annotation tools to facilitate role assessment (Covarrubias & Martínez, 2012). Annotations tools can be composed in different ways (Gehl & Svarre, 2013). The annotation tool we use considers three elements. Namely, the examined process, the examined participant and the types of roles that the participant may play. Table 3 shows how these elements integrate in our annotation tool.

Table 3 Annotation tool showing the roles performed by participants of p3 (boiling).

p3 (boiling)	Participant	Articulatory	Kinetic	Sensory	Regulatory	Symbolic
	Human	X	X	X	X	X
	Kettle	X	X	X	X	X
	Water	X	X	X	X	X

As shown above, all participants of p3 (boiling) perform articulatory, kinetic, sensory, regulatory and symbolic roles. This, however, might not occur in other processes. Table 4 (below) shows the roles performed by participants of p5 (mixing). Notice that the human and the tea leaves are the only participants that perform the five types of roles in p5.

Table 4 Annotation tool showing the roles performed by participants of p5 (mixing).

p5 (mixing)	Participant	Articulatory	Kinetic	Sensory	Regulatory	Symbolic
	Human	X	X	X	X	X
	Cup	X		X	X	
	Water	X	X	X	X	
	Teabag	X	X	X	X	
	Saucer	X		X	X	
	Tea leaves	X	X	X	X	X

Spoon	X	X
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3.3 Laying out internal and external links

After completing role assessment, the next step is to draw internal and external links between roles. For this purpose, designers can create a role matrix. A role matrix is a list in which roles are grouped under categories (e.g. human roles, kettle roles, cup roles, etc.). In a role matrix, roles are given a numeric id. Roles can also be labelled to indicate their type and the process of which they are part of. Table 5 shows the ids and labels for the roles performed by the kettle.

Table 5 *Ids and labels for the roles performed by the kettle.*

Id	Label
R26	Kettle_articulatory_p2
R27	Kettle_kinetic_p2
R28	Kettle_sensory_p2
R29	Kettle_regulatory_p2
R30	Kettle_articulatory_p3
R31	Kettle_kinetic_p3
R32	Kettle_sensory_p3
R33	Kettle_regulatory_p3
R34	Kettle_symbolic_p3

Designers can specify the source and target of internal links using the role matrix (Cherven, 2015). As stated in section 2, all the roles that a participant performs in an activity should interconnect (Nelson & Stolterman, 2012). This means that an internal link will go from R26 to R27, another from R26 to R28, and so on. Once internal links that depart from R26 are established, designers can move on to look at those that depart from R27.

Notice that internal links are non-directional. Thus, when modelling the internal links that depart from R27, there is no need to draw one from R27 to R26. The reason for this is that the connection between R26 and R27 was established in advance. Namely, when the links departing from R26 were drawn. Figure 2 shows the kettle's internal links. These links constitute the kettle's internal cluster (IC). An IC is to be modelled for each human and nonhuman involved in an activity.

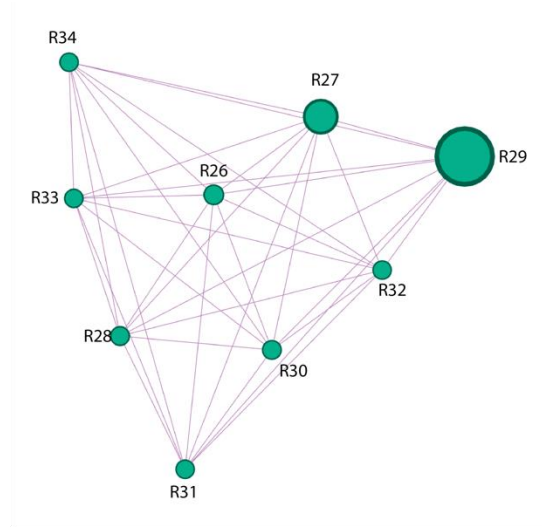


Figure 2. Kettle's internal cluster composed by internal links that connect the roles performed by the kettle.

Once ICs are modelled, designers can start modelling the external links of $p_1 \dots p_5$. This results in an external cluster (EC) for each process. To facilitate the identification of the source and target of external links, designers can define linkage criteria for each mode of interaction. In this paper, we draw external links between articulatory roles in a restrictive manner. That is, we draw external links considering “*who couples with who*”. The same is done for sensory roles i.e. external links are set based on “*who provides data to who*”.

In contrast, external links between kinetic roles are established in a non-restrictive manner. This means that all kinetic roles in a process connect to each other. The same is done for regulatory and symbolic roles. Notice that linkage criteria admit different levels of resolution. Namely, designers may draw external links considering specific body parts, artefacts or commodities. Likewise, designers can set external links to model specific forms of co-regulation (e.g. water consumption, preparation time, etc.) or world-viewing (gender, identity, power relations, etc.).

3.4 Centrality reckoning

Activity scenarios (AS) are comprised by roles that interconnect via internal and external links. Given their position within an AS, roles may exhibit different levels of centrality. As established in section 2, centrality is a measure of influence (Caldarelli & Catanzaro, 2012). The centrality of roles within an AS can be calculated using different algorithms. The algorithm we selected accounts for centrality in a variety of networks (Brandes, 2001). We selected this algorithm because the structure of AS may vary in view of people's preferences, availability of commodities and artefacts, the activity being modelled, etc. Thus, we prioritised an algorithm that would allow us to consistently measure centrality in AS of different characteristics.

The selected algorithm works as follows. First, the algorithm finds the shortest interdependence route between every pair of roles. Then, the algorithm quantifies how many of these routes pass through each role. The greater the number of interdependence routes that go through a role, the more central the role will be (Cherven, 2015). Figure 3 (below) shows the AS modelled from the video tutorial on tea-making. In what follows this activity scenario is referred as AS1. Role centrality in AS1 is indicated by the size of the roles. In other words, the greater the diameter of a role, the more central the role is.

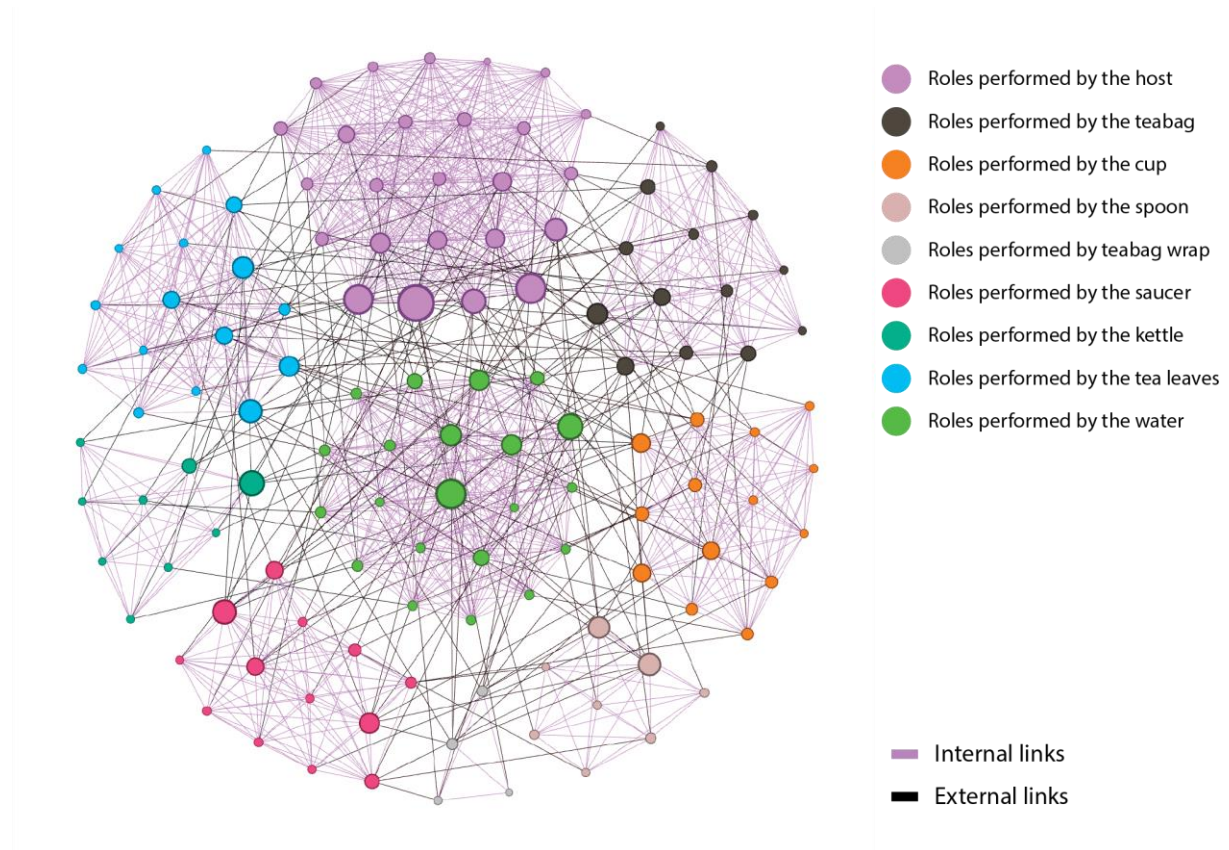


Figure 3. Activity scenario (AS1) modelled from the video tutorial.

4. Analysing activity scenarios

Once AS are modelled, the roles that composed them can be indexed based on their centrality. Insights provided by centrality analysis can be interpreted in different ways. One approach is to think of the most central roles as leverage points. That is, roles with high potential to influence the performance of an activity (Abson et al., 2017; Meadows & Wright, 2008).

To clarify, let's consider the following. R08 is the most central role in AS1. R08 accounts for the sensory role performed by the tutorial's host in p1 (i.e. tea leaves flow). As Figure 4 shows, R08's ego-network is comprised of internal and external links. Internal links (in pink) tie R08 to the rest of the roles performed by the tutorial's host.

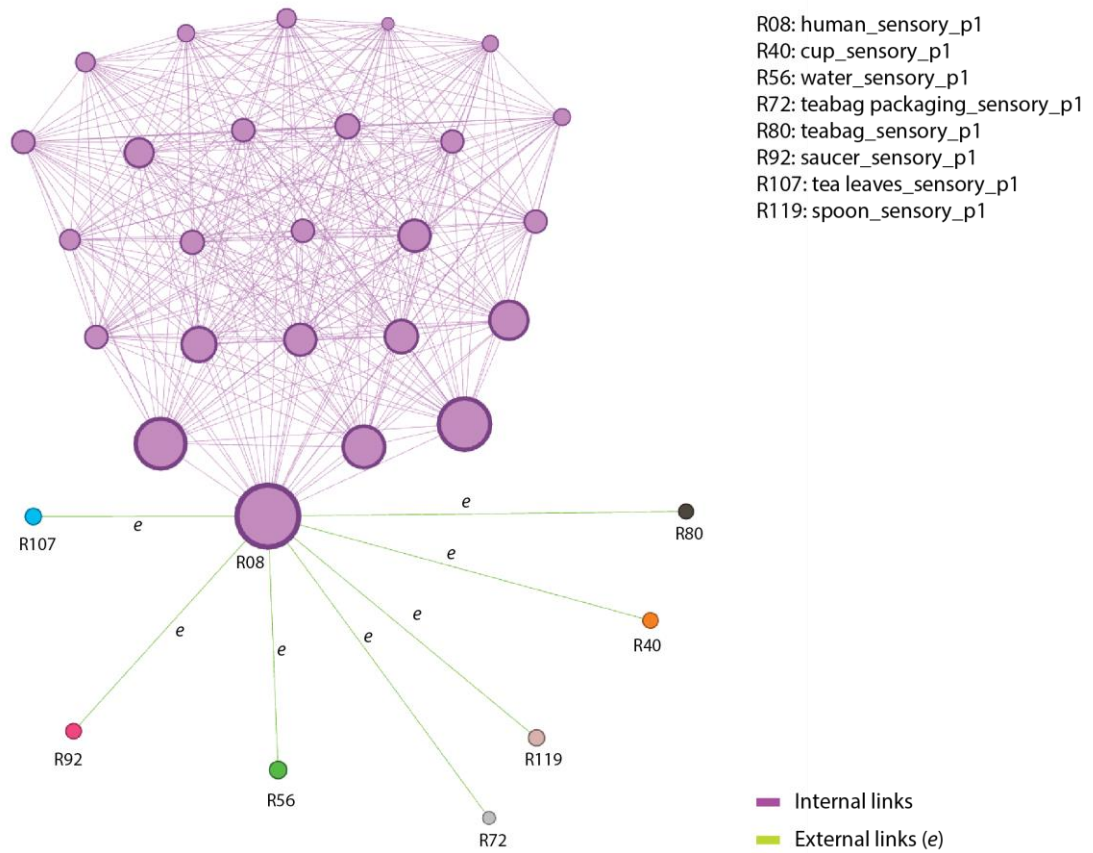


Figure 4. R08's ego-network.

External links (in green) on the other hand, connect R08 to other participants that perform sensory roles in p1. That is, external links account for sensory exchanges between participants of p1. In these exchanges, the tutorial's host is the only participant receiving data. Thus, the performance of R08 is estimated by the ways the tutorial's host senses and interprets data provided by other participants of p1.

Grasping sensory data is a learnt action. That is, the way people sense and interpret data is a by-product of personal history, social life, culture, etc. (Giard, 1998; Rodaway, 2002). Consider for instance how visual evaluation of tea strength can vary among individuals, generations, regions, etc. Acquired ways of grasping data can be referred as "*perception styles*" (Rodaway, 2002).

Designers can revisit the video tutorial to better understand the host's perception style. Succinctly, p1 starts with the host taking the teabag out of its wrap and concludes with the host placing the teabag in the saucer after removing it from the cup. As p1 takes place, the host is exposed to a variety of data (e.g. tactile, visual, etc.) (Dickens, 2017).

To cope with the above, designers can consider what the host says about p1 (Halliday & Matthiessen, 2013). Asides of unveiling nonobvious data that the host may be sensing; this can help designers elucidate the relative importance of different chunks of data, how the host interprets data, etc. To clarify, let's consider the following phrase.

"This is where people often go wrong with the teabag. They'll stand and dunk the teabag and as soon as the colour looks about right, they'll think it's ready to drink. Well, teabag tea is the same as any tea, it needs time for the full flavour to come out. So, we say that you must give it a minimum of three minutes to brew properly... (02:36)"

The phrase above suggests that the host's perception style is hierarchical. This means that, in the host's worldview, time tracking is more relevant than the visual assessment of colour. The host talks about the relevance of time at different moments. For example, at the beginning of the tutorial he comments: "Now, when people are using teabags they are often in a rush and they don't make the tea properly... (00:08)"

The above analysis is by no means comprehensive. Namely, the host's perception style may comprise more than time tracking and visual assessment. Another thing to consider is that perceptions styles vary among individuals. Since this paper examines the doing of one individual only, what we report here constitute insights, not overall findings. In other words, what we present here is not in-depth account of tea-making practices. Instead, through this paper we seek to provide directions on how to model and analyse activity scenarios.

5. A research agenda for activity scenario modelling

The research agenda we present here is aimed at enabling the use ASM to design for sustainability. The term sustainability refers here to fostering ways of proceeding in which nature is cherish, not dominated (Bannon, 2016; Gaard, 1993; Haraway, 2016). For this purpose, we have set both short-term and long-term activities. We have defined these activities taking into account the achievements and limitations of the work we have done so far. In regards to achievements, work with video tutorials has allowed us to identify five interdependent modes of human-artefact interaction. Namely, physical coupling, joint mobilisation, sensory exchange, co-regulation and world-viewing. The work with video tutorials has also enabled us to conceptualise and prototype a method to model and analyse the interdependencies between various modes of human-artefact interaction.

While online tutorials provided a suitable ground for our initial explorations, we acknowledge the limitations of this scheme of work. Online tutorials provide a good foundation to assess physical coupling and joint mobilisation. However, the access video tutorials provide to sensory exchange, co-regulation and world-viewing is limited. This is because, the non-observable acts (e.g. perception, decision making, etc.) associated with these modes of interaction are not always clear or made explicit by the hosts of the tutorials (Nevile, 2005). Another problematic aspect of working with video tutorials is resource variability (van der Bijl-Brouwer & van der Voort, 2014). That is, variations in the artefacts and ingredients that the hosts of the tutorials use. While these variations can facilitate the identification of a wide

range of opportunities for intervening tea making; they can also difficult the comparative analysis of people's performance.

Considering the above, short-term activities in our research agenda will focus on collecting data from primary sources. To do so, we will conduct one-to-one sessions with tea makers. In these sessions, people will be asked to make themselves a cup of tea (Kuijter et al., 2013). The utensils required for this task will be provided by us. With the latter, we expect to reduce resource variability to a manageable level (Mawhorter et al., 2014). As they proceed, participants will be asked to articulate what they are doing (Hanington & Martin, 2012). This approach will enable the documentation not only of participants' ways of proceeding, but also the ideas, motivations, beliefs, etc. that guide their actions. Tea making will be followed up by a short interview. One-to-one sessions will be documented via photographs, video/audio recordings and field notes. Data collected during one-to-one sessions will inform the modelling of activity scenarios (AS). We will model an activity scenario for each of these sessions. Subsequently, we will integrate individual activity scenarios into an 'overall AS'. The overall AS will account for the collective performance of our participants (van der Bijl-Brouwer & van der Voort, 2014). Besides of informing the next step in our research agenda, the overall AS will constitute the anchoring point between ASM and design for sustainability (DfS).

The next step in our research agenda consists on co-design sessions. These sessions will be directed towards making the performance of our participants more sustainable. Co-design sessions will be divided in two parts. During the first part, we will examine the symbolic interactions documented in the overall AS. Specifically, we will look at how the natural substances (e.g. water, tea leaves, etc.) are discursively constructed by our participants (Halliday & Matthiessen, 2013). We will pay special attention to discursive constructions that allude to a sense of domination over nature (Bannon, 2016; Gaard, 1993; Haraway, 2016). When such constructions are identified, we will examine how is that they relate to other modes of human-artefact interaction (i.e. physical coupling, joint mobilisation, sensory exchange and co-regulation). During the second part of the co-design sessions, participants will be divided in three groups. The first group will be asked to select and modify one or more of the artefacts that comprise the overall AS. These modifications can be directed at challenging, reducing and/or eradicating specific expressions of domination over nature. The second group will be asked to conceptualise design solutions that can be introduced into the overall AS to allow people to perform without a sense of domination over nature (Boehnert, 2018). The third group will be asked to identify changes in standards, regulations, policies, etc. that manufacturers and governments could implement to incentivize tea makers to proceed in a non-dominating way (DiSalvo, 2012; Fry, 2011).

The long-term research activities will focus on examining the cumulative effects of design solutions conceived to challenge, reduce and/or suppress domination over nature. For this purpose, a longitudinal study will be conducted. That is, the artefacts conceived in co-design sessions will be prototyped and included in subsequent one-to-one sessions. Design solutions will also be modelled and included into the overall AS. These steps will be undertaken

iteratively. Complementarily, we will explore connections between ASM and evolutionary computation. The cross over between ASM and evolutionary computation can be achieved in different ways. One alternative is to use ASM to inform the implementation of multi-agent systems (Epstein & Axtell, 1996; Kronefeld, 2004). That is, systems in which the properties of agents and the interaction between agents are defined in alignment with the outputs of one-to-one sessions and co-design sessions (Montes de Oca Munguia et al., 2009). A second alternative is to use the outputs of one-to-one sessions and co-design sessions to develop cultural algorithms (CA) (Kobti et al., 2004; Reynolds & Ali, 2007). Namely, populations of agents that exchange information, resources, etc. associated with the resolution of specific problems (e.g. making a cup of tea). With the above, we expect to develop a better understanding of the long-term changes (intended and unintended) that design solutions may bring about in everyday activities.

The research agenda we described above is aimed at bridging ASM and design for sustainability (DfS). We foresee that this connection can occur in four ways. First, ASM can assist the identification of expressions of human domination over nature that are embedded in everyday activities. Secondly, ASM can enable the reorganisation of everyday activities in ways that do not perpetuate domination over nature. Third, ASM may facilitate the elucidation and critical analysis of the long-term changes that design can bring about in the way people interact with artefacts and nature. Fourth, ASM can provide a framework to challenge standards, regulations, policies, etc. that regulate our interaction with artefacts and nature.

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