Representing Artefacts as Media:
Modelling the Relationship Between Designer Intent and Consumer Experience

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The design literature contains many diagrammatic models that represent the relationship between how designers intend artefacts to be experienced and how they are subsequently experienced by consumers, users and other stakeholders. Despite the prevalence of such models, they remain largely disconnected from each other, both within and across design disciplines, and also disconnected from the models of communication whose basic structure they share. The existing models are therefore difficult to locate and useful conceptual developments are often overlooked. The consequences of this are that unnecessary effort is expended in developing representations that duplicate those that already exist or new models are developed from inappropriate foundations. To address such issues, this article reviews many of the existing models that can be found in the different disciplines that comprise the fields of communication and design. The most pertinent features of these models are extracted and synthesised into a generic communication-based model of design. This acts as both a guide to what the existing models emphasise and an integrated foundation from which future models might be developed.

Keywords – Communication, Consumer Response, Design Intention, Interaction, Mass Media, Product Experience.

Relevance to Design Practice – The design process is constituted by negotiations between many disparate stakeholders, including designers, clients, manufacturers, and others involved in the processes of production and consumption. Diagrammatic models that represent artefacts as media can assist in these negotiations by rendering design more intelligible to non-designers, and by providing a common reference for discussion.

Introduction

Designed artefacts can be experienced in many different ways, including stimulation of the senses, the assignment of meaning and various forms of emotional response (Desmet & Hekkert, 2007; Schifferstein & Hekkert, 2008). Taking everyday products as an example, the chairs presented in Figure 1 can be appreciated for their perceptual properties (e.g. colour, shape, texture), attributed with certain qualities (e.g. comfortable, reliable, adaptable) and they can elicit different feelings (e.g. curiosity, satisfaction, irritation). This variety of interpretations is relevant not just to the physical products of industrial design, but also to the forms and spaces of architecture, the user interfaces of software applications, and the outputs of many other design activities. Designers shape these artefacts to exhibit certain features, and they can intend these features to elicit certain interpretations. As consumers (defined here to include users and other stakeholders[1]) encounter artefacts, their interpretations may correspond with those that were intended, but might also differ from those intentions in many varied ways. Interpretation cannot be reliably controlled because different people will construct different meanings depending on factors such as context, motivation and values.

An interest in the relationship between designers' intentions and consumers' interpretations has prompted many design theorists to view design as an instance of communication (see Crilly, Good, Matravers, & Clarkson, 2008). When adopting this perspective, authors across different design disciplines have developed diagrammatic representations that depict the artefact as a communicative medium.[2] Perhaps the best-known of these diagrams are Norman's (1986/1988, p. 16) depiction of the 'system image' mediating between the designer's conceptual model and the user's mental model, and Krippendorff and Butter's (1984) communication-based representation of product semantics. While such diagrams are broadly applicable across different design disciplines, there are also a number of more discipline-specific diagrams that appear in different branches of the design literature. For example, de Souza (1993; 2005, p. 88) represents how software interfaces connect programmers to their users; Shedroff (1999, p. 271) represents how producers influence their audience through the use of information design; and Coates (2003, p. 120) represents how physical products mediate between corporations and designers on the one hand, and consumers and the broader

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Figure 1. Furniture in a private London home (Julian Cowie Architects).
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public on the other. Despite their variety, these different diagrams all emphasise the physical, temporal or cultural distances that can

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separate designers from consumers. They thereby also emphasise that the designed artefact will be interpreted without access to the designer, and independently of the original intentions.

Diagrams of the kind discussed above can be regarded as 'models', because they assert an essential correspondence between some simplified representation and certain aspects of the modelled phenomenon. More formally, they employ "a structure of symbols and operating rules which is supposed to match a set of relevant points in an existing structure or process" (Deutsch, 1952, p. 357). This allows the model reader to interpret and act upon the representation rather than being forced to directly understand the full variety and complexity of the structures and processes of interest. It is this simplifying and selective nature of models that makes them useful and allows them to serve as both *organisational* devices that reveal previously unperceived relationships and *heuristic* devices that facilitate the generation of new ideas (Deutsch, 1952, pp. 360-361).[3] In this sense, communication-based models of design structure a wide variety of phenomena within a single view, and consequently promote the identification of processes that influence both the artefact and how that artefact is experienced. The utility of the models is therefore

evinced by their existence, since their authors have used them to conceptualise their subject and convey it to others. Of course, abstraction is inherent in any representation, and neither the full complexity of design nor communication can be depicted in any single model (Minai, 1984, pp. 109-110). There are consequently many aspects of design that the communication-based models do not represent, but it is still claimed that they provide a profoundly useful perspective for analysing the design and interpretation of artefacts, and that the implications of that perspective have not yet been fully explored (Draper, 1994, pp. 61, 66; Frascara, 1988, p. 29).

Although communication-based models of design appear in many branches of the design literature, they have typically been employed to illustrate very specific issues and their relationship to more general communication-based design models is not readily apparent. This is regrettable for two reasons. Firstly, many general communication-based design models are applicable to a variety of specific scenarios. Secondly, many details of the specific models are also applicable more generally. Such overlaps are not evident from the design literature however, because the models have remained largely disconnected from each other both within and across design disciplines, and there is often little evidence that later models are founded on those that precede them. Furthermore, although these representations of design take notions of communication as their basis, explicit reference to theories or models of communication is seldom made. Design theorists thus risk unnecessarily reproducing the work of their peers, and also overlooking the work of communication theorists who have already addressed similar issues. The consequences of this are two-fold. Firstly, useful conceptual developments are overlooked, and relevant features from existing models are absent from those that follow them. Secondly, well-known but misleading models are adopted and then either unhelpfully adhered to or else laboriously converted into some more useful form (often resembling pre-existing but undiscovered models from other fields). These difficulties in identifying and exploiting the most appropriate foundations compromise the ease with which the existing models can be interpreted, the efficiency with which new models are developed, and the quality of the models that result. Communicative perspectives on design therefore often fail to offer the conceptual clarity or explanatory power that the analogy would seem to promise.

Developing an Integrated Model

To address the problems discussed above, this article seeks to raise awareness of the variety of communication and design models that exist,[4] to identify the most useful features that they exhibit, and to synthesise those features into an appropriate foundation for viewing design as communication. In doing so, no attempt is made to privilege general models over specific ones, but simply to identify the issues that are applicable most generally (issues which are relevant to the general models and also to the specific ones). To explore these issues, we review a range of existing models drawn from the fields of communication and design. As described above, many of these models have been developed

independently of each other, separated by divisions between disciplines and sub-disciplines. Consequently, in their original forms they constitute an incoherent set, the variety of language and graphic styles obscuring their most pertinent similarities and differences. Discussion of the models' key features is therefore structured around the development of a simplified representation, which is then extended in various ways to produce an integrated communication-based model of design. This model is not necessarily intended to replace those that precede it, but to offer guidance to what those models offer. Our objective, therefore, is not to develop a representation that integrates all features of the existing models, but rather to achieve simplicity and transparency while striving to avoid the inclusion of misleading terms and features. To achieve this, we first turn our attention to the model's basic structure before exploring the various extensions that are possible.

Establishing the Basic Structure

In Shannon's (1948/1993) model of communication, an information source produces a message that is encoded into a signal and transmitted across a channel; a receiver decodes this signal and a message arrives at the destination. The use of terms such as 'transmitter' and 'receiver' betray Shannon's interest in the engineering of telegraph systems, a subject that he acknowledged had little to do with issues of interpretation (p. 5). However, this model, with its representation of 'communication as transmission', has strongly influenced communication theory generally (Beniger, 1990), and design theory specifically. In design theory, it has encouraged scholars to represent artefacts as the transmitter of a message that is subsequently decoded by consumers. Early examples of this appear in architectural theory, including Koenig's (1974, chap. 2) chapter-long description of buildings as *l'emittente del segnale,*[5] and Broadbent's (1973, p. 299; 1980, p. 209) explicit adaptation of Shannon's model. With respect to product design, Monö (1997, pp. 43-45) also cites Shannon, and develops a model in which the product is represented as the device by which designers transmit messages to users. This notion of 'products as transmitters' can also be seen in more specific design models that address issues of branding (Karjalainen, 2004, p. 53), response to form (Crilly, Moultrie, & Clarkson, 2004), computer aided design (Mengoni & Germani, 2006; Mengoni, Germani, & Mandorli, 2006) and perceived quality (Forslund, Dagman, & Söderberg, 2006). However, the influence of Shannon's model is evident not only in the work of those design scholars who adopt and adapt it, but also in those who refer to it obliquely. For example, without explicitly citing Shannon, Giard (1989, p. b3) links the design process to communication theory by stating that "the designer transmits a message to the user by using the product itself as the device of transmission" (also see Kawama, 1987, pp. 58-59; Kutschinski-Schuster, 1989, p. j5; Muller, 2001, p. 299; Mullet & Sano, 1995, p. 2).

Although Shannon's model is one of the most commonly cited representations of the communication process, its structure and language are often claimed to offer an inappropriate foundation for design thinking (see Crilly et al. 2008). In particular, the notion that artefacts act as transmitters has been strongly criticised

for casting consumers of the artefact in an overly passive role (e.g. Barnard, 2005; Frascara, 1997). Instead, consumers approach artefacts with their own motivations, experiences and expectations, and therefore artefacts will be interpreted in different ways by different people in different contexts. While designers might attempt to shape artefacts in a manner that promotes certain interpretations and prevents others (Crilly, Moultrie, & Clarkson, in press), the interpretation of artefacts can never be entirely controlled (Richardson, 1993). Consequently, we might shift our emphasis from the transmission of a signal to the production of an artefact, and from the reception of a signal to the interpretation of that artefact (e.g. see models by Maser, 1976, p. 42; Krippendorff & Butter, 1984, p. 6; Norman, 1988, p. 190; Coates, 2003, p. 120).

Using a mediated communication process for our basic structure, we here represent the foundations of the model that will be extended later (see Figure 2). The designer is depicted as holding some intentions for how the artefact should be interpreted, and these intentions lead to the definition of the artefact. That artefact (here represented as a cube) is shown situated between the designer and the consumer, and is the only means by which the designer exerts their influence (i.e. no other communication channels[6] are shown). The consumer then interprets the artefact in ways that may relate to the category to which it belongs, to its specific details and features, to the entire artefact, or to how that artefact relates to its surroundings. The designer's intentions shape the artefact and the artefact shapes interpretation, but interpretation still takes place independently of the original intentions.
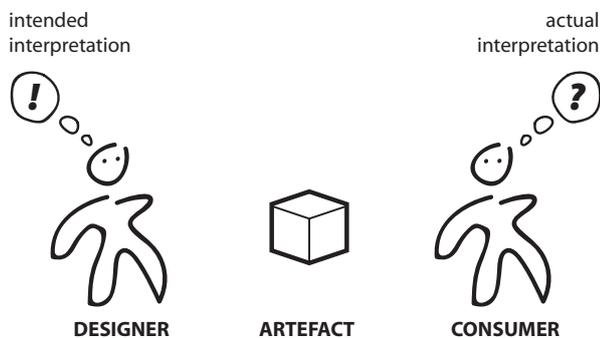

Figure 2. Basic structure of a communication-based model of design.

The basic model proposed here does not specify any particular relationship between the designer and the artefact, or between the artefact and the consumer. This is in contrast to many of the existing models that employ left-to-right arrows directed from the designer to the artefact and from the artefact to the consumer. Where used, these arrows can be thought of as implying either *temporal order* (intentions precede the artefact and the artefact exists prior to interpretation), *causation* (intentions influence the artefact and the artefact influences interpretation) or *reading direction* (the models are simply read from left to right). However, such arrows are often read as though meaning is being sent from the designer to the artefact and then from the artefact to the consumer. Such a reading suggests that meaning is actively transmitted by the product and passively received by the

consumer.[7] For this reason, we here omit any designer-artefact or artefact-consumer arrows, seeking to discourage readings where the artefact is seen to contain or emit meaning. Instead, by simply representing the artefact as something that the designer and consumer are oriented towards, a variety of different designer-artefact-consumer relationships can be explored.

Extending the Basic Structure

With some variation, the mediated communication process outlined above provides the basic structure that underlies many of the existing models of communication and design. However, as each of these models has been developed to emphasise different aspects of the specific discipline to which they apply, their basic structure has been extended in various ways. Many of these extensions are relevant across design disciplines, and, in particular, eight key features can be identified as useful inclusions in any communication-based model of design. These features represent the following issues:

1. *Context and characteristics*. The contexts that designers and consumers operate in and the characteristics that influence or define them.
2. *Reflective representation*. The iterative process by which intentions are formed as designers reflect on the representations they construct.
3. *Interactive interpretation*. The iterative process by which interpretations are formed as consumers interact with the artefacts they encounter.
4. *Artefact variation*. The discrepancies between the artefact as planned and the artefact as experienced.
5. *Mutual awareness*. The image that designers and consumers have of each other.
6. *Consumer engagement*. The processes by which designers engage with consumers, or by which consumers engage with designers.
7. *Collective production*. The role of the individuals or institutions that interact with the design team.
8. *Collective consumption*. The role of the individuals or institutions that interact with consumers.

In developing their models, different authors have represented these eight issues by employing diagrammatic features that are reasonably consistent between authors (see Figure 3). In the sections that follow, each issue (and its corresponding feature) is elaborated by drawing on those models and on some of the commentaries that surround them. Where possible, each section starts with reference to models from the communication literature before the work of design theorists is considered. The only exceptions to this are the sections on 'interactive interpretation' and 'artefact variation', where the communication models have little to offer, but the design models do. However, it should be noted, that with the exception of Waller's (1979; 1987) models, the opposite is true for issues of 'reflective representation' and 'mutual awareness'. Following discussion of each of the eight issues, the features that represent those issues are combined within a single communication-based model of design, the potential applications of which are discussed in the article's conclusion.

(0) Basic structure
Designer situated on the left, consumer on the right and the designed artefact (mediating) between them.

Communication models: Bloomfield (1935); Jacobson (1960); Newcomb (1966); Nystrand (1982).* **Design models:** Kawama (1987); Nadin (1988); Karjalainen (2004); Curran (2004).*

*Also see works cited below.

(1) Context and characteristics
Designer and consumer labelled with the various contexts they operate in and the characteristics that define them.

Communication models: Berlo (1960); Schramm (1961); Maletzke (1981), **Design models:** Krippendorff & Butter (1984); Swann (1991); Salles et al. (2001); Coates (2003); Crilly et al. (2004; in press).

(2) Reflective representation
Designer depicted as expressing their ideas in some representation and then receiving feedback from that representation.

Communication models: Schramm (1961); Maletzke (1981). **Design models:** Waller (1979).

(3) Interactive interpretation
Consumer depicted as acting on the artefact within an environment and receiving feedback which prompts futher action.

Design models: Krippendorff & Butter (1984); Krippendorff (1989); Norman (1988); de Souza (1993; 2005); Salles et al. (2001).

(4) Artefact variation
Artefact depicted as changing between its intended state and its realised state.

Design models: Monö (1997); Forslund, Dagman & Söderberg (2006).

(5) Mutual awareness
Designer and consumer each depicted as having an image of the other.

Communication models: Newcomb (1966); Maletzke (1981). **Design models:** Waller (1987).

(6) Consumer engagement
Designer depicted as the recipient of consumer information.

Communication models: Westley & MacLean (1966); Maletzke (1981). **Design models:** Krippendorff & Butter (1984); Swann (1991); Salles et al. (2001); Coates (2003); Crilly & Clarkson (2006).

(7) Collective production
Designer depicted as part of a team who collaborate in the definition and production of the artefact.

Communication models: Westley & MacLean (1966). **Design models:** Krippendorff & Butter (1984); Coates (2003).

(8) Collective consumption
Consumer depicted as belonging to the broader public, members of which interact thereby influencing each others' interpretation.

Communication models: Schramm (1961). **Design models:** Coates (2003).

Figure 3. Key issues represented by communication-based models of design along with the authors who represent those issues and the diagrammatic features that are typically employed.

Context and Characteristics

Berlo's (1960, p. 72) model of the 'ingredients' that comprise communication emphasises the influence of various personal factors. Specifically, Berlo identifies 'communication skills', 'attitudes', 'knowledge', 'social system' and 'culture' as important characteristics of the sender and receiver, or of the contexts within which they operate. Although Berlo mostly concentrates on verbal communication, he suggests that his ideas can be generalised to activities such as painting, drawing and gesturing (p. 42). The potential for making similar extensions to design is evident in models such as Krippendorff and Butter's (1984). Here, the factors that either define or influence the user are considered, including their 'cultural background', 'literacy of use', 'mental models of product' and 'conditions of use' (p. 6). More generally, Shedroff (1999, p. 271) emphasises 'personal', 'local' and 'global' contexts, while Maser (1976) extends such considerations to both the user and the designer, characterising each by their 'consciousness', 'values', 'feelings', 'experiences', 'insights' and 'sensibilities'. See row '(1)' of Figure 3.

Reflective Representation

In developing his sequence of communication models, Schramm (1961, p. 9) notes that communicators are themselves recipients of their own messages, decoding and interpreting their utterances and reforming them to better reflect their intentions. Consequently, Schramm represents message formation as an iterative process that precedes or coincides with delivering that message to the recipient.[8] This reflects how those involved in creative acts discover or re-discover their intentions during an exploratory creative process (Gombrich, 1968, pp. 301-302; Wollheim, 1968, p. 62). It may therefore be a mistake to construe intentions and their principal expression as two quite separate things if thoughts and acts are interdependent (Scruton, 1979, pp. 58, 273). With respect to design, Waller (1979, pp. 217, 220) considers a similar issue in depicting the link between intention and expression as bi-directional. In this way, Waller's diagram represents the view that designers engage in 'conversation' with design materials such as sketches, because intentions are formed and reformed during activities of representation (also see Goldschmidt, 1994; Lawson, 2004, pp. 46-49; Schön & Wiggins, 1992). See row '(2)' of Figure 3.

Interactive Interpretation

In de Souza's (1993) model of human-computer interaction, a distinction is made between two communicative roles of software products: they are messages sent from designers to users through the computational medium, but they are also "message senders and receivers at the immediate interface level" (p. 753).[9] Therefore, in addition to representing software systems as media, de Souza (2005, p. 88) represents users as interacting with those systems by providing them with 'input codes' and interpreting their 'output codes' (also see Norman, 1988, p. 190). In other words, the consumers' interpretation of the artefact leads to action, and this action causes the artefact to exhibit some change in state or configuration. This change is then perceived and interpreted to allow further action.[10] Such considerations clearly have relevance beyond software usage and Krippendorff and Butter's (1984) more general design model also represents users manipulating products and receiving feedback from those manipulations. However, they also situate the product within a 'context of use' (e.g. the immediate physical environment) and represent consumers as manipulating not just the product, but the context too and receiving feedback from both. See row '(3)' of Figure 3.

Artefact Variation

In Monö's (1997) communication-based model of design, the designers' intended message is disrupted at every stage of the process, including "flaws in construction and manufacture" (p. 45). This means that the very artefact that the consumer encounters may differ from that which the designer intended. Taking this further, but now specifically considering the perception of physical product quality, Forslund et al. (2006) emphasise the design's 'sensitivity' to variations in manufacturing tolerances and distinguish between the design, *as intended*, and the product, *as produced*. Even where artefacts are manufactured in accordance with designers' expectations, damage incurred during distribution or use may affect the artefacts' form and features. As such, the artefact that the consumer encounters may not be a faithful reflection of the original intent due to changes that occur either during or after manufacture. Where relevant, this artefact might be considered to include not only, for example, a physical device, but also its packaging, supporting documentation and any other associated services or materials (Mick, Burroughs, Hetzel, & Brannen, 2004; Nadin, 1988, p. 274). All of these may or may not have been adequately accounted for during the design process, or even if accounted for, might exist in forms that were not anticipated. See row '(4)' of Figure 3.

Mutual Awareness

In Maletzke's (1963/1981, p. 14) model of the mass media, those who construct and those who interpret messages are each depicted as holding an image of the other party. This may influence the intentions that are held, the messages that are constructed, the media selected and the interpretations that are formed. In this sense, Waller (1987, chap. 5) develops a model in which the writer produces a text for 'imagined readers' and readers read a text produced by some 'imagined writer' (also see Luhmann, 1984, p. 198; 1995, p. 143). With respect to design, this means that designers anticipate consumers, the contexts those consumers operate in and the ways in which they will respond to the artefact. Such anticipation informs the design process by directing attention towards the various relevant stakeholders and their orientation towards the goals, tasks and environments of interest, Similarly, as consumers respond to artefacts, they may become aware of their own place in the processes of production and consumption. This can involve inferring the intentions that lie behind artefacts if they recognise that those artefacts were intended to elicit certain responses. Whether such inferences correspond with the original intentions or not, they can reinforce or conflict with other responses and thereby influence interpretation (Gibbs, 1999; Crilly et al., 2008, pp. 440-442). See row '(5)' of Figure 3.

Consumer Engagement

Maletzke's model represents communicators as receiving feedback from their audience as that audience responds to both the message and the medium with which they are presented. This feedback informs the image that communicators have of their audience and the content of the messages that they prepare. With respect to design, similar concerns are relevant as designers must be aware of their audiences' experiences in order to communicate with them, and they may engage in research activities to find out more about them (Frascara, 1988, p. 20). Such research may be conducted before, during or after the design process as designers seek to gain insight into consumers' lifestyles, their relationship to different artefacts, and the nature of the contexts within which they operate (Kotro & Pantzar, 2002; Laurel, 2003). Krippendorff and Butter's (1984) model represents such considerations by depicting designers and their colleagues as recipients of information originating from the user, including 'sales figures', 'research findings' and the results of 'user experiments'. Expanding on this model, Crilly and Clarkson (2006) represent how information on consumers informs the design process, and how different sample groups, research methods and researchers may be employed for this purpose. Such activity permits a better assessment of how people experience artefacts, and is thus claimed to help designers better elicit the responses they intend (van Breemen, 1999; Suri, 2005, p. 171). See row '(6)' of Figure 3.

Collective Production

In Westley and MacLean's (1957/1966) model of the mass communication process, a 'gatekeeper' acts as an intermediary between the source of the message and its recipient.[11] For example, within the realm of the mass media, this intermediary could be a print journalist who mediates between a newspaper organisation and its readers. However, Westley and MacLean intended their model to be applicable beyond the realm of linguistic texts to include all artefacts to which people attach meanings (pp. 84-85). The use of a similar representation for design can thus be constructed, with those who commission or manage design communicating with the consumer via the designer (see Zeisel, 1984, p. 34).[12] This casts the designer in the role of an intermediary who seeks to fulfill some other party's needs by, for example, translating a client's brief into tangible form. In addition to the client, designers also interact with and are influenced by many other stakeholders in the production process, including marketers, researchers, manufacturers, distributors and retailers. This is reflected in Krippendorff and Butter's model, where the designer is joined by an 'engineer' and a 'salesman', indicating that different members of the producing organisation influence both the artefact and how that artefact is experienced (also see Coates, 2003, p. 120). See row '(7)' of Figure 3.

Collective Consumption

With a concern for how mass audiences interpret messages, Schramm (1961, p. 21) depicts many individual 'receivers', each responding to one of many identical messages. Each of these audience members is connected to a group whose other members may or may not have received the same message, but who nevertheless interact with each other. As they interact, they respond to each other and to each other's interpretations, and this prompts reinterpretation of the message. Similarly, but now with respect to design, Coates' (2003, p. 120) model represents consumers and users as constituents of a general public that includes, for example, the press. Consumers either interact with or respond to this public, so the interpretation of artefacts does not occur in isolation, but is instead a process that involves social interaction (Forlizzi, 2007). Consequently, the interpretation of artefacts may be considered as a process that is influenced by peer behaviour, and also by the actions of the artefact's advocates and critics. See row '(8)' of Figure 3.

Synthesis: Towards an Integrated Model

Having now considered the various issues that communication-based models of design represent, we here propose a model that seeks to integrate the necessary features within a single representation. For graphic clarity, this is done by depicting the communicative aspects of design from two different but related perspectives: firstly, from a perspective that views design as mass communication; and secondly, from a perspective that views design as interpersonal communication. These two perspectives are related to each other by an individual designer, artefact and consumer (shown in bold) that are common to both views (see Figure 4).

The upper part of the figure – representing a mass communication perspective – is divided into producers on the left and consumers on the right, with designed artefacts mediating between them. The producers are comprised of a collection of groups, with each group comprising a collection of individuals. For simplicity, only the design team, their client and the manufacturers are shown, but, depending on the particular design situation, other groups, such as engineers, retailers, marketers, trend agencies and branding consultants might also be involved in the definition and production of the artefact. Bi-directional arrows indicate the reciprocal interaction (collaboration) between these parties (the uni-directional arrows used elsewhere indicate communication that is not reciprocal). The artefact itself, again represented as a cube, may be produced in near-identical multitudes, with each instantiation being surrounded or supported by a variety of other materials. These materials might include promotional matter, packaging, instructions, services, upgrades and add-ons, all of which influence the interpretation of the artefact. Consumers either engage with the artefact in isolation, or within the various groups that they belong to. Each of these groups may interact with the others and influence their interpretations, even if only some of them perceive the artefact directly. Of particular note are groups such as the press, who may interpret the artefact and then respond in a way that influences the interpretations of a mass audience. Representatives of the various consumer groups may be the subject of investigations that are conducted by consumer researchers. These investigations are commissioned by the producers, or are conducted by them or in collaboration with them. Alternatively,

consumers may engage directly with producers by providing feedback on the artefact, issuing feature requests and proposing design improvements. Whatever form of consumer engagement is relevant, it can inform the design of the artefact by providing insights into consumers and the contexts they operate in.

The lower part of the figure – representing an interpersonal communication perspective – takes an individual designer, artefact and consumer from the illustration above it (those in bold) and elaborates how the artefact mediates between the intentions of the designer and the interpretations of the consumer.

The designer, like the consumer, is characterised by his or her experiences, beliefs, motivations, expectations, capabilities and culture. The designer also has some anticipation of the eventual consumer, including some intentions for how that consumer should respond to the product. This leads the designer to express his or her intentions in a representation of the artefact, and reflect on that representation to reform their intentions. Although the artefact is nominally produced in accordance with some such representation, the realised artefact may differ from that which was planned either because of intended or unintended design
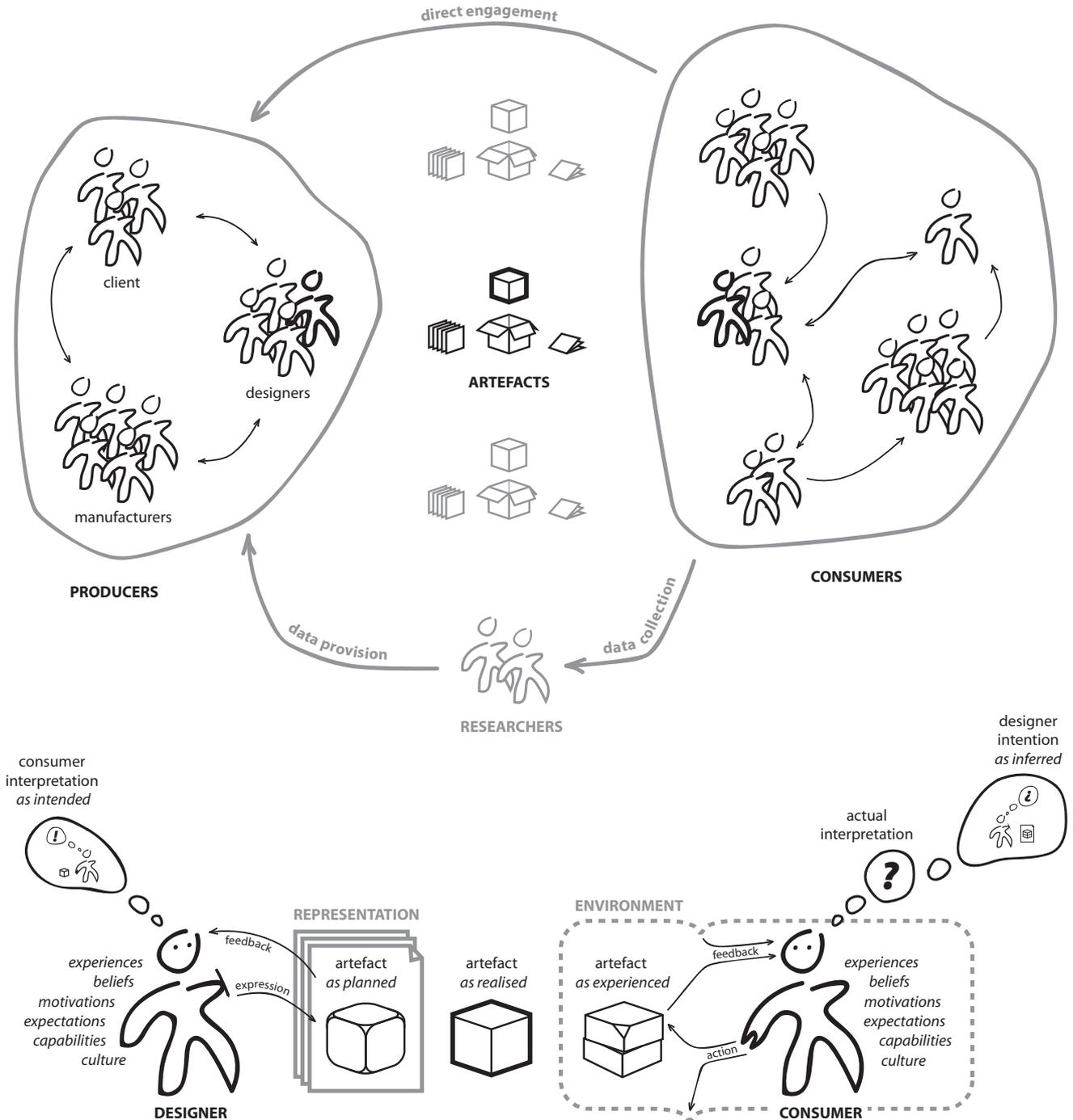

Figure 4. Integrated communication-based model of design.

changes during production. Furthermore, once situated within the consumer's environment, the artefact may differ from its initial manifestation due to the effects of distribution, storage, retail or use. The consumer is shown acting on both the artefact and their environment, both of which respond in a way that provides feedback to the senses. This in turn prompts further action, with the iterative process of acting, perceiving and reacting contributing to an evolving interpretation of the artefact. This interpretation may or may not correspond with those originally intended by the designers (here represented as not corresponding). In addition to direct interpretation, consumer response may involve some inference of what response was originally intended. However, this inference may or may not correspond with those actual intentions (again, here represented as not corresponding).

Like all representations, the model proposed here emphasises certain aspects of the situation and de-emphasises others. It particularly assumes some significant separation between designers and consumers, and that the eventual consumers have no direct access to the designers. The processes by which the designers' intentions are translated into artefacts are therefore only very loosely connected to the processes by which consumers interpret those artefacts. While this can be a useful perspective to adopt, one consequence is that the model under-represents the possibility of a shared perspective held by both designers and consumers ('designers are consumers too'), or a close cooperation between them. The model also fails to fully acknowledge the prior understanding that designers have of consumers, an understanding that is independent of that provided by consumer researchers, and it does not properly account for activities such as participatory or collaborative design. However, this separation between designers and consumers is emphasised here because this is typically the problem that is being addressed when communicative perspectives on design are adopted. Therefore, although the model is seemingly quite simple, we believe it provides a highly appropriate foundation for representing design generally and for developing more specific models. This is because it retains the most pertinent features of prior work yet avoids some of the problematic concepts that have been adopted in the past. For example, issues of mutual awareness, reflective representation and artefact variation are all depicted; notions of transmission, reception and signal noise are not. The designer and consumer are consequently represented as both being oriented towards the artefact, while the artefact itself is open to different interpretations.

Conclusions

Communication-based models of design have been employed for many years to support theoretical accounts of design and interpretation. However, these models also have potential applications in empirical, educational and industrial contexts. In empirical work, researchers investigating the use of products and services may use the models to frame their studies and to illustrate their findings. Detailed work may thus be positioned within the broader contexts of production and consumption, and the relationship with other work may be illustrated. In education, the instructive potential of diagrams may be useful in programmes where students are encouraged to anticipate and influence how the artefact will be interpreted. Issues such as branding, usability and aesthetics can all be considered within the framework that the models provide while opportunities for divergent interpretations can be explored. In industry, negotiations between designers and other stakeholders can be facilitated by using the models to render the processes of design and consumption intelligible to non-designers. By providing a common basis for discussion, the model can assist in defining the scope of a project and in defining the methods to be used in undertaking and evaluating it.

Considering collaboration between designers and other stakeholders raises the question of how the communication models discussed in this article might be used to represent communication in design more generally. Design can be viewed as an activity constituted by communications between different designers working on the same project, and between those designers and other stakeholders (Maier, Eckert, & Clarkson, 2005). Such communications typically involve the use of words and gestures, but also the use of drawings, physical products and other media.[13] This suggests a communication process in which designed artefacts are central. Hence, the models of communication considered here may be of use not just for representing how artefacts mediate between designers and consumers, but also for how artefacts (and other design materials) mediate between designers and their collaborators. The eight communication issues discussed above are relevant in these contexts too, and the representation of these issues may support discourses that focus on communication in, between and around design teams. With respect to model development, this would involve representing the many interactions indicated in the upper part of Figure 4 at the same level of detail used in the lower part of that figure. Such work might involve substantial adaptation and elaboration of what has been presented here, but adopting an approach that centres on artefacts rather than messages shows much promise.

Whether considering communications between designers and consumers, or considering the communications that constitute the design process, selecting or developing appropriate diagrammatic models can help us to think about and talk about the issues of interest. It is hoped that this article might support such work, either through the provision of an appropriate model, or through encouraging exploration of the existing models and the development of new ones. On initial inspection, the various models reviewed in this article and the new model that has been proposed may all appear to be distinguished from each other by only modest variations. However, for those seeking established models as a foundation to build on, efforts to select the most appropriate model are rewarding even where the distinctions between the available models are subtle. While it is important that the chosen foundational model provides adequate scope for expansion and adaptation, its usefulness is reduced if it is a poor fit or offers a misleading basis for studying design. Careful model selection can therefore minimise the work that is required to address fundamental differences in perspective, with attention instead being devoted to tailoring the most acceptable model to reflect the specific demands of the domain or phenomena of interest. There is therefore benefit in exploring the variety

of models that exist irrespective of their field of origin or their particular focus. Only by drawing on the wealth of prior work in this area can we avoid unnecessary repetition of what has gone before or hope to progress beyond it.

Acknowledgements

Endnotes

1. The term 'consumer' is defined here quite broadly to include anyone who engages with the artefact (Schroeder, 2002), including activities of selection, purchase, usage, maintenance and disposal. The term 'user' is employed interchangeably in this sense to permit consistency with the language of the different authors cited. For similar reasons, the terms 'artefact', 'product' and 'system' are also used interchangeably to denote the final output from the processes of design and production.

2. Here, the use of the term 'media' assumes a broader definition than conventional use of the term might permit, but it is not unprecedented. Luhmann (1984, p. 220ff; 1995, p. 160ff), for example, distinguishes between three different types of media that are complementary: *language*, which is visible in linguistic forms, such as sentences; *media of dissemination*, such as writing, printing, and electronic broadcasting; and – following Parsons (1963) – *symbolically generalised communication media*, such as money as a medium for transaction (Luhmann, 1984, p. 220ff; 1995, p. 161; also see McLuhan, 2001). Despite writing for a different audience, Luhmann's line of argument could be extended to denote a product, or representations of it (such as a sketch, CAD-model or physical prototype) as media (Maier, 2007).

3. Deutsch also describes the *predictive* and *mensurative* functions of models, but describes these functions primarily in terms of physical systems.

4. We focus here on mediated communication models and do not address the 'non-linear' models such as those by Gerbner (1956) and Dance (1967).

5. Koenig's book is structured around Eco's (1968, p. 58) appropriation of Shannon's model.

6. In communication theory, the term 'channel' is used in many different ways, but Berlo (1960, pp. 63-64) presents an analogy to illustrate its various definitions: if two individuals, separated by a body of water, communicate by sending packages back and forth, Berlo describes the channel as comprising the boat (within which the packages are placed), the water (upon which the boat travels) and the docks (by which packages can be both loaded onto the boat and removed from it). In applying this analogy to spoken communication, Berlo equates sound waves with the boats, air with the water and speaking/hearing

with the docks. Despite describing the channel in some detail, Berlo is less concerned with the details of its definition than he is with its function. He says "the channel is a medium, a carrier of messages" (p. 31), adding later "[it must] couple the source and the receiver, enabling them to communicate" (p. 67).

7. To prevent such readings, some authors have employed an arrow directed from the consumer to the artefact to reflect how the interpretation of artefacts such as maps and diagrams is active and goal-oriented (e.g. see Waller, 1979, p. 217; Nystrand, 1982, p. 82; Curran, 2004, p. 23). Others employ bi-directional artefact-consumer arrows (e.g. see, Maser, 1976, p. 42; Karjalainen, 2004, p. 53), or leave the relationship between those graphical elements undetermined (e.g. see Monö, 1997, p. 45; Forslund et al., 2006).

8. Similarly, in Maletzke's model of the mass media, the creative process of message formation is depicted as cyclic; communicative intentions shape the message, but the message and the medium by which it will be expressed both inform intentions.

9. This system-as-medium perspective is originally represented diagrammatically where the user communicates with the system within a situated context, and the designer produces that system from outside the situated context (de Souza, 1993, p. 756). de Souza later adopts Jacobson's model of communication to represent this view (de Souza, 2005, pp. 66, 88; de Souza, Barbosa, & Prates, 2001; p. 463). In Jacobson's (1960, p. 353) model, the 'addresser' sends a message to the 'addressee'; the message must have a context that is referred to, a code that is at least partially common to both parties and a channel through which psychological connection is established and maintained. Lyons (1977, p. 36) argues that Jakobson's model is essentially the same as Shannon's.

10. When considering the interpretation of artefacts, or the interpretation of the feedback that they provide, issues of sensory perception are of relevance. This perception might involve various sensory modalities, each of which provides different types of information (Schifferstein & Cleiren, 2005; Schifferstein, 2006). Consequently, in Berlo's (1960, p. 72) communication model each of the senses is represented as a separate communication channel providing information to the receiver. However, separating perception from interpretation might be taken to imply that perception is an entirely receptive process that precedes interpretation. This is neither supported philosophically or psychologically (for a discussion centred on design, see Daley, 1982), but can still be conceptually useful when considering the different influences that might predominate at each 'stage' (e.g. physiological factors influencing perception, and cultural factors influencing interpretation).

11. Westley and MacLean's model is an expansion of Newcomb's (1953/1966) more basic model of communication.

12. An alternative interpretation is provided by Salles et al. (2001, p. 457) who, in translating Westley and MacLean's model to the context of human-computer interaction, equate *the source of the message* with the designer, *the recipient of the message* with the user and *the intermediary* with the

computer. The adaptations that Salles et al. make to Westley and McLean's model are primarily driven by the notions that all communication processes are mediated and that the system-user relationship is dialogic (that there is a two-way conversation).

13. A number of studies in design refer to the potential for products and representations of the product to facilitate communication within the design process. In particular, products serve as a means of translation, co-ordination and alignment (Vinck & Jeantet, 1995), and provide a point of reference, especially for explanations and the externalisation of thoughts (Carlile, 2002; Eckert & Boujut, 2003, p. 146).

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