SERIAL REPRODUCTION AS A METHOD FOR STUDYING SOCIAL REPRESENTATIONS

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Abstract: The contribution concerns the relevance of certain aspects of the work of Bartlett (1932) for social representations (SR) research. Three main points will be argued: a theoretical, a methodological, and an empirical one. Theoretically, the contention is that the work of Bartlett, especially what he calls conventionalisation, is eminently relevant for SR theory, and that this relevance has been insufficiently appreciated as of yet. It is shown is that conventionalisation is identical to what can be understood as the *process* of social representation. The methodological point is that the method of *serial reproduction*, which is the methodological counterpart of conventionalisation, can be adapted for use in the framework of SR research. Examples from a study in which this method was applied to the study of the SR of conception are presented. The empirical contention is that existing research on the SR of conception has neglected to address the fundamental importance of personification. This is illustrated by research results. Finally, some theoretical implications of the use of the method of serial reproduction in SR research are briefly discussed.

BARTLETT'S HERITAGE IN PSYCHOLOGY, SOCIAL PSYCHOLOGY AND SOCIAL REPRESENTATIONS RESEARCH

It is a fact beyond dispute that the work of Bartlett (1932) enjoys canonical status as one of the forerunners of modern cognitive psychology. Two examples can illustrate this point. First, Bartlett is widely recognized as being the ancestor of modern schema theory (Schwartz and Reisberg, 1991). Second, Bartlett has been presented as the ancestor of a *reconstructive, functional* approach to memory, as opposed to a *reproductive and mechanistic* approach, a forerunner of which is Ebbinghaus (Kintsch, 1995). It is

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probably a reliable indicator of the legacy of one's work when one is used to define an entire scientific discipline. "Noncognitive" approaches in social psychology also have recognized the importance of Bartlett's work. For example, Edwards and Middleton (1987) have argued that the official history of cognitive science has distorted Bartlett's legacy, obscuring the true nature of his contributions to a cultural and functional approach to memory in particular and psychology in general (Kashima, 1997). Bartlett is also well-known among anthropologists. For example, his work has been studied by Douglas (1986) and Connerton (1989), especially his less well-known book, *Psychology and Primitive Culture* (1923).

Within the tradition of social representations (SR) research, there has been isolated commentary on various aspects of the work of Bartlett. The discussion between Moscovici and Jahoda in the *European Journal of Social Psychology* made some mention of the role of Bartlett as a possible forerunner of SR theory (Moscovici, 1988; Jahoda, 1988). Moscovici (1984), Jodelet (1992), and Flick (1995) have all commented on the similarity between conventionalisation and social representation. In addition, Jodelet (1992) discusses the importance of Bartlett's work for a social psychological approach to memory. However, despite this sporadic interest, there has been as yet very little systematic treatment of the relation between what Bartlett called conventionalisation and what one may nowadays call the *process* of social representation, i.e. how knowledge is transformed when it circulates between groups. One notable exception is Saito (1996), who offers both a theoretical discussion of the similarities between conventionalisation and SR and an empirical illustration through a case study of the different conceptions of Zen Buddhism in Britain and Japan.

Conventionalisation and the Process of Social Representation

Saito (1996, p. 263) defines conventionalisation as "a process in which an item or system of culture transferred from one cultural or social group to another, undergoes a series of transformations and finally arrives at a relatively stable form distinctive to the given group". Bartlett's (1932/1995) book *Remembering* contains a section on social psychology, and it is here that one finds his presentation of conventionalisation. The following three quotations are taken from this section.

> We can ask: "What happens to *x*, a group of cultural elements, when it is brought into effective relationship to *y*, another group of cultural elements?" and we can seek an answer to this question, without referring specifically to any ideas, feelings or actions of any individual of either group (p. 243, italics in original).

> [The study of conventionalisation] raises all those interesting and important problems which have to do with the principles by which items, or systems, of culture, moving about from one group to another, undergo change, and finally arrive at relatively fixed and accepted forms in whatever group they reach (pp. 245-246).

> The emphasis passes, for the moment, away from psychology, in the strict sense, towards sociology. It is not with emotions, images, ideas, individual attitudes, that we are concerned, but with objective changes of culture (p. 268).

In light of these quotations, the parallels between the phenomenon of conventionalisation and certain central propositions of SR theory seem rather evident.

There is in both cases an emphasis on (1) transformation of content as a result of circulation of information between different subsystems of society or different cultures, and (2) the fact that these changes are matters of objective social reality, independent of individual factors. This second aspect is particularly interesting, because it contains the essence of Durkheim's (1924/1967) thought on collective representations.

So much for the similarity between the two concepts. One may now turn to a more detailed aspect of the comparison, namely a comparison of the processes postulated to be taking place. Bartlett (1932/1995, pp. 268-280) describes four principles by which conventionalisation functions: (1) assimilation to existing cultural forms, (2) simplification or dropping out of elements peculiar to the group from which the representation comes, (3) retention or accentuation of details peculiar to the receiving group, and (4) a process of social constructiveness. It is widely accepted (Moscovici, 1981, 1984; Wagner, Elejabarrieta & Lahnsteiner, 1995) that two subprocesses of social representation are anchoring and objectification. The juxtaposition of these two different approaches to the same phenomenon gives some idea of their similarities. Likewise, Saito (1996) comes to the conclusion that there is a large degree of equivalence between the major theoretical propositions of both approaches. It seems apparent that Bartlett's description (with the exception of what he calls "social constructiveness") is made almost on an ethnological level. Indeed, Bartlett explains what he means using examples taken mainly from ethnological studies, as well as his own experimental data. Bartlett's experimental studies of conventionalisation were performed using the method of *serial reproduction* (pp. 118-185). The basic principle of this method is as follows: some symbolic material is given to the first subject, who must, after a suitable interval to study the material, reproduce it from memory as accurately as possible. This reproduction is then given to the second subject who must also reproduce it, and so on. In this way, a series of texts (or drawings) are produced, which contain transformations of content which can be described in different ways. Bartlett applied this method with various types of material, including picture material, as well as descriptive and argumentative texts. A well-known illustration of this method (Bartlett, 1932/1995, pp. 180-181) is where an egyptian hieroglyph representing an owl is progressively transformed into a house cat.

Serial Reproduction As a Method For Studying Social Representations

It seems interesting, given the similarities between conventionalisation and SR outlined above, to develop and expand this method for use within the theoretical framework provided by SR theory. How can this be done? First, it is worth opening a short historical parenthesis in order to mention that this method has also been used in other areas of psychology. Allport and Postman (1945) applied a variant of it in their research on wartime rumour, Haque and Sabir (1975) used it to study stereotypes, and the method has also been applied in cognitive psychology (Stadler & Kruse, 1990).

Bartlett applied the technique in just one chain, and analyzed the results in a rather informal fashion. Nowadays, SR research has developed a wide spectrum of methods for analysis of the content and semantic structure of representations, which are the object of much recent discussion (for an overview, see De Rosa, 1994), and these make it necessary to develop the sophistication of Bartlett's original procedure. A number of

possible research designs are indicated in Figure 1. The first variant encompasses a number of parallel chains of reproduction. Each text that is reproduced can be situated in a given chain and in a given generation. Features which may be analyzed include for example, transformation of text or sentence structure, generation of novelty, progressive selection (dropping out) of various contents, and so on.

An alternative version of this design could be labelled an "explosive" scheme (Figure 1), where each text of the parent generation is reproduced by a larger number of subjects. This version probably would have more potential for generating variability of content. Both of these designs allow for systematic statistical treatment of the data, because of their uniformity. However, one could also imagine an "explorative" version where interesting results are allowed more room for development in order to generate hypotheses for further research (Figure 1).

It is also interesting to speculate on what the predictions of central nucleus theory would be in this context. For example, Abric (1989) found in more classical memory tasks that elements of the central nucleus of a SR were better recalled than peripheral elements. Likewise, one could speculate that such elements would be more likely to "survive" transformation intact than others. Another possibility would be that elements of the central nucleus of the SR of the receiving group are "implanted" in the course of the chain of reproduction.

Serial Reproduction Applied to the Study of the SR of Conception

Choice of the Topic

In order to explore the potential of the method, the SR of conception was investigated, for several reasons. First of all, it has already been studied by Wagner, Elejabarrieta, and Lahnsteiner (1995). Therefore, there is already an existing theoretical framework, as well as some data that may be used for guidelines. Second, this topic exemplifies on the one hand one of the original fields of research of SR, namely the transformation of scientific knowledge into common sense (Moscovici, 1961, 1984), and on the other hand can be interpreted according to Bartlett as knowledge circulating from one culture to another, i.e. from scientific to lay culture. This is of course the precondition for conventionalisation.

Theoretical Assumptions

Wagner et al. (1995) investigated the role played by metaphor in objectification for the SR of conception. Their main assumption was that the abstract and unfamiliar biological process of conception (the target domain) is made intelligible by most laypersons by assimilating it to an area of experience (the source domain) with which they are familiar, and which bears some degree of structural similarity to the conception process, namely their own everyday experience of sex roles and sexual behavior. Using an experimental questionnaire design, the authors were able to demonstrate that their subjects preferred using sexual metaphors over nonsexual metaphors to describe the behavior of sperm and

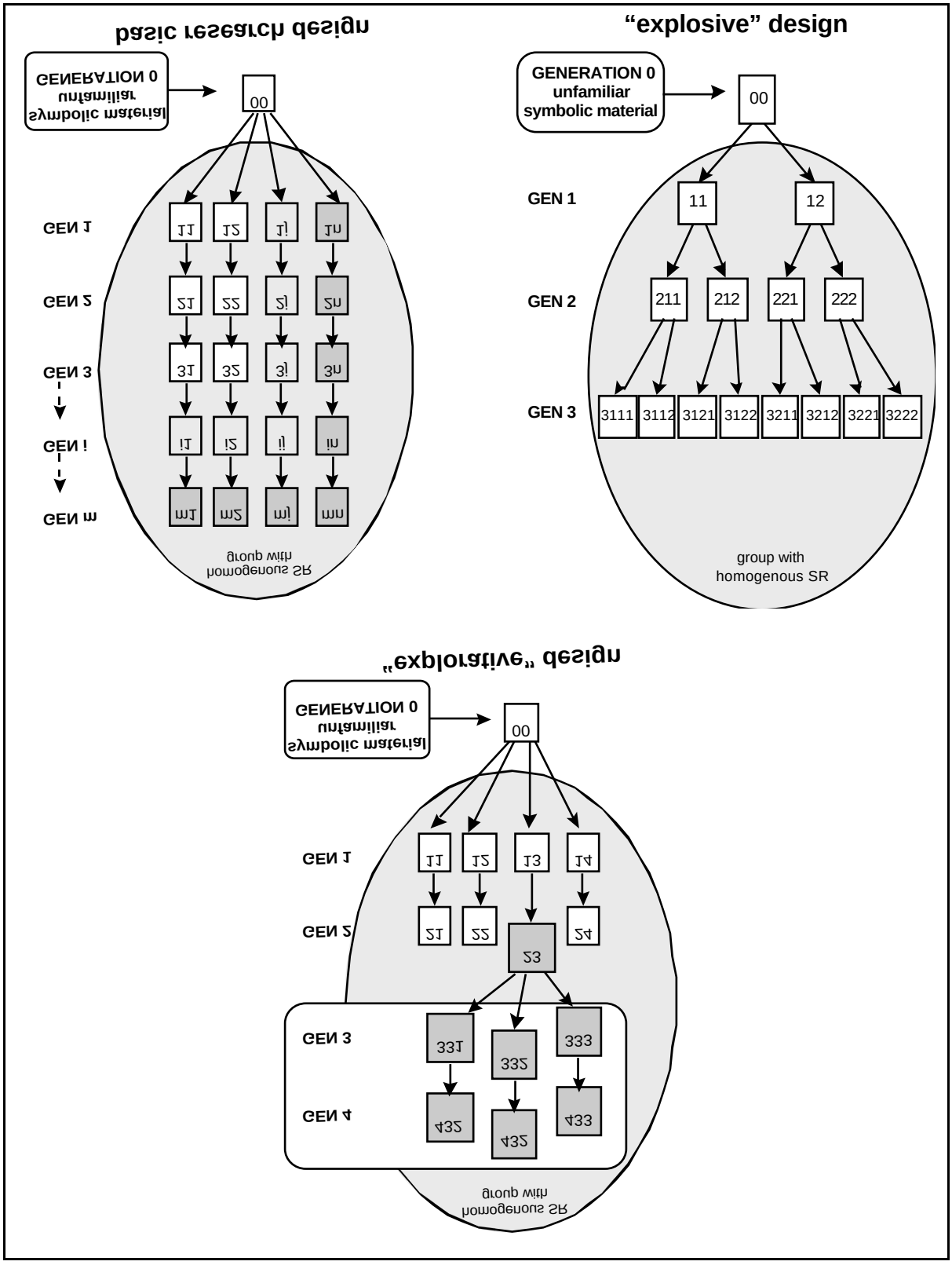

Figure 1
Three possible serial reproduction designs.

ovum, and that ratings of different aspects of their behavior corresponded to the projection of sex-role stereotypes onto the sperm and ovum. The authors interpreted this as evidence confirming their assumptions.

This study highlights the role played by language in general and by metaphor in particular in the objectification process. It opens an important new dimension of research on objectification, and also on the relationship between SR and language. However, concerning the specific research topic, it seems that the a priori decision on the part of the experimenters to focus on the interaction between sperm and ovum *as central elements of the reproductive process* obscures one of the most interesting aspects of the transformation of this scientific representation into common sense. In other words, conception is an exceedingly complex (physiological, endocrinological, biochemical and so on) affair in which the interaction of sperm and ovum is only a part (even if it is an important part, indeed the purpose of the whole process). One might contend that the more fundamental phenomenon from the point of view of SR theory is the process by which this complex affair is reduced to a situation in which two main actors, namely sperm and ovum, interact in a more or less purposive manner. Thus, it seems reasonable to postulate a more basic level of functioning of the SR of conception where the projection of sex-role stereotypes on sperm and ovum (Wagner et al., 1995 restricted themselves to this aspect) is a part of a more fundamental process of *personification* (for a discussion of personification, see Moscovici & Hewstone, 1983, as well as Lakoff & Johnson, 1980). In other words, it was assumed that, in the course of the conventionalisation of the scientific representation of conception, a dual process would take place. First, abstract descriptions would "fade into the background", whereas the role of sperm and ovum would be accentuated, and these would be depicted in an increasingly anthropomorphic manner. Second, and on the basis of the first process, sex-role-stereotypical behavior would be projected onto the sperm and ovum.

PROCEDURE

Based on a textbook article on reproductive animal biology, (Austin & Short, 1976), a short text (239 words) describing the process of conception was written. This text was then used as the original for the serial reproduction, which was conducted according to the first design presented in Figure 1. An expert (a university professor for reproductive animal biology) was consulted in order to ensure that the text contained no errors. The design (44 subjects) incorporated 11 chains of 4 generations each. The study was conducted with German Swiss psychology undergraduates, and therefore the original text was in German. An approximate English translation is presented here (it is slightly longer, containing 266 words):

Fertilization takes place in the fallopian tube between the ovary and uterus. The ovum, which develops in a follicle, is transported to the fallopian tube. The walls of the fallopian tube are covered with ciliae, whose movement creates a current of liquid. The ovum is transported to the place of fertilization by this current, as well as by muscle contractions of the walls of the fallopian tube. Both the intensity of the ciliae movement and the strength of the contractions are controlled by the sex hormones, oestrogen and progesterone.

During copulation, the semen is deposited directly in the vagina. Contractions of the female genital tract play an important role in transporting the spermatozoa to the place of fertilization.Here as well, cilae in the fallopian tube cause a current which facilitates the transport of the spermatozoa. Even though several hundred million spermatozoa are brought into the vagina, only several thousand reach the place of fertilization.

The meeting of sperm and ovum apparently takes place randomly and not through any chemical attraction. The first contact between sperm and egg takes place through an attachment reaction (agglutination) between substances on the surface of the egg and sperm. One sperm must penetrate through the outer membrane into the egg. This is attained through a local dissolution of the outer membrane by so-called lysines, which probably come from the acrosome of the sperm. Immediately after the fusion of the egg and sperm, several processes take place, which lead, among other things, to a hardening of the cell membrane. This has the consequence that no further spermatozoa can penetrate into the ovum.

Subjects were told to study the text and to try and understand its content. They had approximately 15 minutes to do this. After a short distracting task (10 minutes), they were instructed to write down as exactly as possible what they had read before (15 minutes).

Data Preparation and Analysis

Data was prepared for analysis by segmenting all sentences in the texts into simple propositions (i.e. sentences with subordinate clauses were segmented), so that each proposition contained only one verb. There is some linguistic and psychological evidence that the verb is a central semantic element of a proposition (Mösch, 1985), and related to attribution processes (see for example Au, 1986). This segmentation constituted the basis for further coding of the data. In order to investigate the personification hypothesis, verbs were coded according to 3 categories: action, state, and process verbs. Action verbs express activity on the part of the subject (i.e. the sperm cells *arrive* in the vagina). State verbs designate more or less unchanging states or simple existence on the part of the subject (i.e. the walls of the oviduct *are* also *filled* with cilae). Process verbs indicate change, or some kind of process that *happens to* the subject (i.e. a current *arises*; fertilization *takes place*). In addition, the occupant of the subject position of sentences with action verbs was also coded. For sentence clauses with action verbs, subjects were coded as being either *"things"* (i.e. physical objects, for example *sperm, ciliae, oestrogen*) or *processes* (i.e. "sequences of events", for example *contractions, current, fertilization*). "Things" in the subject position of the sentence were further coded as either *sexual cells* (i.e. sperm or ovum), or *other*. This coding procedure is summarized in Figure 2.

Stereotypical projection of sex-role characteristics is the main focus of the study performed by Wagner et al. (1995). This was examined differently in the present study. One possibility is to analyse those sentence clauses which describe a form of interaction between sperm and ovum, i.e. where sperm and ovum appear relative to one another in the subject and object position (a similar method was applied by Kruse, Weimer & Wagner, 1988 in their study of social representations of male-female interactions in the written press). More specifically, the evolution of two types of sentence clauses was analyzed: (1) sperm in subject and ovum in object position, and (2) ovum in subject and sperm in object position. A second dimension of sex-role related behavior concerns the

movement of the sperm and ovum to their meeting point. It is evident in the original text that both sperm and ovum are largely dependent on macrophysiological factors for their transport to the meeting place. Independent navigation (e.g. "swimming") on the part of the sexual cells plays a small role in this process. However, it would seem to be consistent with the sex-role stereotype of sperm as active and ovum as passive if the sperm were to be increasingly depicted as *actively travelling* to the meeting point, whereas the ovum were to be increasingly depicted as being *passively transported.* In order to investigate this, the sentence clauses describing movement on the part of the sperm or ovum were analyzed.

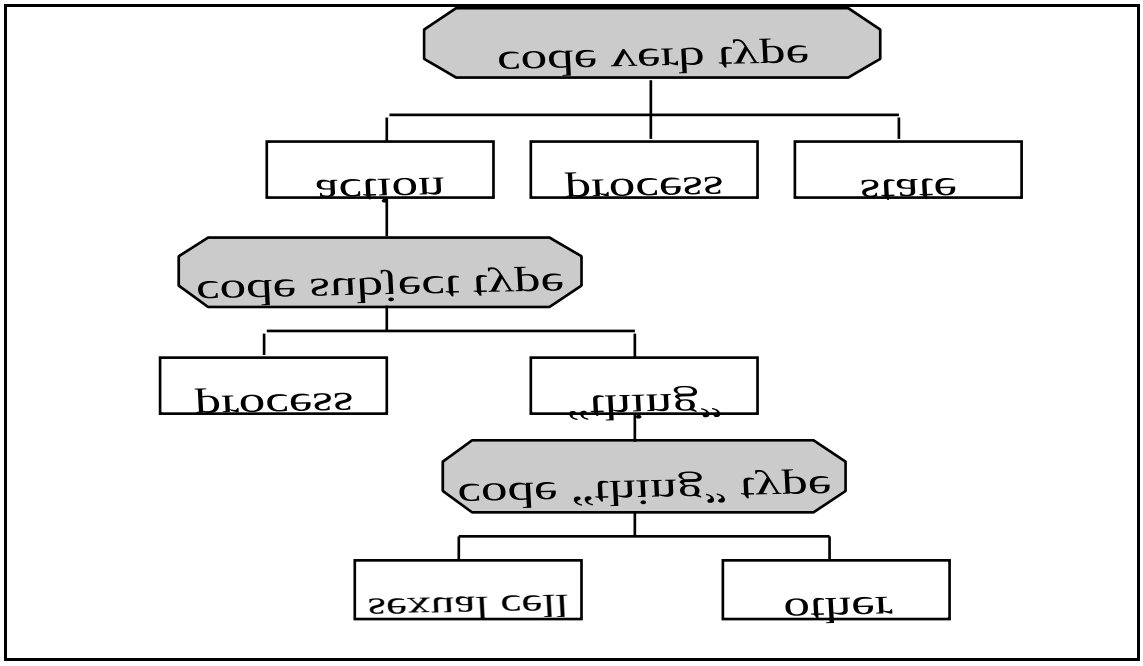

Figure 2
Coding procedure for personification hypothesis. Coding of verb type is followed by coding of subject type and of the type of "thing" in the subject position

Interrater agreement was assessed for all steps of the coding process by calculating Cohen's kappa statistic (based on two independent codings of 11 texts, i.e. 25% of the data set). Kappa varied between .78 and .89 for all coding steps. According to Fleiss (1981), this indicates excellent interrater agreement.

Proportions were calculated for each generation and for the original text. Predictions were made concerning the increase or decrease of relevant proportions over reproductive generations. These proportions were analyzed using repeated-measures ANOVAs with the reproductive generation as a within-subjects factor with four categories (generations 1 to 4). In addition, all first-generation reproductions were compared with the original text using one-sample *t*-tests.

Results

Descriptive statistics concerning both the personification and stereotypification hypothesis are presented in Table 1. None of the ANOVA results indicated any significant

differences between proportions from different generations. In what follows, the results of the t-tests are examined.

Table 1

Mean proportions (standard deviations) of variables relevant to personification and sex-role stereotypification hypotheses, ordered by generation.

	Generation				
	0	1	2	3	4
Personification					
Verb type					
Action	.50	.62 (.10)	.62 (.09)	.69 (.07)	.69 (.14)
Process	.41	.21 (.09)	.25 (.11)	.16 (13.)	.23 (.13)
State	.09	.17 (.07)	.13 (.11)	.14 (.10)	.08 (.12)
Subject type					
"Thing"	.45	.73 (.15)	.74 (.18)	.83 (.10)	.87 (.15)
Process	.36	.14 (.08)	.14 (.13)	.07 (.08)	.07 (.11)
"Thing" type					
Sexual cell	.40	.63 (.21)	.72 (.24)	.73 (.16)	.68 (.25)
Sex-role stereotypification					
Sperm as subject/ ovum as object	1.00	.82 (.40)	.80 (.42)	.93 (.15)	.69 (.46)
Sperm travels	.20	.39 (.29)	.64 (.36)	.70 (36)	.55 (.42)
Ovum is transported	1.00	.73 (.47)	.80 (.35)	.48 (.47)	.86 (.38)

Note. Concerning the variable *subject type*, the total proportions of *"things"* and *processes* are not equal to 1 because of other categories which are not indicated here.

PERSONIFICATION

Concerning the hypothesis of personification, it was found that the proportion of sentence clauses with action verbs increased significantly between the original and the first generation ($t(10) = 3.9$, $p = .0015$). Proportions for each generation are shown in Figure 3.

Thus, on the level of verb type, there is an increase in the proportion of action verbs used to describe the whole process of conception. Action verbs imply an active subject, and so it seems that a first aspect of personification can be shown here. However, it is also necessary to analyze the type of subject for sentence clauses with action verbs. "Things" were contrasted with processes. Results are similar to those above: the overall increase between the original proportion of things and the first-generation proportion was also significant ($t(10) = 6.1$, $p < .001$).

Thus, the proportion of action verbs with "things" in the subject position increases in relation to the proportion with processes in the subject position. This transformation also corresponds to a more concrete, everyday schema of object causation or *reification.* Thirdly, among the proportion of sentence clauses with things in the subject position, it was found that the proportion of sentence clauses where the "things" were one of the sexual cells also increased significantly between the original and the first generation ($t(10)$

= 3.6, p = .0025). This seems to indicate that among "things", the sexual cells (sperm and ovum) were increasingly depicted in the subject position, i.e. as logical actors.

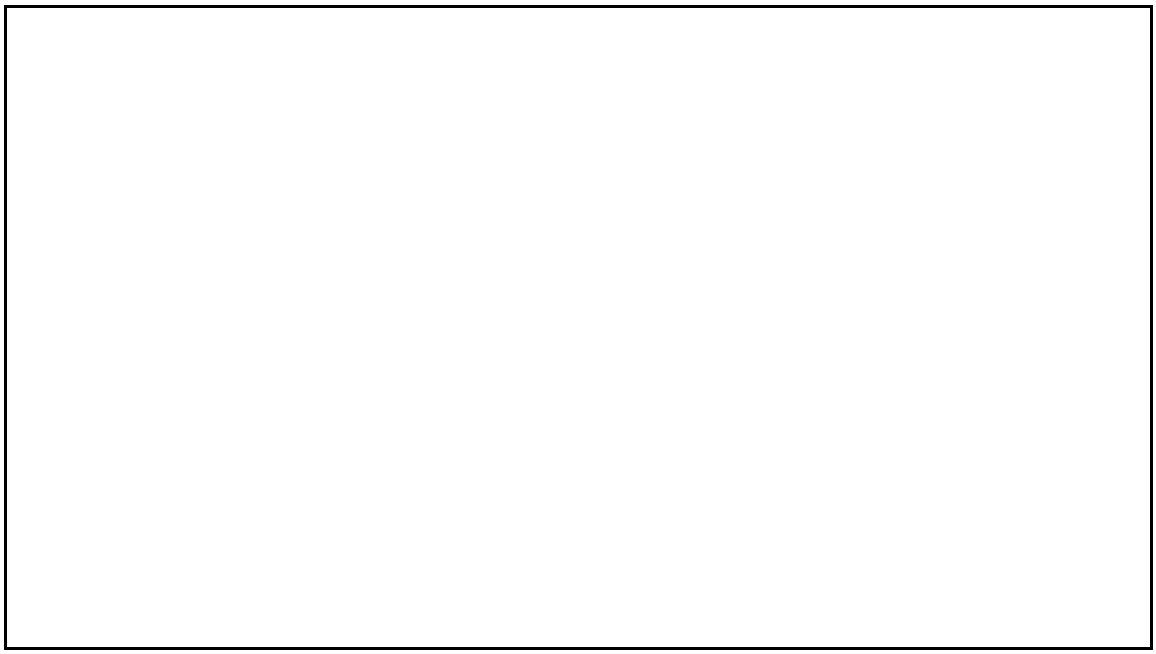

Figure 3
Mean proportions and standard deviations of action, state, and process verbs for original text (O) and four generations of serial reproduction.

Projection of Sex-Role Stereotypical Characteristics

If stereotypical attributes of dominance are projected onto the sperm and submissiveness onto the ovum, then one would expect the proportion of sentence clauses with sperm in subject and ovum in object position to increase. In the original text, the proportion in question was 100%, so this was not possible. Therefore, one would expect this proportion not to decrease between the original and the first generation. This was the case ($t(10)$ = -1.49, p = .084).

Concerning the movement of sperm and ovum to the meeting point, the ovum was described in the original text as being passively transported in 100% of all transport sentence clauses. Contrary to expectations, the proportion for the first generation was significantly smaller than the original ($t(10)$ = -1.94, p = .04). However, for the sperm the proportion of sentences describing it as actively travelling increased betwen the original and the first generation, as expected ($t(10)$ = 2.12, p = .03).

Discussion

The results may be summarized as follows: all of the transformations shown to be taking place occurred only between the original text and the first reproduction. There were no significant differences between proportions from the first to the fourth reproductive generation. This may be due to the fact that the texts become increasingly short with each reproductive generation (the length of the text decreases approximately by half between

the original and the first reproduction). The consequence of this is that texts from later generations are easier to remember. Since the instructions given to the subjects are to try and remember the text as accurately as possible, when the text is too easy to remember, this interferes with the phenomena one is trying to produce. Possible solutions for this problem could be (1) increasing the length of the original text, or (2) compensating by increasing the (horizontal) breadth of the reproductive design. Increasing the breadth of the design would probably also contribute to reducing the high variance (see Table 1) which is possibly an intrinsic feature of serial reproduction, since one would expect reproductions from different chains to become increasingly divergent over generations.

However, the fact that no changes were apparent for the variables coded does not mean that there is no variation at all beyond the first generation. There are in fact very radical changes on a different, more qualitative level of content. As an example, consider the following chain of four transformations of a sentence from a pilot study: the original sentence clause was "during copulation, the semen is DEPOSITED directly in the vagina" (see translation of text above), and remained unchanged after the first reproduction. After the second reproduction, the sentence clause became "the sperm cells ARRIVE directly in the vagina", and after the third reproduction it became "of the millions of sperm cells that ARRIVE directly in the vagina", and finally (after the fourth reproduction) "however only a couple of thousand PENETRATE randomly in the vagina". The qualitative transformation *over all four generations of reproduction* of the verb used to describe the behavior of the sperm is evident.

In this study, results illustrating two separate processes expected to take place during the transformation from a scientific representation to a social representation of conception were presented. Personification was manifested by the progressive transformation of the type of verb (increase of the proportion of action verbs) and of the subject type (increase in the proportion of things relative to processes and sperm and ovum relative to other things). Some aspects of sex-role stereotypification were also evident. It seems interesting to argue that the social representation of conception also implies a metaphorical process of personification which operates on a more fundamental level than the sex-role stereotypification investigated by Wagner et al. (1995). In other words, metaphorically representing conception as an interaction between two "homonculi" or actors is a logical precondition of representing it as an interaction between man and woman. It is also interesting to speculate to what degree this is also the case for social representations of scientific theories in general. In a similar vein, Moscovici (1984, pp. 41-43) offers a discussion on animism: "Every culture has its basic device for turning its representations into reality. Sometimes people and sometimes animals have served this purpose. Since the beginning of the mechanical age, objects have taken over and we are obsessed with a *reverse animism* that peoples the world with machines instead of living creatures" (p. 41). In this light, it might be said that conventionalisation of scientific representations (e.g. through metaphor) consists of "re-animating" the objectified world of science.

Concerning the methodological point, it is appropriate at this point to emphasize the fact that the study presented is but one possibility of employing the method of serial reproduction as a method for studying social representations. It seemed that the best way to demonstrate the potential of the method was to apply it to the study of a topic that had already been investigated to some degree. However, this should not obscure the fact that other uses are possible.

Applying the method of serial reproduction implies an important theoretical question, namely, how is one to interpret the results produced by this technique? A "cognitive" interpretation would be that the individual subjects are best able to recall what is familiar to them, whereas incongruous or strange contents are more difficult to recall. One the other hand, one might also say that incongruous material attracts more attention and triggers more intensive cognitive processing, thereby resulting in better recall. Such problems have been discussed in research on schema theory (Mandler, 1984).

An alternative, "non-cognitive" interpretation would be to contend that conventionalisation has little to do with memory itself (despite the fact that it is discussed by Bartlett as a chapter in a book on memory). Memory is the "mechanical" component of the process of conventionalisation; its significance for the process characteristics studied here can be considered analogous to the significance of understanding the brain in order to understand culture: it is purely at the level of a *sine qua non* condition. Rather it seems that studying conventionalisation has a lot more in common with discourse and communication than with memory (Kashima, 1997).

As an illustration, consider what Sperber (1989) called an "epidemiological" approach to representation: the diffusion of ideas in a culture can be decribed using a metaphor of *contagion.* Similarly, an *evolutionary* metaphor could be invoked to make sense of the results presented above. According to classical evolutionary theory, evolution is explained by two independent mechanisms. The first is random genetic mutation, and the second is selection of viable mutations through environmental pressure. Likewise, in the case of conventionalisation, one has random mutations of the original text. They are certainly not random reproductions *per se*, but random on the social level, because they reflect the idiosyncrasies of the individual subject which has produced them. And there is also an analogical equivalent of environmental pressure operating here, which are the norms, values, and ideological and aesthetic preferences of the group to which the individual subjects belong. One might say that idiosyncratic transformations "die out" in the long run (i.e. given a sufficient amount of generations), whereas transformations which are viable in the psychological climate of the receiving group "survive" and attain some kind of stable form. Such forms have a function for the group in question, because they enable it to conceptualize the original unfamiliar object.

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