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Bartlett's schema theory: The unreplicated "portrait d'homme" series from 1932

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In 1932, Frederic Bartlett laid the foundation for the later schema theory. His key assumption of previous knowledge affecting the processing of new stimuli was illustrated in the famous "portrait d'homme" series. Sequenced reproductions of ambiguous stimuli showed progressive object-likeness. As Bartlett pointed out, activation of specific schemata, for instance "the face schema", biases memory retrieval towards such schemata. In five experiments (Experiment 1, $n = 53$; Experiment 2, $n = 177$; Experiment 3, $n = 36$; Experiment 4, $n = 6$; Experiment 5, $n = 2$), we tested several factors potentially influencing retrieval biases—for example, by varying the general procedure of reproduction (repeated vs. serial) and by omitting versus providing visual or semantic cues for activating face schemata. Participants inspected face-like stimuli with the caption "portrait of the human" and reproduced them repeatedly under specific conditions. None of the experiments revealed a systematic tendency towards Bartlett's described case, even when the participants were explicitly instructed to draw "a face" like the previously inspected one. In one of the "serial reproduction" experiments, we even obtained contrary effects with decreasing face-likeness over the reproduction generations. A close analysis of the original findings raises questions about the replicability of Bartlett's findings, qualifying the "portrait d'homme" series more or less as an illustrative example of the main idea of reconstructive memory.

Keywords: Perceptual learning; Learning and memory; Face; Object; Schema theory; Prototype theory; Adaptation; Distortion; Plasticity.

In his seminal book *Remembering* (Bartlett, 1932), Sir Frederic C. Bartlett laid the foundations for his later schema theory. One classic finding continuously described in books on cognitive science and referred to in numerous research articles illustrates the impact of the schema theory, although it has not been empirically tested yet (see Edwards & Middleton, 1987). In the course of repeated reproduction, a face-like but somehow ambiguous visual stimulus will increasingly be
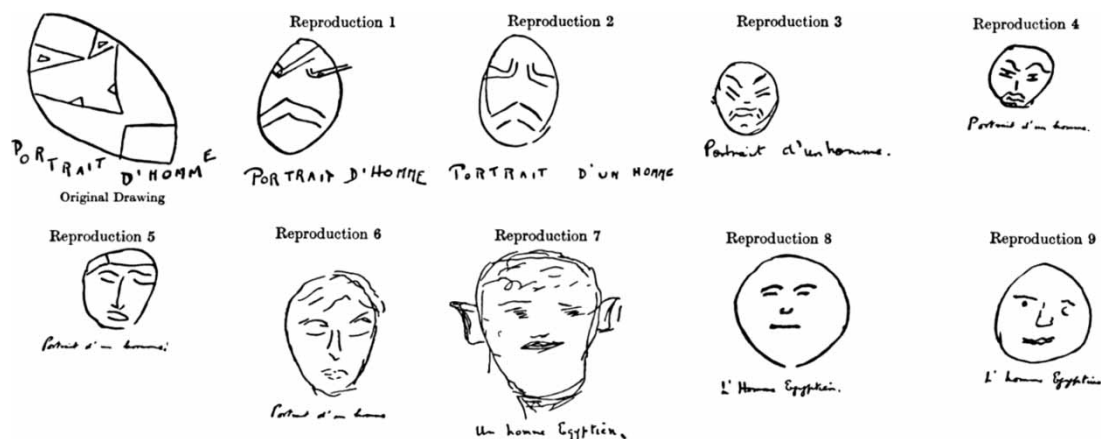
Figure 1. *Original illustration of the "portrait d'homme" series by Bartlett (1932) often found in text books of cognitive psychology. The naming of the depiction ("portrait d'homme") was always reproduced. From* Remembering: A Study in Experimental and Social Psychology *(pp. 178–179), by F. C. Bartlett, 1932, Cambridge, UK: Cambridge University Press. Copyright 1932 by Cambridge University Press. Reprinted with permission.*

changed towards a simple and prototypical face. Figure 1 shows the original picture series consisting of one original (Original Drawing) and nine successive reproductions (1–9).

Bartlett noted a couple of characteristics of the development of reproduction. The most important characteristic was that drawings became more and more face-like. Additionally, he observed the drawings becoming increasingly "simplified" and more "conventional" (Bartlett, 1932, p. 185). It is of major importance that the caption ("portrait d'homme") was continuously used for each drawing. Bartlett himself stressed that "in the early experiments on perceiving it became clear that the assignment of a name to objects observed often strongly influenced their immediate reproduction or description" (Bartlett, 1932, p. 183). Pioneering work on this aspect was done by Carmichael, Hogen, and Walter (1932) who demonstrated that the mere naming of an ambiguous stimulus directs the observer's interpretation towards the representation activated by the caption of the stimulus (see Figure 2).

These effects have been replicated in various domains—for instance, even understanding and appreciation of art are modulated by entitling the artwork (Leder, Carbon, & Ripsas, 2006). We would like to summarize this factor as the "naming hypothesis". Other factors influencing specific schemata might be the delay between inspection and reproduction of stimuli (see Wheeler & Roediger, 1992), the context and instruction during both phases (von Hippel, Jonides, Hilton, & Narayan, 1993), and the specific kind of reproduction technique—for example, "repeated reproduction", during which people have to reproduce their own reproduction again and again, or "serial reproduction" (see Bartlett, 1932), which follows the idea of Chinese whispers.

Although Bartlett's schema theory is clearly an important part of the classic theories of cognitive psychology and is obviously present in everyday life experiences, empirical proof of his original experiments on remembering (Bartlett, 1932) using picture material is sparse, and paradigms have not been replicated so far.

Present study

In the present study, we test several factors to identify key variables triggering schemata sensu Bartlett (1932), mainly the *naming hypothesis*. Therefore, we replicated Bartlett's methods of "repeated" (Experiments 1 and 5) and "serial reproduction" (Experiments 2, 3, and 4). In both experimental procedures, participants had to draw previously

Figure 2. Illustration of the ambiguous stimuli used in the study of Carmichael, Hogen, and Walter (1932) (see in the centre) and some examples of drawings evoked by different naming of the stimuli (see left and right). From "An Experimental Study of the Effect of Language on the Reproduction of Visually Perceived Form", by L. Carmichael, H. P. Hogen, and A. A. Walter, 1932, Journal of Experimental Psychology, 15(1), p. 75. Copyright 1932 by the American Psychological Association. Reprinted with permission. The material is now in the public domain.

inspected sketches. In the repeated procedure, each participant reproduced the same initial object several times in a row, whereas participants in the serial procedure reproduced one single stimulus, and then the drawing was shown to another participant, who then had to reproduce it, and so on. We employed both procedures in one study to increase external validity of the effects of the tested factors on the reproduction quality and direction. To test the naming hypothesis, we omitted any explicit reference to faces in Experiments 1 and 2, whereas we made such a reference in Experiments 3 and 4 and even biased participants towards face reproduction in a rather suggestive way in Experiment 5. To test the impact of delay between inspection of the pictures and reproduction, we implemented delays of 15 min, 24 hours, and one week, respectively. As we were also interested in the impact of initial face-likeness of the stimulus material, we varied this experimental variable on three and six levels, respectively.

PRESTUDY A: ASSESSMENT OF FACE-LIKENESS OF BARTLETT'S "PORTRAIT D'HOMME" SERIES

As an initial test, we assessed the face-likeness of Bartlett's (1932) "portrait d'homme" series, because it is not clear that an increasing face-likeness was indeed obtained by Bartlett. In fact, the face-likeness was never empirically evaluated.

Method

Participants
Seven students (undergraduates and graduates) of the University of Bamberg (2 female, mean age = 29.6 years, range: 19–46 years) participated. All of them were naïve to the purpose of the study.

Material
We used the reproductions that were done in the first six (reproduction) sessions of Bartlett's "portrait d'homme" series (Reproductions 1–6, see Figure 1), which were obtained via "serial reproduction" (see details in the Procedure section of

Table 1. *Prestudy A: Means and standard deviations of the face-likeness rating of the "portrait d'homme" series*

	Rating	
Session number	M	SD
1	3.00	1.29
2	2.57	0.98
3	3.57	1.13
4	5.57	0.79
5	6.29	0.76
6	6.57	0.54

Note: Ratings: 1 = "not face-like at all"; 7 = "very face-like".

Experiment 2). In contrast to Bartlett's original drawing, we presented them without the caption "portrait d'homme" to avoid suggesting that this was the portrait of a human, which in this case would be evidently very face-like.

Procedure
Participants evaluated one stimulus after another in a randomized order on a 7-point Likert scale (1 = "not face-like at all" to 7 = "very face-like"). There was no time limit for the evaluation.

Results and discussion

The ratings are shown in Table 1.

A one-way repeated measurement analysis of variance (ANOVA) with *session number* as a within-subjects factor revealed a strong increase in face-likeness from Reproduction 1 to Reproduction 6, $F(5, 30) = 29.86$, $p < .0001$, $\eta_p^2 = .833$.

PRESTUDY B: ASSESSMENT OF FACE-LIKENESS OF THE STIMULI

As the initial face-likeness seems to be an important variable for triggering face-specific "remembering processes" (sensu Bartlett, 1932), we varied the face-likeness of new stimuli on a maximum of six levels. To validate our manipulation of face-likeness, in Prestudy B participants had to assess this variable.

Initial object		1	2	3	4	5	6
Face-likeness scores	M	2.43	4.57	2.43	4.00	6.00	4.29
	SD	0.98	0.79	0.98	1.63	0.58	1.70

Figure 3. Objects used as initial stimuli in Experiments 1–5. Object 1 is identical with the object that Bartlett (1932) used and showed in his book. Face-likeness scores are displayed based on the results of Prestudy B.

Method

Participants

Seven undergraduate students of the University of Bamberg (2 female, mean age = 25.3 years, range: 21–30 years) participated. All of them were naïve to the purpose of the study.

Material

We used six more-or-less face-like pictures, of which one (Figure 3, Object 1) was Bartlett's (1932) original starting image of the "portrait d'homme" series. The other pictures were specifically created for the present study to ensure unfamiliarity of the stimulus material due to potential displays of the original material in basic psychological courses. To ensure full compatibility between the procedure of Bartlett's studies and the present study, we used the same subtitle (German: "Portrait des Menschen", i.e. "portrait of the human").

Procedure

Participants evaluated one stimulus after another in a randomized order on a 7-point Likert scale (1 = "not face-like at all" to 7 = "very face-like") without a time limit.

Results and discussion
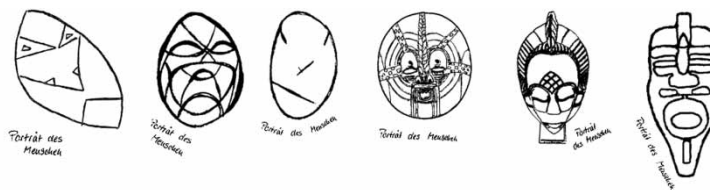
The mean face-likeness values are displayed in Figure 3. The face-likeness ranged from very low ($M = 2.43$) to very high ($M = 6.00$) enabling us

to test the impact of initial face-likeness on the quality of the subsequent process of reproduction.

EXPERIMENT 1: REPEATED REPRODUCTION WITHOUT EXPLICIT NAMING

The major aim of Experiment 1 was to replicate Bartlett's original procedure of "repeated reproduction" (Bartlett, 1932) in the visual domain without explicit naming.

Method

Participants

Fifty-three undergraduates (49 female; mean age = 21.4 years, range: 19–33 years) of the University of Bamberg participated for course credit. All of them were naïve to the purpose of the study.

Material

We used three pictures showing objects (Figure 3, Objects 1–3), which had been assessed with Prestudy B. Objects 4–6 were not used in Experiment 1 in order to reach a representative number of participants in the series for all initial objects, due to typical increase of dropout with advancing test session numbers.

Procedure

We used Bartlett's method of "repeated reproduction" described in Bartlett (1932, chapter 9). The

participants were randomly assigned to one of three groups, each inspecting a different object for approximately 30 s. After inspection, they completed a cover task lasting about 15 min. They then received the following instruction: "Please draw the picture as accurately as you can remember it." After a delay of one week, they were again instructed to draw the initial object as accurately as they could remember it. We repeated this procedure five more times with a delay of one week between two consecutive sessions.

To measure the face-likeness of the produced material, 7 participants (3 female; mean age = 22.3 years, range: 20–28 years) from a different sample from the experimental group rated the degree of face-likeness of the drawings on a 7-point Likert scale (1 = "not face-like at all" to 7 = "very face-like").

Results and discussion

Bartlett (1932) based his description of the schema theory on the observation of successively increasing object-(face-)likeness resulting from ambiguous stimuli as initial stimuli. In consequence, the dependent variable of interest in the present study is face-likeness. We analyzed the correspondent ratings with a two-way mixed-design ANOVA with *initial object* (1 to 3) as between-participants factor and *session number* (1–6) as within-participants factor. We did not find an effect either for initial object, $F(2, 50) = 1.43$, $p = .250$, *ns*, or for session number, $F(5, 250) = 1.82$, $p = .109$, *ns*. The interaction did not reach significance either: $F(2, 50) = 2.14$, $p = .128$, *ns* (means are displayed in Table 2). Although the initial objects used differed widely to the degree of face-likeness as ascertained by Prestudy B, face-likeness of the initial objects did not seem to modulate face-likeness of the drawings across the sessions. Furthermore, we did not find the development towards face-likeness as described by Bartlett (1932). In summary, we could not replicate Bartlett's original results when participants were not explicitly instructed to reproduce the "portrait of the human". One possible explanation for this failure to replicate the findings is the mere fact that we did not explicitly force participants to reproduce the "portrait of the human", but instructed them to reproduce what they had previously inspected. Actually, only 50 out of 318 drawings included in the final analysis of Experiment 1 showed, at least partially, the initial caption (means for face-likeness are shown in Table 2). A Wilcoxon signed-rank test for paired samples revealed no significant difference in face-likeness between drawings with and without initial caption, $T = 6$, $p = .116$, *ns*, but further conclusions should be drawn carefully due to unequal sample sizes. Another possible reason for the results could be the fact that the first delay between inspection and reproduction was of 15 min only, whereas the following delays between the reproduction sessions were of one week. Taking into account that the reproduction sessions are test situations for the participants, reproduction 15 min after studying the stimulus possibly enhances later retention (Roediger & Karpicke, 2006; Wheeler & Roediger, 1992). Therefore, it does not seem surprising that the picture material of the participants did not change in a significant way with subsequent reproductions.

Bartlett (1932) had already noted that the method of "repeated reproduction" only partially produces typical effects in accordance with the schema theory, because participants tend to stop the development of forms at a relatively early level of transmission as soon as a certain degree of stereotypicality has been reached. We therefore decided (a) to expand the set of initial objects and —linked with this—the range of face-likeness, and (b) to employ the more sensitive method of "serial reproduction" to further test the naming hypothesis.

EXPERIMENT 2: SERIAL REPRODUCTION WITHOUT EXPLICIT NAMING

The major aim of Experiment 2 was to replicate Bartlett's original procedure of "serial reproduction" (Bartlett, 1932, pp. 178–179) in the visual domain without explicit naming.

Table 2. *Means of the face-likeness ratings for Experiments 1 to 5, including face-likeness ratings separated for drawings with and without caption*

Experiment	Initial object	Session number					
		1	2	3	4	5	6
1	1	2.63	2.64	2.84	2.72	2.69	2.68
	2	3.17	2.94	2.81	3.01	2.57	2.71
	3	3.29	3.34	3.88	3.33	3.11	3.22
	Caption	3.14	3.17	2.57	2.66	2.52	2.55
	No caption	3.01	2.92	2.93	3.08	2.80	2.90
	Mean	3.04	2.96	2.89	3.01	2.76	2.84
2	1	3.39	2.92	2.78	2.56	3.10	3.01
	2	4.17	3.71	3.71	3.91	3.64	3.52
	3	4.37	3.88	4.06	4.04	4.00	4.12
	4	3.81	3.13	2.82	2.70	2.56	2.50
	5	5.12	4.79	4.61	4.83	4.77	4.65
	6	3.38	2.97	3.06	2.82	2.65	2.52
	Caption	3.79	3.86	4.79	n.a.	n.a.	n.a.
	No caption	4.04	3.53	3.44	3.44	3.38	3.29
	Mean	4.01	3.54	3.47	3.44	3.38	3.29
3	1	1.43	1.43	2.29	2.29	3.43	1.57
	2	4.29	1.71	1.00	1.00	1.43	1.00
	3	1.14	3.43	3.43	5.00	3.71	3.14
	4	4.43	3.00	2.43	1.57	1.43	1.43
	5	4.29	4.57	3.71	5.86	6.00	5.57
	6	3.71	4.00	3.43	2.57	2.71	2.71
	Caption	3.21	3.03	2.77	3.34	3.26	2.80
	No caption	3.00	2.43	1.57	1.43	1.43	n.a.
	Mean	3.21	3.02	2.71	3.05	2.95	2.57
4	1	1.86	1.86	1.86	1.43	1.43	1.14
5	1	3.64	3.71	3.86	3.71	3.78	4.57

Note: Experiments 4 and 5 only included drawings with and without captions, respectively. Data cells with "n.a." (not available) indicate missing data due to nonexisting drawing for this specific condition.

Method

Participants
A total of 177 undergraduates of the University of Bamberg (147 female; mean age = 22.7 years, range: 19–71 years) participated for course credit. All of them were naïve to the purpose of the study.

Material
We used the same three pictures as those from Experiment 1 plus three additional pictures of comparable pictorial quality (Figure 3, Objects 1–6). Face-likeness of all six pictures had been

evaluated in Prestudy B, described in Experiment 1. Again, all pictures were labelled as "portrait of the human".

Procedure
We used Bartlett's method of "serial reproduction" described in Bartlett (1932, chapter 5). The participants were randomly assigned to one of six conditions. Each group started with a different initial object, which the participants had to inspect for 30 s. After a delay of 15 min, participants were given 60 s to draw the inspected object. Each following week, they inspected reproductions

produced by different participants, which they again had to reproduce following the procedure employed for the initial session. All in all, the experiment lasted six weeks for each participant.

To measure the face-likeness of the produced material, 7 participants (6 female; mean age: 21–43 years, mean = 24.7 years) from a different sample from any of the groups used in the present study rated the degree of face-likeness of the drawings on a 7-point Likert scale (1 = "not face-like at all" to 7 = "very face-like").

Results and discussion

The face-likeness ratings were evaluated with a two-way mixed design ANOVA with *initial object* (1–6) as between-participants factor and *session number* (1–6) as within-participants factor. A significant effect of session number was obtained, $F(5, 39) = 9.69$, $p < .0001$, $\eta_p^2 = .112$ (see Figure 4) with decreasing (!) face-likeness from

the initial to all the following reproduction sessions, ps < .001. This means that our findings are in contrast to Bartlett's (1932) results, as participants did not tend towards more stereotypical sketches, but in fact showed a significantly reduced association to face-like representations.

Furthermore, a significant effect of initial object, $F(5, 77) = 8.59$, $p < .0001$, $\eta_p^2 = .358$, was obtained. Pairwise comparisons revealed significant differences with sessions of Initial Object 5 being more facelike than those of Initial Objects 1, 4, 6 (ps < .001) and, as a trend, Object 2 ($p = .075$). Means are shown in Table 2.

As in Experiment 1, only a small part of the drawings included in the final analysis showed, at least partially, references to the initial caption (13 out of 498). A Wilcoxon signed-rank test for paired samples revealed no significant difference in face-likeness between drawings with and without initial caption, $T = 3$, $p = .285$, *ns* (see Table 2), but due to unequal sample sizes,
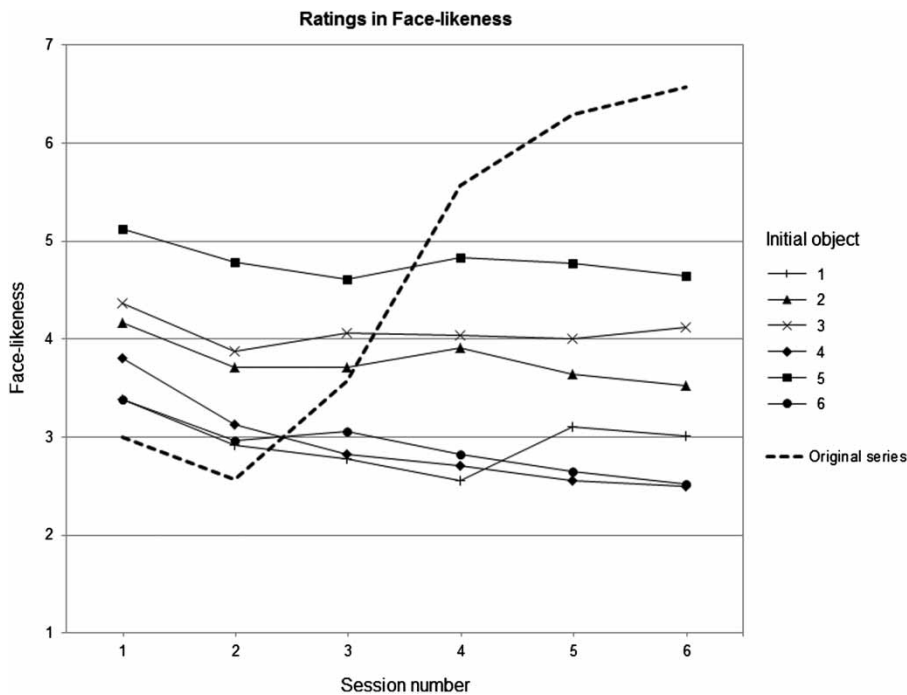

Figure 4. *Face-likeness ratings in Experiment 2. For each initial object, one graph with session number (x-axis) is shown. Means are indicated. An additional graph displays the ratings in face-likeness of the first six drawings of the "portrait d'homme" series.*

conclusions on these data should be drawn carefully. The missing signatures again confirm the assumption that participants, who were not forced to copy the caption along with the inspected object, did not associate the caption as being relevant for the picture, which also prevented a tendency towards more face-likeness.

EXPERIMENT 3: SERIAL REPRODUCTION WITH EXPLICIT NAMING

The major aim of Experiment 3 was to replicate Bartlett's (1932) original procedure of "serial reproduction" with explicit naming by unequivocally asking the participants (a) to "draw the face" seen before, plus (b) to copy the signature "portrait of the human".

Method

Participants
Thirty-six undergraduates of the University of Bamberg (29 female; mean age = 23.7 years, range: 20–51 years) participated for course credit. All of them were naïve to the purpose of the study.

Material
We used all six pictures from Experiment 2 (Figure 3, Objects 1–6). Again, all pictures were labelled as "portrait of the human".

Procedure
We again used Bartlett's (1932) method of "serial reproduction" as described in Experiment 2. In contrast to Experiments 1 and 2, we explicitly instructed them to reproduce "the face seen before". To measure the face-likeness of the produced material, 7 participants (4 female; mean age = 25.4 years, range: 19–47 years) from a different sample from any of the groups used in the present study rated the degree of face-likeness of the drawings on a 7-point Likert scale (1 = "not face-like at all" to 7 = "very face-like").

Results and discussion

The face-likeness ratings were evaluated with a two-way mixed design ANOVA with *initial object* (1–6) as between-participants factor and *session number* (1–6) as within-participants factor. There was no significant effect of factor session number, $F(5, 18) = 1.69$, $p = .140$, *ns*, but the factor initial object reached significance, $F(5, 36) = 32.93$, $p < .0001$, $\eta_p^2 = .821$, which is due to the fact that only one series for each initial object was done (see Table 2). Pairwise comparisons revealed significant differences with sessions of Initial Object 3 being more face-like than those of Initial Objects 1 ($p = .001$) and 2 ($p < .0001$), those of Initial Object 5 more face-like than those of Initial Objects 1, 2, 3, 4 ($ps < .0001$), and those of Initial Object 6 more face-like than those of Initial Object 2 ($p < .001$).

In contrast to Experiments 1 and 2, the majority ($n = 29$) of the 36 participants copied the signature. A Wilcoxon signed-rank test for paired samples revealed a significant difference in face-likeness with drawings with initial caption being more face-like than drawings without caption, $T = 5$, $p = .043$, $r = -.64$, but still, further conclusions should be drawn with caution due to unequal sample sizes (means are shown in Table 2). Although most participants copied the signature, none of the series showed a trend in the direction predicted by Bartlett (1932). These findings suggest that naming is not the only determinant for activating the schema of a face to progressively generate more face-like drawings.

EXPERIMENT 4: SERIAL REPRODUCTION WITH EXPLICIT NAMING AND EXTENDED DELAY

Since naming as the only determinant of activating the face schema did not work in Experiment 3, the major aim of Experiment 4 was to increase the memory demands of Experiment 3 by extending the delay between the inspection and reproduction phase to 24 hours. This was done to increase the probability of forgetting the initially inspected

stimuli following the finding of long intervals between tests potentially facilitate forgetting (Wheeler & Roediger, 1992). This slight adaptation of the experimental procedure should increase the influence of a face schema biasing retrieval towards it.

Method

Participants
Six undergraduates of the University of Bamberg (3 female; mean age = 26.5 years, range: 21–47 years) participated for course credit. All of them were naïve to the purpose of the study.

Material
Since we focused on the determinants that could enable the transmission of an ambiguous sketch into a drawing of a prototypical face, we only used the original picture (Figure 3, Object 1) as shown in the "portrait d'homme" series. Again, the picture was labelled as "portrait of the human".

Procedure
We again used Bartlett's (1932) method of "serial reproduction" as described in Experiment 2. We explicitly instructed the participants to reproduce "the face seen before", as already done in Experiment 3. To test the influence of another factor besides naming, the delay between inspection and reproduction was extended to 24 hours.

To measure the face-likeness of the produced material, 7 participants (2 female; mean = 28.3 years, range: 21–38 years) from a different sample from any of the groups used in the present study rated the degree of face-likeness of the drawings on a 7-point Likert scale (1 = "not face-like at all" to 7 = "very face-like").

Results and discussion
The face-likeness ratings were evaluated with a one-way repeated measurement ANOVA with *session number* (1–6) as within-participants factor. We found no significant effect, $F(5, 30) = 1.74$, $p = .156$, *ns*, which means that neither explicit naming nor an extended delay leads to drawings as shown

by Bartlett (1932). Importantly, the caption was not reproduced by any of the participants.

EXPERIMENT 5: REPEATED REPRODUCTION WITH HIGHLY SUGGESTIVE NAMING AND EXTENDED DELAY

The major aim of Experiment 5 was to further increase the potential activation of a face schema by using Bartlett's (1932) procedure of "repeated reproduction" not only with an explicit naming task, as done in Experiments 3 and 4, but also instructing the participants to inspect and then reproduce "a face inspired by the inspected display before". As in Experiment 4, an extended delay of 24 hours was used.

Method

Participants
Two graduates of the University of Bamberg (2 female; 29 and 44 years) participated in the present study. They were naïve to the purpose of the study.

Material
As in Experiment 4, we only used the original picture (Figure 3, Object 1) as shown in the "portrait d'homme" series. Again, the picture was labelled as "portrait of the human".

Procedure
We used Bartlett's (1932) method of "repeated reproduction" as described in Experiment 1 to increase the possible influence of suggestive instruction. We explicitly instructed the participants to inspect "the face" and then reproduce "a face inspired by the inspected display before" and repeated the instruction to draw "a face" at each reproduction session. As in Experiments 3 and 4, the delay between inspection and reproduction was extended to 24 hours.

To measure the face-likeness of the produced material, 7 participants (2 female; mean age = 28.3 years, range: 21–38 years) rated the degree of

face-likeness of the drawings on a 7-point Likert scale (1 = "not face-like at all" to 7 = "very face-like"). The people were the same participants as those in Experiment 4. Ratings for Experiments 4 and 5 were done in the same session.

Results and discussion

The face-likeness ratings were evaluated with a one-way repeated measurement ANOVA with *session number* (1–6) as within-participants factor. We found no significant effect, $F(5, 30) = 1.45$, $p = .235$, *ns*. Although using highly suggestive naming and extended delay, we found no tendency towards the findings reported by Bartlett (1932), although the caption was reproduced by both participants.

GENERAL DISCUSSION

In the present study, we tested several factors potentially influencing the quality of reproductions based on the inspection of ambiguous stimuli. The experimental design was derived from Bartlett's (1932) book *Remembering*, which is known as the pioneer book of the so-called schema theory. Primarily, we focused on the *naming hypothesis*. In his original work, Bartlett (1932, pp. 178–179) refers to one series of reproduction with each single reproduction generation showing an explicit reference to the naming of the stimulus ("portrait of the human"), which might be a reason for strongly activating the schema of a face to progressively generate more face-like drawings. To empirically test the influence of naming and other factors such as the delay between inspection and reproduction, we conducted a series of five experiments. In the first two experiments, we let participants reproduce series of drawings following Bartlett's methods of "repeated reproduction" (Experiment 1) and "serial reproduction" (Experiment 2) without explicitly stressing any face association, except for the signature of the initial pictures.

In Experiment 1, we could not replicate the original findings documented by Bartlett (1932): Face-likeness did not change across six subsequent reproduction sessions. The procedure employed here is, however, known to be relatively insensitive for detecting subtle schema-directed developments, as already pointed out by Bartlett. We therefore employed a second experiment (Experiment 2) using the more sensitive method of "serial reproduction". Again, we did not find any increase in face-likeness across succeeding sessions.

The schema theory proposes that ambiguous material will be elaborated as long as it reaches a direction to meaningful characteristics. If such a level has been reached, the schematization process should lead to a stable solution. Consequently we carefully created and used stimuli with a variety of initial face-likeness including the original material provided by Bartlett (1932). Still, none of the pictures evoked the assumed development towards more face-likeness with subsequent reproductions. On the contrary, Experiment 2 even revealed opposite effects with a significant decrease of face-likeness over time.

A deeper inspection of the routine of reproducing the caption showed that most participants did not remember, or at least did not consider it important to reproduce, the caption at all. Interestingly, the significant drop of reproducing captions revealed from the first to the second session is strongly related to a concordant decrease of face-likeness (in Experiment 2). Bartlett (1932) already speculated about the naming of ambiguous stimuli as an essential predictor for the degree of schematization, although he did not take systematic empirical evidence into account.

As we failed to replicate any tendency towards Bartlett's (1932) original findings, we conducted three additional experiments (Experiments 3–5) to get closer to Bartlett's obvious procedure of explicitly stressing the face-likeness nature of stimuli. In Experiments 4 and 5, we additionally employed an extended delay to increase the probability of forgetting the original visual display and thus activating a face schema "overwriting" the inspected stimulus. Even though we explicitly instructed the participants to draw "the face" (Experiments 3 and 4) or to draw "a face" (Experiment 5), none of the series of reproductions followed Bartlett's prediction of progressively increasing face-likeness.
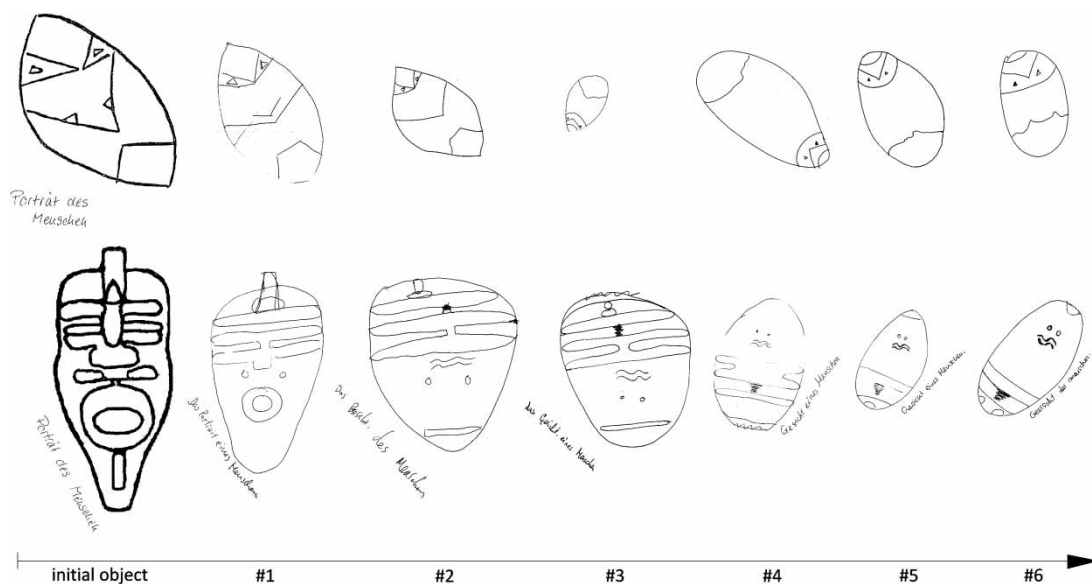
Figure 5. *Typical outcomes of the experiments.*

Summing up the results, we did not find any systematic development towards more face-likeness across the sessions for all variations of procedure, delay, and instruction. In Experiment 2, we even found a contrary effect with significantly decreasing face-likeness. Exemplary, and highly typical, outcomes of our experiments are shown in Figure 5.

As even explicitly stressing face-related associations in Experiments 3 and 4 did not show the expected effects, we could not verify the naming hypothesis. We could also qualify the idea of social desirability triggering the expected effects as quite unlikely shown by the ineffectiveness of highly suggestive instructions in Experiment 5. The sum of the resulting data pattern raises the question of Bartlett's (1932) "portrait d'homme" series (Figure 1) being a typical outcome of reproduction experiments. As Roediger and Thompson (1997) already noted, "in some cases, his 'experiments' were hardly more than controlled anecdotes" (p. 491).

CONCLUSION

Despite the specific criticisms prompted by the present research, we should not neglect the important insights that Bartlett's (1932) ground-breaking observation of continuous schematization of ambiguous material has provided for cognitive research. Whether we qualify parts of his pioneering work as rather speculative or just illustrative, they have had an immense impact on the development of cognitive theory, mainly in the domains of concept formation and memory distortion. As humans in a hypercomplex world of dynamic cognitive demands, we essentially need a cognitive mechanism systematically described and theorized by Frederic Bartlett to structure and facilitate interaction with our environment and the cognitive references to it. Without any doubt, we possess such abilities, with schematization clearly being an essential capability. Just as one example from the domain of vision science, Biederman, Glass, and Stacy (1973) demonstrated the power of schemata in misperceiving delocalized objects in real-world scenarios. Most relevant, Bartlett's idea of verbal schematization can be observed in everyday life contexts—for instance, Chinese whispers emerge from a mixture of ambiguous facts, missing information and unqualified interpretations. As our cognitive apparatus essentially uses such schematization, we interact in loops of

simplification and alteration. These processes change information, bias interpretations, and lead our actions. Even if we label this altering force an undesirable homunculus, it is a genuine part of what we call "cognitive processing".

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