TUM School of Education

Lehrstuhl für Wissenschaftskommunikation

Die „Aura“ des Originals – Wahrheit oder Mythos?

Wahrnehmung, Bewertung und Verarbeitung von authentischen Objekten in Ausstellungen von Wissenschafts- und Technikmuseen

Julia Constanze Hampp

Vollständiger Abdruck der von der Fakultät *TUM School of Education* der Technischen Universität München zur Erlangung des akademischen Grades eines

Doktors der Philosophie (Dr. phil.)

genehmigten Dissertation.

Vorsitzende:	Univ.-Prof. Dr. Annette Noschka-Roos
Prüfer der Dissertation:	1. Univ.-Prof. Dr. Wolfgang M. Heckl
	2. Univ.-Prof. Dr. Stephan Schwan (Institut für Wissensmedien, Tübingen)
	3. Univ.-Prof. Dr. Doris Lewalter

Die Dissertation wurde am 16. Juni 2014 bei der Technischen Universität München eingereicht und durch die Fakultät *TUM School of Education* am 12. September 2014 angenommen.

Herzlichen Dank an…

Prof. Dr. Wolfgang Heckl
Prof. Dr. Stephan Schwan
Prof. Dr. Doris Lewalter

Daniela Augstein
Dr. Jela Bauer
Janos Frisch
Marco Gerling
Daniel Jacob
Dr. Lorenz Kampschulte
Uta Karrer
Prof. Dr. Annette Noschka-Roos
Nicole Pertl
Barbara Schorr
Melanie Schreyer
Dr. Inga Specht
Malgožata Stefanovič
Andrea Weniger

die Kuratoren
die wissenschaftlichen Mitarbeiter
die Mitarbeiter der Werkstätten
die Mitarbeiter des Aufsichtsdienstes
und die Besucher des Deutschen Museum

Norbert Gast
Annika Menke
Dr. Nina Möllers
Ole Weber

Jeder Einzelne von Ihnen / Euch hat wesentlich dazu beigetragen, dass mein Promotionsprojekt ein Erfolg wurde!

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1 Problemstellung, Forschungsstand, Definitionen

Objekte stehen seit jeher im Mittelpunkt der meisten Museen und Ausstellungen. Selbst wenn inzwischen auch vielfältige andere Vermittlungsformen zum Einsatz kommen, die neben anschaulichen Texten und Abbildungen auch Medienstationen oder interaktive Exponate umfassen, sind echte, „authentische“ Objekte nach wie vor die Hauptattraktionen in vielen Ausstellungen. Die Möglichkeit, Objekte zu präsentieren, unterscheidet Museen grundsätzlich von anderen informellen Orten der Wissensvermittlung. So müssen sich Massenmedien oder Internet darauf beschränken, Dinge und damit verbundene Inhalte anhand von Abbildungen oder Texten zu repräsentieren. Die meisten Museumsexperten sind sich zudem einig, dass Objekte gegenüber anderen Ausstellungselementen spezifische Vorteile aufweisen. Sie nehmen an, dass Museumsbesucher Objekte nicht nur höher bewerten (Pearce, 1994), sondern sich auch eingehender mit ihnen beschäftigen und sie besser verarbeiten (Scholze, 2004) als beispielsweise Fotografien. Für die tatsächliche Rolle von Objekten im Hinblick auf Prozesse der Informationsverarbeitung und des Wissenserwerbs gibt es bislang allerdings kaum empirische Evidenz.

Einen ganz besonderen Stellenwert in Museen haben authentische Objekte von historischer Bedeutung. Dementsprechend stehen sie als „kulturelles Erbe“ auch im Mittelpunkt der Museumsdefinition des International Council of Museums:

> A museum is a non-profit, permanent institution in the service of society and its development, open to the public, which acquires, conserves, researches, communicates and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment (ICOM, 2007).

Tatsächlich ist der hohe Stellenwert von authentischen, historisch bedeutsamen Originalen im Hinblick auf die Sammlungen eines Museums unbestritten, denn sie sind prestigeträchtig, von hohem ökonomischem Wert und ermöglichen historische Forschung.

Auch was die Präsentation in den Ausstellungen betrifft, gehen viele Museumsexperten von einer besonderen Wirkung von originalen Objekten aus (Hein, 2007). Denn als „Zeitzeugen“ sei es ihnen möglich, Geschichten aus vergangenen Epochen, von fernen Orten und berühmten Personen zu erzählen (Korff, Eberspächer, König, Tschofen, & Baumunk, 2002). Ob die Museumsbesucher diese Geschichten auch hören und authentische Objekte von historischer Bedeutung auch für sie eine besondere Rolle spielen, ist bislang jedoch nicht empirisch überprüft worden und sollte kritisch hinterfragt werden.

1.1 Die Wirkung von (Museums-)Objekten – Forschungsstand

Insgesamt handelt es sich bei der Wirkung von Objekten im Museum um ein beliebtes Forschungsthema. In mehreren empirischen Studien wurde untersucht, inwiefern Objekte Interesse wecken, das Verstehen von wissenschaftlichen Inhalten erleichtern, oder auch die kritische Auseinandersetzung mit wissenschaftlichen Themen fördern (z. B. Paris, 2002). So konnte beispielsweise gezeigt werden, dass Objekte eine hohe Anziehungskraft *(attraction power)* besitzen und eine lange Verweildauer der Besucher *(holding power)* bewirken (Boizvert & Slez, 1995; Sandifer, 2003). Zudem führt die Beschäftigung mit Objekten bei den Besuchern zu Gesprächen über ihre Bedeutung. Dies wurde vor allem bei Familienbesuchen oder in der Kommunikation zwischen Eltern und ihren Kindern deutlich (Leinhart & Crowley, 2002). Die Gespräche haben wiederum ein besseres Verständnis wissenschaftlicher Erkenntnisse und Forschungsprinzipien zur Folge (Zimmermann, Reeve, & Bell, 2009). Auf die Ursachen für die spezifischen Vorteile von Objekten wurde in der empirischen Museumsforschung bislang allerdings nur wenig eingegangen.

Worauf könnte die besondere Wirkung von Objekten also zurückzuführen sein? Objekte zeichnen sich im Gegensatz zu medialen Repräsentationen wie beispielsweise Fotografien unter anderem durch ihre Drei-Dimensionalität und Materialität aus. Dadurch können sie ihren Betrachtern ein Vielfaches an Informationen liefern. Tatsächlich konnten in Studien, die Objekte und Abbildungen miteinander verglichen, Vorteile hinsichtlich der Verarbeitung echter Objekte gefunden werden (Felix, Parker, Lee, & Gabriel, 2011). In der Konsumentenforschung zeigten sich diese Vorteile auch bei interaktiven, drei-dimensionalen Abbildungen, die im Gegensatz zu nicht-interaktiven digitalen Fotografien gedreht und vergrößert werden konnten (Daugherty, Li, & Biocca, 2008). Entsprechend fanden Internetkunden drei-dimensionale, interaktive Produktabbildungen detaillierter sowie einfacher und unterhaltsamer in der Verwendung als herkömmliche, nicht-interaktive Produktabbildungen, was wiederum zu einer größeren Zufriedenheit führte (Ozok & Komlodi, 2009).

Denkt man allerdings an die Präsentation von drei-dimensionalen Objekten im Museum, so können diese aus konservatorischen Gründen von den Besuchern häufig nicht von allen Seiten exploriert werden. Objekte werden hier meist hinter Glas in einer Vitrine ausgestellt, was die Anzahl an Blickwinkeln auf das Objekt deutlich reduziert. Letztendlich bietet das Objekt so oft nicht mehr Informationen als eine Fotografie. Dennoch unterscheiden sich Objekt und Fotografie in einem wesentlichen Punkt, der sich auf den ontologischen Status des Gegenstands bezieht: Das echte Objekt wird präsentiert und steht damit für sich selbst. Es hat irgendwann einmal einem bestimmten Zweck gedient und könnte, wenn man es aus der Vitrine herausnehmen würde, zumindest theoretisch wieder zu diesem Zweck eingesetzt

werden. Fotografien von Objekten können hingegen nicht für den vorgesehenen Zweck des Objekts eingesetzt werden, sie stehen nicht für sich selbst, sondern repräsentieren lediglich das Objekt, das sie abbilden. Die Präsentation des für sich selbst stehenden, echten Objekts kann in diesem Zusammenhang als authentisch bezeichnet werden. Da in den einzelnen Studien der vorliegenden Arbeit unterschiedliche Aspekte des Begriffs *authentisch* beleuchtet wurden, soll er im Folgenden genauer ausdifferenziert werden.

1.2 Was ist ein authentisches Objekt? – Definitionen

In einer sehr breiten Definition handelt es sich bei einem authentischen Objekt also um einen drei-dimensionalen, materiellen und prinzipiell funktionsfähigen Gegenstand in Abgrenzung zu einer medialen Repräsentation wie beispielsweise einer Fotografie. Allerdings gibt es bislang keine empirischen Studien, die die spezifischen Vorteile des ontologischen Status von in diesem Sinne authentischen Objekten systematisch überprüfen. Die erste Studie der vorliegenden Dissertation widmet sich daher der Wirkung von authentischen Objekten im Sinne dieser breiten Definition.

Während die Fotografie eines Objekts auf den ersten Blick als Reproduktion eingeordnet werden kann, gibt es auch Reproduktionen, die sich nicht sichtbar vom authentischen Objekt unterscheiden. Gegenstände, die speziell für Ausstellungen konzipiert wurden, wie Nachbildungen von Originalen, Modelle oder aber auch Demonstrationen, zeichnen sich zwar auch durch die Attribute Materialität und oft auch durch ihre Verwendbarkeit aus, trotzdem stehen sie nicht für sich selbst, sondern repräsentieren das Original. In einer etwas engeren Definition handelt es sich daher bei authentischen Objekten um Gegenstände, die entweder in der realen Welt entstanden sind oder für bestimmte Zwecke hergestellt wurden (Evans, Mull, & Poling, 2002; Gurian, 1999). Der Begriff authentisch ist in diesem Fall gleichbedeutend mit *original*.

In einer noch engeren Definition darf der Begriff authentisch nur für solche originalen Objekte verwendet werden, die in einer physischen Verbindung mit einem bedeutenden historischen Ereignis, einer Entwicklung oder einer berühmten Person standen (Frazier, Gelman, Wilson, & Hood, 2009). Beispiele für solche Objekte sind die Ausrüstung einer Raumfahrtmission, Erfindungen, die damals einen wissenschaftlichen Meilenstein markierten oder Instrumente von berühmten Wissenschaftlern.

Ein anderer Aspekt von authentischen Objekten ist ihre Einzigartigkeit. Ein Objekt wird also nur dann als authentisch bezeichnet, wenn es sich um ein einzelnes Exemplar handelt, von

dem keine (oder nur sehr wenige) Kopien existieren (Newman & Bloom, 2012). Bedeutsamkeit und Einzigartigkeit sind häufig eng miteinander verknüpft. Ein typisches Beispiel ist der Patent-Motorwagen von Carl Benz aus dem Jahr 1886, der nur einmal gebaut wurde und im Deutschen Museum in München ausgestellt ist.

In der zweiten und dritten Studie dieser Dissertation wurde eine Definition für authentische Objekte zugrunde gelegt, in der sowohl die Originalität als auch die historische Bedeutsamkeit der Objekte eine Rolle spielen. Authentische Objekte sind demnach originale Objekte, die einen Zweck in der Welt außerhalb des Museums erfüllten, somit also nicht nur für Ausstellungszwecke hergestellt wurden und zudem von historischer Bedeutung sind.

1.3 Die Wirkung von Originalen im Gegensatz zu anderen Objekttypen – Forschungsstand

Authentische Objekte im Sinne von originalen Objekten von historischer Bedeutung kommen in den Studien zur Wirkung von Museumsobjekten nur selten vor. In einigen Studien, die in Wissenschaftsmuseen oder Science Centern durchgeführt wurden, standen hingegen andere ausgewählte Objekttypen im Fokus. Zum einen waren dies interaktive „Hands-on“-Exponate, zum anderen handelte es sich um Modelle oder Demonstrationen. Diese Objekttypen unterscheiden sich durch einige wesentliche Merkmale von authentischen Objekten. Hands-on-Exponate zeichnen sich dadurch aus, dass sie der Besucher anfassen und dadurch explorieren und erforschen kann. Modelle und Demonstrationen visualisieren wissenschaftliche Phänomene oder Prinzipien, die häufig nicht direkt wahrgenommen werden können, da sie entweder auf sehr großen oder aber auch kleinen zeitlichen und räumlichen Maßstäben zu verorten sind (wie beispielsweise Sonnensysteme oder Strukturen im Nanometerbereich). In mehreren Studien wurde die Interaktion mit und die Kommunikation über diese beiden Objekttypen untersucht. Der Lernerfolg hing dabei vor allem von der Auswahl und dem Design der dargebotenen Phänomene ab (Afonso & Gilbert, 2007; Allen & Gutwill, 2004; Falk, Scott, Dierking, Rennie, & Jones, 2004). Zudem stellte sich heraus, dass die interaktive Beschäftigung mit echten Objekten und digitalen Simulationen zu einem vergleichbaren Lerneffekt führt (Olympiou & Zacharia, 2011; Triona & Klahr, 2003).

Eine der wenigen Studien, die sich mit der Wirkung von Originalen beschäftigen, stammt von Lindgren-Streicher und Reich (2007), die originale Artefakte mit gegenständlichen und digitalen Modellen verglichen. Anhand einer Konstruktionsaufgabe und einer Aufgabe zur Interpretation des Exponates ließen sich unterschiedliche Vorlieben im Umgang mit den Objekten, Einstellungen und Lernerfolge erkennen. In einer weiteren Studie in einem

botanischen Garten verglichen Eberbach und Crowley (2005) lebende, authentische Pflanzen mit Modellen und virtuellen Pflanzen. Dabei stellte sich heraus, dass lebende Pflanzen bei den Besuchern mehr Bezüge zum alltäglichen Leben hervorrufen, während Modellpflanzen und virtuelle Pflanzen eher Erklärungen zu ablaufenden Prozessen liefern.

Auch wenn in den beiden zuletzt beschriebenen Studien authentische, originale Objekte eine Rolle spielen, so stehen sie doch wieder im Kontext eines interaktiven Experimentierumfeldes. Üblicherweise werden authentische Objekte von historischer Bedeutung hingegen so präsentiert, dass sie nur betrachtet, nicht aber berührt oder gar ausprobiert werden können. Unterschiede in der Wahrnehmung oder Bewertung authentischer Objekte und entsprechender identischer Nachbildungen können daher nicht mehr auf mögliche Vorteile in der Handhabung, sondern müssen auf Mechanismen der Bedeutungszuschreibung zurückgeführt werden.

Jenseits des Museumskontextes findet man einige empirische Studien, die sich mit Wirkunterschieden von Objekten beschäftigt haben, die allein auf die unterschiedliche historische Bedeutung dieser Objekte zurückzuführen sind. In diesen Studien wird deutlich, dass Authentizität im Sinne von Bedeutsamkeit und Einzigartigkeit ein wichtiges Merkmal von Objekten und Besitztümern zu sein scheint. So wurden authentische Objekte im Vergleich zu entsprechenden, unbedeutenden Gegenständen aus dem alltäglichen Leben als wertvoller eingeschätzt und riefen ein höheres Bestreben hervor, sie aufzubewahren, zu besitzen oder zu berühren (Frazier et al., 2009). In der empirischen Forschung zu diesem Thema ging es vor allem um den Vergleich zwischen authentischen Objekten und Nachbildungen oder Fälschungen oder um den Vergleich zwischen Gegenständen von prominenten Persönlichkeiten und Alltagsgegenständen (Newman & Bloom, 2012; Newman, Diesendruck, & Bloom, 2011).

Auch wenn es nahezu keine empirische Evidenz für die Wirkung von authentischen Objekten im Museum zu geben scheint, gibt es empirische Belege dafür, dass es sich für die Besucher eines Museums bei der Möglichkeit, ein berühmtes authentisches Objekt zu sehen, um ein ganz besonders zufriedenstellendes Museumserlebnis handelt (Pekarik et al., 1999; Kirchberg & Tröndle, 2012). Entsprechend zeigte eine Umfrage unter Schülern, dass sich das Betrachten eines authentischen Objektes nachhaltig auf Einstellungen, Interessen, Verständnis, Ansichten und Werte der Individuen auswirken kann (Soren, 2009). Vor diesem Hintergrund ist die Forderung nach empirischen Studien, die die Beziehung zwischen unterschiedlichen Objekttypen, Kontexten und Besuchereigenschaften systematisch überprüfen (Latham, 2013), mehr als nachvollziehbar.

2 Forschungsfragen und Hypothesen

Die Studien, die der vorliegenden Dissertation zugrunde liegen, sollen die oben beschriebenen Forschungslücken schließen und die Rolle authentischer Objekte auf Museumsbesucher systematisch überprüfen. Die erste, hypothesengeleitete Studie konzentriert sich dabei auf die Verarbeitungsprozesse authentischer Objekte im Sinne von drei-dimensionalen, materiellen Objekten und kontrastiert sie mit Fotografien dieser Objekte. Die Hypothesen lauten:

1.1 Realistische, maßstabsgetreue Fotografien von Objekten erhalten weniger Aufmerksamkeit als die entsprechenden realen Objekte.

1.2 Realistische, maßstabsgetreue Fotografien von Objekten werden weniger gut erinnert als die entsprechenden realen Objekte.

Die anderen beiden Studien haben im Gegensatz zur ersten Studie vor allem einen explorativen Charakter. Hier geht es um die Wahrnehmung und Bewertung von authentischen Objekten im Sinne von originalen Objekten von historischer Bedeutung. Beide Studien vergleichen diese Originale mit identischen Nachbildungen dieser Objekte. In Studie 2 stehen dabei die Bewertung der Objekte sowie die Kriterien, nach denen diese Bewertung erfolgt, im Fokus. Die Studie basiert auf den folgenden Forschungsfragen:

2.1 Welche Rolle spielt Authentizität für die Wahrnehmung von Objekten bei Museumsbesuchern?

(a) Bewerten Besucher authentische Objekte, definiert als originale Objekte von historischer Bedeutung, höher als identische Nachbildungen?

(b) Welche Dimensionen von Authentizität können unterschieden werden?

2.2 Welche anderen Faktoren – neben Authentizität – gibt es, die die Wahrnehmung von Objekten bei Museumsbesuchern beeinflussen?

Studie 3 konzentriert sich im Vergleich zu Studie 2 auf Originale von besonders signifikanter historischer Bedeutung, die auch als Meisterwerke bezeichnet werden. Im Zentrum stehen die Wahrnehmung und die Bewertung dieser Objekte, die sich in folgenden Forschungsfragen spiegeln:

3.1 Nehmen Museumsbesucher authentische Objekte, definiert als originale Objekte von signifikanter historischer Bedeutung, anders wahr als identische Nachbildungen?

(a) Bemerken Besucher den Authentizitätsstatus der ausgestellten Objekte?

(b) Berichten Besucher andere Aspekte bei der Wahrnehmung authentischer Objekte als bei der identischer Nachbildungen?

3.2 Bewerten Museumsbesucher authentische Objekte anders als identische Nachbildungen?

(a) Aus welchen Gründen bewerten Besucher authentische Objekte (nicht) höher als identische Nachbildungen?

(b) Führen authentische Objekte bei Besuchern zu einem stärkeren Bedürfnis, das Objekt zu berühren und zu besitzen, und wird ihr ökonomischer Wert höher eingeschätzt als der Wert identischer Nachbildungen?

3 Methode

Die Studien wurden im Deutschen Museum in München, einem der größten Wissenschafts- und Technikmuseen weltweit, durchgeführt. Allen insgesamt drei Studien lag ein experimentelles Design zugrunde, wobei jeweils der Status der präsentierten Objekte variiert wurde. Für die Studien 1 und 2 wurde in der Ausstellung „Neue Technologien“ ein kleines Ausstellungsensemble konzipiert. Es bestand aus drei in einer Reihe angeordneten Vitrinen, die mit unterschiedlichen Aufbauten zu Themen aus dem Bereich der neuen Technologien bespielt wurden (vgl. Abbildung 1).

Abbildung 1: Vitrinenensemble zum Thema Nanotechnologie

Für die dritte Studie, die in der Ausstellung „Raumfahrt“ durchgeführt wurde, wurde kein Experimentalensemble konzipiert. Vielmehr wurden hier geeignete Objekte, die in der bestehenden Ausstellung präsentiert werden, für das Experiment ausgewählt. Eingesetzt wurden sowohl quantitative als auch qualitative Methoden, die sich gegenseitig ergänzen und ihre jeweiligen Schwächen ausgleichen sollten.

3.1 Studie 1 – Objekte vs. Fotografien in der Ausstellung „Neue Technologien“

Im Mittelpunkt der ersten Studie stand jeweils die mittlere Vitrine des oben beschriebenen Ausstellungsensembles, während die beiden flankierenden Vitrinen eine möglichst natürliche Ausstellungssituation herstellen sollten. In der mittleren Vitrine wurden zwei Objekte inklusive einer Beschreibung auf einem Label präsentiert, die von Texten, Grafiken und Abbildungen an der Rückwand der Vitrine umgeben waren. Die Objektpaare illustrierten jeweils einen konflikthaften wissenschaftlichen Sachverhalt, wobei eines der beiden Objekte einen Vorteil einer neuen Technologie repräsentierte, während das andere Objekt für einen Nachteil der

ausgestellten Technologie stand. Von jedem der ausgewählten Objekte wurde eine maßstabsgetreue Fotografie angefertigt, die das Objekt im selben Blickwinkel zeigte, wie es auch in der Vitrine zu sehen war. Insgesamt wurden drei unterschiedliche Aufbauten getestet. Eine Auflistung aller Objekte inklusive der Abbildungen der in der Studie gezeigten Fotografien befindet sich im Anhang (A 2.1).

In insgesamt vier Teilexperimenten wurden sowohl der Status der Objekte (echtes Objekt vs. Fotografie) als auch das Thema der Vitrine (Medizintechnologie vs. Nanotubes vs. Nanosilber) systematisch variiert. In den Experimenten 1 und 2 ($n_1 = 55$, $n_2 = 53$) wurden die Objekte hinsichtlich ihrer Präsentationsform *unbalanciert* präsentiert. Das heißt, eines der beiden ausgestellten Objekte wurde als echtes Objekt, und das jeweils andere als Fotografie ausgestellt. Dabei wurde der einen Hälfte der Teilnehmer eine Vitrine dargeboten, in der das echte Objekt ein Pro-Argument repräsentierte, während die Fotografie für ein Contra-Argument stand. Für die andere Hälfte der Teilnehmer wurde die Zuordnung umgedreht, so dass das Pro-Argument durch eine Fotografie dargestellt wurde, und das Contra-Argument durch ein echtes Objekt. In den Experimenten 3 und 4 ($n_3 = 54$, $n_4 = 53$) wurden die Objekte in der Vitrine *balanciert* präsentiert. Den Teilnehmern wurden dabei entweder zwei echte Objekte oder zwei Fotografien dargeboten (vgl. Abbildungen 2 und 3).

Abbildung 2: Balancierte Präsentation mit zwei Objekten

Abbildung 3: Balancierte Präsentation mit zwei Fotografien

In jeweils einem der beiden balancierten und unbalancierten Experimente (Experimente 1 und 3) wurde die Hypothese getestet, dass Fotografien weniger Aufmerksamkeit erhalten als die entsprechenden echten Objekte. Dazu wurden die Teilnehmer mit einem mobilen Eyetracker ausgestattet (Locarna PT-Mini, update rate: 30 Hz, resolution: 720 x 480). Nach der Kalibrierung wurden die Teilnehmer gebeten, die oben beschriebenen Experimentalvitrinen in ihrer eigenen Geschwindigkeit und nach ihren persönlichen Interessen zu

betrachten. Die Eyetracking-Daten wurden im Hinblick auf die Anzahl der Fixationen auf die echten Objekte und die Fotografien ausgewertet. Eine Fixation war dabei definiert durch eine Dauer von mindestens fünf *frames* (ca. 167 msec) und einen maximalen Durchmesser von 50 pixel in den Videoaufzeichnungen des Eyetrackers (Salthouse & Ellis, 1980). Verweilte der Blick der Teilnehmer für mindestens den genannten Zeitraum innerhalb eines Kreises mit dem definierten Durchmesser, wurde dies als eine Fixation gezählt. Die Fixationszeiten für die jeweiligen Gegenstände wurden berechnet, indem die Zeiten der einzelnen Fixationen auf das echte Objekt oder die Fotografie zusammengezählt wurden.

In den verbleibenden Experimenten 2 und 4 wurde die Hypothese getestet, dass Fotografien weniger gut erinnert werden als die entsprechenden echten Objekte. Hier mussten die Teilnehmer keinen Eyetracker tragen, sondern wurden lediglich gebeten, die Vitrinen in ihrem eigenen Tempo und nach ihren persönlichen Interessen zu betrachten. Nach einer Stunde, in der sie andere Ausstellungen des Museums betrachten konnten, wurden sie gebeten, die Vitrine so genau wie möglich hinsichtlich ihrer Inhalte und ihrer Gestaltung zu beschreiben. Diese Rekonstruktionen wurden mit einem Aufnahmegerät aufgezeichnet und transkribiert. Die Transskripte wurden von zwei unabhängigen Codern ausgewertet, wobei zum einen die Nennung der jeweiligen Objekte und die Anzahl der genannten Objektdetails eine Rolle spielten. In einem Wiedererkennungstest (vgl. Anhang A 3.1) wurde den Teilnehmern im Anschluss eine Liste mit Abbildungen von mehreren Objekten vorgelegt. Hier sollten die Teilnehmer ankreuzen, welche Objekte sie in den Experimentalvitrinen gesehen hatten und ob die Objekte als Fotografien oder als echte Objekte präsentiert worden waren.

In allen vier Experimenten wurden die Besucher zudem gebeten, einen Fragebogen (vgl. Anhang A 3.2) auszufüllen, der neben Fragen zu soziodemographischen Daten auch Fragen zum Interesse und zum selbst eingeschätzten Vorwissen der Teilnehmer im Bereich Naturwissenschaften und neue Technologien sowie Fragen zu ihrer Ambiguitätstoleranz (Dalbert, 1999) enthielt.

3.2 Studie 2 – Originale vs. Nachbildungen in der Ausstellung „Neue Technologien“

Im Mittelpunkt dieser Studie standen die beiden äußeren Vitrinen des oben beschriebenen Experimentalvitrinen-Ensembles. In diesen Vitrinen wurde jeweils im Vordergrund ein Objekt präsentiert. Das Objekt wurde von Texten und Abbildungen umrahmt, die im Hintergrund an der Rückwand der Vitrine angebracht waren. Im Gegensatz zur ersten Studie wurden lediglich zwei Themen variiert. Während das Thema Medizintechnologie aus der ersten

Studie übernommen wurde, wurden die beiden Aufbauten zu Nanosilber und Nanotubes zum Aufbau Nanotechnologie zusammengefasst.

Während des Experiments wurde der Authentizitätsstatus der in den beiden äußeren Vitrinen ausgestellten Objekte systematisch variiert. Dazu wurden die Objekte den Besuchern abwechselnd als Originale oder als Nachbildungen präsentiert. Ausgetauscht wurde dabei aber nur die Information auf dem Label, die die Objekte entweder als Originale oder aber als identische Nachbildungen auswies. Die Objekte selbst wurden hingegen nicht ausgetauscht (vgl. Abbildungen 4 und 5). Anhang A 2.2 bietet eine Übersicht über alle getesteten Objekte inklusive der Variationen ihrer Labeltexte.

Abbildung 4: Präsentation des Rastertunnelmikroskops als Original

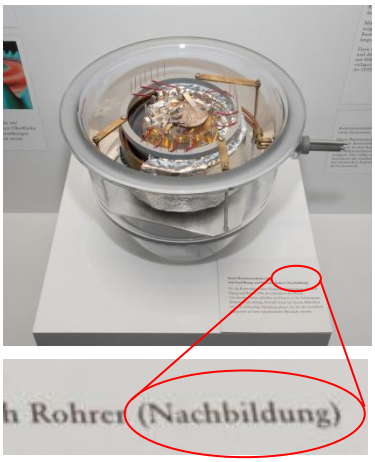

Abbildung 5: Präsentation des Rastertunnelmikroskops als Nachbildung

Insgesamt wurden 56 teilstrukturierte Interviews mit Besuchern geführt, die direkt in der Ausstellung „Neue Technologien“ rekrutiert wurden. Dabei wurden nur Besucher angesprochen, die die drei Experimentalvitrinen aus eigenem Antrieb angesehen hatten. Die Grundlage für das Interview bildete ein Leitfaden, der ausformulierte Fragen zu den wichtigsten anzusprechenden Themen enthielt (Gläser & Laudel, 2004). Dieser Fragenkatalog diente dem Interviewer als Gedächtnisstütze, wobei die Fragen je nach individuellem Interviewverlauf flexibel eingesetzt werden konnten. So ließ der Leitfaden genug Spielraum, spontan auf Antworten der Teilnehmer zu reagieren (Hopf, 1978). Die Interviews begannen mit einer Aufwärmphase, in der die Besucher um Angaben zu ihrer Person und zu den Begleitumständen ihres Museumsbesuchs gebeten wurden. Danach sollten die Teilnehmer die drei-dimensionalen Objekte, die sie in den Vitrinen gesehen hatten, in eine Rangreihenfolge bringen, beginnend mit dem Objekt, das sie am besten fanden. Parallel dazu wurden sie gebeten, ihre Entscheidung zu begründen und die Kriterien

zu nennen, nach denen sie die Objekte eingestuft hatten. Durch non-direktives Nachfragen des Interviewers wurden die Antworten der Teilnehmer weiter ausdifferenziert und eventuelle Unklarheiten beseitigt (Bortz & Döring, 2009). Falls die Teilnehmer den Authentizitätsstatus der Objekte nicht bereits in ihren Ausführungen aus eigenem Antrieb thematisiert hatten, wurden sie im nächsten Schritt gefragt, ob es sich bei den einzelnen Objekten in den Vitrinen um Originale oder Nachbildungen gehandelt habe. Unabhängig von der Richtigkeit ihrer Einordnung der Objekte als Originale oder Nachbildungen wurden die Teilnehmer anschließend aufgefordert zu beschreiben, was sich verändern würde, wenn es sich anstatt eines Originals um eine Nachbildung handeln würde oder umgekehrt. Der vollständige Interviewleitfaden befindet sich in Anhang A 3.3.

Alle Versuchspersonen wurden nach ihrer Teilnahme über den Hintergrund der Studie und vor allem über den richtigen Status der Objekte aufgeklärt. Die Interviews wurden mit Einverständnis der Teilnehmer mit einem Diktiergerät aufgezeichnet. Die Transkription erfolgte mithilfe der Software f4 mit Fokus auf den Inhalt der Redebeiträge ohne Berücksichtigung mikrosprachlicher Details, nonverbaler Äußerungen oder Sprecher-überlappungen (Kuckartz, Dresing, Rädiker, & Stefer, 2008).

Die Interviews wurden sowohl quantitativ als auch qualitativ ausgewertet. Die quantitativen Daten der durch die Teilnehmer erstellten Rangordnung der Objekte wurden statistisch analysiert. Im Fokus standen dabei die Unterschiede zwischen den Rangplätzen der als Originale gekennzeichneten Objekte und den Rangplätzen der als Nachbildungen gekenn-zeichneten Objekte. Alle anderen Teile des Interviews wurden unter Verwendung der Software MAXQDA qualitativ ausgewertet. Im Zuge der qualitativen Inhaltsanalyse wurden die Transskripte in einem ersten Materialdurchlauf in inhaltlich sinnvolle Textsegmente unterteilt, die jeweils einen Gedanken der Interviewten repräsentierten. Textsegmente, die für die Forschungsfragen der Studie relevant waren, wurden in einem nächsten Schritt zwei deduktiv aus den Forschungsfragen abgeleiteten Oberkategorien zugeordnet (Hopf, Rieker, Sanden-Marcus, & Schmidt, 1995). Diese Oberkategorien wurden *Aspekte von Authentizität* und *Relevante Faktoren in der Bewertung von Museumsobjekten* genannt. Die Kategorien innerhalb dieser beiden Oberkategorien wurden induktiv aus dem Text generiert. Für jeden neuen Authentizitätsaspekt und jeden neuen Faktor in der Objektbewertung wurde eine neue Kategorie gebildet, die durch das Formulieren von Kodierregeln und durch die Auswahl eines „Ankerbeispiels“ in der QDA-Software definiert wurde (Mayring, 2010). Die so gewonnenen Kategorien wurden im Folgenden entweder weiter verfeinert und in Subkategorien ausdifferenziert oder aber zu übergeordneten Kategorien zusammengefasst (Kuckartz & Rädiker, 2010). Dies erfolgte in Abhängigkeit davon, ob die weiteren Textsegmente neue Aspekte bezüglich einer Kategorie liefern konnten oder sich herauskristallisierte, dass

einzelne schon bestehende Kategorien aufgrund inhaltlicher Nähe zusammengefasst werden konnten. Das Material wurde auf diese Weise von zwei unabhängigen Codern ausgewertet. Abweichungen zwischen den beiden Codern wurden in regelmäßigen Abständen diskutiert und führten entweder zu einer Entscheidung für eine der beiden Varianten oder aber zu einem Kompromiss. Das resultierende induktiv gewonnene Kategorienmuster konnte auf diese Weise während des Auswertungsprozesses ständig erweitert, modifiziert und verfeinert werden.

3.3 Studie 3 – Originale vs. Nachbildungen in der Ausstellung „Raumfahrt“

Für diese Studie wurden in der Raumfahrt-Ausstellung des Deutschen Museums zwei Objekte mit evidenter historischer Bedeutung ausgewählt: Ein Stück Mondgestein und ein Raumanzug. Das Mondgestein, das zusammen mit einer kleinen Deutschlandflagge und einer Widmung des ehemaligen US-Präsidenten Nixon in einer Vitrine ausgestellt ist, kam mit der letzten APOLLO-Mission zur Erde. Der russische Raumanzug Sokol KV-2 wurde von dem deutschen Astronauten Klaus-Dietrich Flade während einer Mission zur MIR-Raumstation im März 1992 getragen.

Wie in der Studie in der Ausstellung „Neue Technologien“ wurde auch in dieser Studie der Status der Objekte systematisch variiert. Da aus der Präsentation der beiden Objekte in der Ausstellung hervorgeht, dass es sich um Originale handelt, wurde in der Originalbedingung keine Veränderung in der Ausstellung vorgenommen. Lediglich in der Nachbildungs-bedingung wurde neben den Objekten jeweils ein Plakat im Format DIN A0 aufgestellt, das die Besucher darauf aufmerksam machen sollte, dass es sich beim jeweiligen Objekt um eine 1:1-Nachbildung handele, da das Original gerade restauriert werde (vgl. Abbildungen 6 und 7).

Abbildung 6: Präsentation des Mondgesteins als Original und als Nachbildung

Abbildung 7: Präsentation des Raumanzugs als Original und als Nachbildung

Wie in der zweiten Studie in der Ausstellung „Neue Technologien“ wurden die insgesamt 120 Teilnehmer direkt in der Ausstellung rekrutiert. Voraussetzung für die Ansprache der Besucher war, dass sie das Objekt sowie – in der Nachbildungsbedingung – auch das ausgestellte Plakat mindestens 30 Sekunden betrachtet hatten. Die Besucher, die sich zu einer Teilnahme bereit erklärt hatten, wurden in einen Nebenraum gebracht, wo sie zuerst gebeten wurden, einen Fragebogen auszufüllen, und danach in einem halbstrukturierten Interview mündlich zu ausgewählten Aspekten befragt wurden.

Der Fragebogen war auf Basis der Ergebnisse des Interviews in der zweiten Studie entwickelt worden und begann ganz allgemein mit 12 Fragen zur Erwartung an Museumsobjekte, gefolgt von weiteren 12 Fragen zu Besonderheiten von Originalen. Der Hauptteil des Fragebogens beschäftigte sich mit dem ausgestellten Objekt – Mondgestein oder Raumanzug – und beinhaltete Fragen zum Status des ausgestellten Objekts, zum persönlichen Bedürfnis, das Objekt anzufassen oder zu besitzen (Frazier et al., 2009) sowie zur Einschätzung des Objektwerts (Newman & Bloom, 2011). Alle Fragen waren auf einer sieben-stufigen Skala zu beantworten. Abschließend wurden die Teilnehmer um sozio-demographische Angaben zu ihrer Person gebeten, inklusive Alter, Geschlecht und Bildungsstand. Der vollständige Fragebogen befindet sich in Anhang A 3.4.

Von den insgesamt 120 Teilnehmern erklärten sich 115 Teilnehmer dazu bereit, im Anschluss an den Fragebogen an einem mündlichen Interview teilzunehmen. Wie in den halbstrukturierten Interviews der zweiten Studie wurde auch hier wieder ein Interviewleitfaden ausgearbeitet, der ausformulierte Fragen zu den anzusprechenden Themen enthielt (vgl. Anhang A 3.5). Im Gegensatz zur zweiten Studie ging es im Folgenden allerdings nur noch um ein einziges Objekt – Mondgestein oder Raumanzug. Dieses sollte aber entgegen des Vorgehens der zweiten Studie erst einmal nicht bewertet werden. Vielmehr wurden die Teilnehmer in einem ersten Schritt gebeten zu beschreiben, was ihnen durch den Kopf gegangen war, als sie das Objekt betrachtet hatten. Falls der Interviewte die Sprache nicht selbst darauf gebracht hatte, wurde das Thema im nächsten Schritt auf den Status des Objekts gelenkt. Die Teilnehmer wurden gebeten, das Objekt als Original oder Nachbildung einzuordnen und ihre Aussage zu begründen. Wie in der zweiten Studie ging es im letzten Teil des Interviews um die Frage, was sich ändern würde, wenn statt dem Original eine Nachbildung ausgestellt gewesen wäre oder umgekehrt. Analog zur zweiten Studie wurden die Antworten der Teilnehmer durch non-direktives Nachfragen weiter ausdifferenziert. Auch die Aufzeichnung der Interviews und ihre Transkription erfolgten wie in der zweiten Studie.

Die Interviews wurden unter Verwendung der Analyse-Software MAXQDA qualitativ ausgewertet. Relevante Textsegmente wurden in einem ersten Schritt drei Hauptkategorien

zugeordnet, die aus den Forschungsfragen abgeleitet worden waren: *Gedanken und Gefühle während der Betrachtung des Objekts*, *Einordnung des Objekts als Original oder Nachbildung* und *Reaktionen auf den Statuswechsel des Objekts*. Im nächsten Schritt wurden wie in der zweiten Studie induktiv Unterkategorien zu den drei Hauptkategorien gebildet (Mayring, 2010). Die Auswertung erfolgte durch zwei unabhängige Coder, Unstimmigkeiten wurden diskutiert und im Anschluss wurde eine Entscheidung für die jeweils passendere Variante getroffen. Die anfangs noch drei Hauptkatgorien konnten im Laufe der Inhaltsanalyse zu zwei Kategorien zusammengefasst werden: der *Wahrnehmung von Authentizität* und der *Relevanz von Authentizität.*

Die quantitativen Daten des Fragebogens wurden statistisch ausgewertet. Im Mittelpunkt standen dabei die Einstellungen zum ausgestellten Objekt in Abhängigkeit davon, ob es als Original oder als Nachbildung wahrgenommen worden war. Ebenfalls in die Analysen einbezogen wurde die Relevanz der Authentizität für die Besucher (relevant vs. irrelevant). Diese Variable wurde aus den Interviews generiert. Abhängige Variablen waren der Wunsch, das Objekt zu berühren, der Wunsch, es zu besitzen sowie die Einschätzung des Objektwertes. Unabhängige Variablen waren der wahrgenommene Status des Objekts (Original vs. Nachbildung), der Objekttyp (Mondgestein vs. Raumanzug) sowie die Relevanz des Objektstatus (relevant vs. irrelevant).

4 Ergebnisse

Die Ergebnisse der drei Studien, die die empirische Basis dieser Dissertation darstellen, werden in den Publikationen im Anhang A 1 detailliert beschrieben. Jede Publikation behandelt dabei eine der drei Studien. Im Folgenden werden die Ergebnisse der Studien lediglich kurz zusammengefasst.

4.1 Studie 1 – “*Re*presentation equals presentation? Photographic depictions of objects receive less attention and are less well remembered than their real counterparts”

Die unbalancierten Experimente 1 und 2, in denen jeweils ein Objekt und eine Fotografie in der Vitrine präsentiert wurden, zeigten keine einfachen Effekte für die Präsentationsform des Gegenstands als echtes Objekt oder Fotografie. Stattdessen war der Effekt der Präsentationsform abhängig von der jeweiligen Kombination aus Objekt und Fotografie. Wenn das Pro-Argument durch ein echtes Objekt illustriert wurde und das Contra-Argument durch eine Fotografie, verstärkten sich die beiden Faktoren Objektladung und Präsentationsform gegenseitig, so dass die echten Objekte mit positiver Ladung wesentlich länger betrachtet und auch besser erinnert wurden. Wurde das Pro-Argument hingegen durch eine Fotografie illustriert und das Contra-Argument durch ein echtes Objekt, nivellierte sich der Unterschied zwischen den beiden Gegenständen in der Vitrine, da sich die Präferenz für das Pro-Argument und für das echte Objekt gegenseitig ausglichen.

In den balancierten Experimenten 3 und 4, in denen entweder zwei echte Objekte oder aber zwei Fotografien präsentiert wurden, zeigten sich hingegen deutliche Effekte für die Präsentationsform der Gegenstände. So wurden die Gegenstände in der Vitrine tatsächlich länger betrachtet, wenn sie als echte Objekte präsentiert wurden und nicht als Fotografien. Zudem erinnerten sich die Teilnehmer an mehr Details, wenn sie die Gegenstände als echte Objekte gesehen hatten.

4.2 Studie 2 – “The role of authentic objects in museums of the history of science and technology: Findings from a visitor study”

In der quantitativen Analyse des Objekte-Rankings zeigte sich, dass die Teilnehmer Objekte, die als Originale präsentiert wurden, nicht höher bewerteten als Objekte, die als Nachbildungen präsentiert wurden. In der qualitativen Analyse der Interviewteile, in denen die

Rangplätze begründet wurden, spielte die Authentizität entsprechend eine untergeordnete Rolle. Stattdessen konnte eine Reihe an Kriterien für die Beurteilung von Museumsobjekten identifiziert werden, die insgesamt zu drei Hauptkategorien zusammengefasst wurden: Die äußere Erscheinung der Objekte *(appearance)*, die Fähigkeit der Objekte, Wissen zu vermitteln *(intellectual insights)* und die individuellen Eigenschaften der Besucher *(personal characteristics)*.

In den Teilen des Interviews, in denen der Authentizitätsstatus der Objekte direkt angesprochen wurde, kristallisierten sich insgesamt vier Dimensionen von Authentizität heraus, auf die für die interviewten Museumsbesucher der Unterschied zwischen Original und Nachbildung zurückzuführen ist. Zu diesen Dimensionen zählen die besondere Geschichte eines authentischen Objekts *(history)*, seine besondere Ausstrahlung *(charisma)*, seine Seltenheit oder gar Einzigartigkeit *(rarity)* sowie seine Funktionalität *(functionality)*.

4.3 Studie 3 – "Perception and evaluation of authentic objects: Findings from a visitor study"

In der dritten Studie waren die Relevanz und Irrelevanz der Authentizität der Objekte bei den Teilnehmern in etwa gleich verteilt. Zudem zeigte sich, dass die Besucher die ausgestellten Objekte selten aufgrund ihrer Kennzeichnung als Original oder Nachbildung als solche einordnen. Die Authentizitätszuschreibung erfolgte hingegen aufgrund einer Reihe von anderen Faktoren.

Die qualitative Analyse der Interviews zeigte zudem, dass sich die Mehrheit der durch die Besucher geäußerten Assoziationen zu Originalen und Nachbildungen nicht wesentlich voneinander unterscheiden. Weiterhin konnten die Authentizitätsdimensionen der zweiten Studie bestätigt werden. Neben den bereits bestehenden Dimensionen kristallisierte sich in dieser Studie in der Raumfahrt-Ausstellung eine weitere Dimension heraus, die sich auf den Prestigefaktor des Originals bezieht *(prestige)*.

Die quantitative Analyse des Fragebogens ergab keine signifikanten Unterschiede hinsichtlich der Bedürfnisse in Bezug auf Originale und Nachbildungen sowie ihrer Bewertung. Allerdings hatten Teilnehmer, für die die Authentizität der Objekte ein relevanter Faktor war, insgesamt höhere Werte – und zwar unabhängig vom tatsächlichen Status des zu bewertenden Objekts.

5 Diskussion

Das Ziel der vorliegenden Dissertation war es, die Rolle authentischer Objekte in Museen zu untersuchen. In einer sehr breiten Definition wurden dabei unter authentischen Objekten zunächst materielle, dreidimensionale Gegenstände im Gegensatz zu medialen Repräsentation verstanden. Ein besonderes Augenmerk lag im nächsten Schritt auf einer Teilmenge dieser Objekte. Authentische Objekte waren hier etwas enger als originale Objekte von besonderer historischer Bedeutung definiert. Insgesamt wurden drei Besucherstudien in einem Wissenschafts- und Technikmuseum, dem Deutschen Museum in München, durchgeführt. Die erste dieser Studien beschäftigte sich dabei mit dem Unterschied zwischen echten Objekten und Fotografien. In der zweiten und dritten Studie standen hingegen historisch bedeutsame Originale im Mittelpunkt, die mit identischen Nachbildungen kontrastiert wurden.

5.1 Verarbeitungsunterschiede zwischen echten Objekten und medialen Repräsentationen

Die Ergebnisse der ersten Studie zeigen, dass echte Objekte von den Besuchern intensiver verarbeitet werden als Fotografien. Echte Objekte erhielten mehr Aufmerksamkeit als Fotografien und bewirkten, dass sich die Besucher mehr Details des jeweiligen Gegenstands merken konnten. Dabei waren die Effekte ausgeprägter, wenn es sich um eine balancierte Präsentation der Objekte in der Vitrine handelte, wenn also entweder zwei echte Objekte oder aber zwei Fotografien in der Vitrine zu sehen waren. In den unbalancierten Vitrinen, in denen jeweils sowohl ein echtes Objekt als auch eine Fotografie ausgestellt waren, entfalteten die echten Objekte ihre Wirkung vor allem im Zusammenspiel mit anderen Faktoren wie zum Beispiel der Ladung der Objekte. So verstärkten sich echtes Objekt und die positive Ladung dieses Objekts gegenseitig, während eine Fotografie mit negativer Ladung besonders geringe Werte erzielte.

Um auszuschließen, dass die Verarbeitungsunterschiede zwischen Objekten und Fotografien nicht auf Unterschiede im Informationsgehalt der beiden Gegenstandsklassen zurückzuführen sind, wurden die möglichen Blickwinkel auf die präsentierten Gegenstände auf ein Minimum reduziert. Eine Analyse der Anzahl der Positionswechsel, die die Besucher beim Betrachten der Gegenstände vornahmen, zeigte, dass die echten Objekte genauso wie die Fotografien zumeist nur von einem Blickwinkel aus betrachtet wurden. Es liegt also nahe, dass die Unterschiede in der Informationsverarbeitung von echten Objekten und Fotografien auf den unterschiedlichen ontologischen Status der beiden Gegenstandsklassen zurück-

zuführen sind. Die Präsentation des Objekts wird demnach intensiver verarbeitet als seine bloße Repräsentation in Form einer Fotografie dieses Objekts. Diese Ergebnisse sprechen dafür, dass die Klassifizierung des Gegenstands als authentische Präsentation eines Objekts in einem frühen Stadium erfolgt und somit die folgenden Schritte der Informationsverarbeitung beeinflusst (*early stage model*). Schon früh als authentisch klassifizierte Objekte würden dabei eine weitere Beschäftigung mit dem Gegenstand auslösen, während ein als nicht-authentische Repräsentation klassifizierter Gegenstand eine Abwendung zur Folge hätte. Fänden sich hingegen keine Unterschiede in der Informationsverarbeitung, würde dies wiederum dafür sprechen, dass die Kategorisierung des dargebotenen Gegenstands erst in einem späteren Stadium stattfindet, dem bereits ein intensiver Informationsverarbeitungsprozess vorausgegangen ist (*late stage model*). Dafür spricht auch, dass im Falle der Repräsentation die Klassifizierung als Fotografie schlechter gespeichert wird als im Falle der Präsentation. So fiel es den Besuchern bei den Fotografien im Nachhinein schwerer als bei den echten Objekten, diese richtig als echtes Objekt oder als Fotografie einzuordnen.

5.2 Relevanz der Authentizität im Sinne von Originalität und historischer Bedeutung

Die Ergebnisse der Studien 2 und 3 zeigen, dass authentische Objekte im Sinne von historisch bedeutsamen Originalen – zumindest für die Besucher eines Wissenschafts- und Technikmuseums – eine geringere Rolle spielen als häufig angenommen wird. So erhielten in der Studie in der Ausstellung „Neue Technologien“ Originale keine höheren Rangplätze als identische Nachbildungen. Die Bewertung der Objekte war hingegen abhängig von anderen Kriterien, die zu einem großen Teil unabhängig vom Authentizitätsstatus der Objekte waren und weiter unten ausführlich diskutiert werden. Obwohl die Objekte der Studie in der Ausstellung „Raumfahrt“ im Gegensatz zu den in der Ausstellung „Neue Technologien“ präsentierten Objekte von signifikanter historischer Bedeutung waren und in einem emotionaleren Kontext präsentiert wurden, zeigte sich hier ein ganz ähnliches Bild: Die Authentizität der Objekte spielte nur für die Hälfte der befragten Besucher eine relevante Rolle, und die Besucher wollten Originale weder lieber anfassen oder besitzen als identische Nachbildungen, noch schätzten sie ihren Wert höher ein.

5.3 Authentizitätsdimensionen

Insgesamt kristallisierten sich in den Interviews beider Studien fünf Dimensionen von Authentizität heraus: Geschichte, Charisma, Seltenheit, Prestige und Funktionalität / Vollständigkeit (*history, charisma, rarity, prestige, functionality / completeness*; vgl. Tabelle 3 in Anhang A 1.2). Zur Dimension *Geschichte* wurden Ausführungen der Besucher zusammengefasst, die sich auf die Fähigkeit authentischer Objekte beziehen, eine Verbindung zwischen Vergangenheit und Gegenwart herzustellen. Diese Dimension entspricht der Perspektive Korffs (2002) auf authentische Objekte, der in ihnen Zeitzeugen sieht, deren Faszination durch ihre gleichzeitige Nähe und Ferne zustande kommt. Auch Pomian (1991) verweist bereits auf die Vermittlungsfunktion authentischer Objekte und bezeichnet sie als Zeichenträger oder Semiophoren, die zwischen Vergangenheit und Gegenwart vermitteln.

Während die Dimension *Geschichte* vor allem Bemerkungen der Besucher umfasst, die sich ganz rational auf den erleichterten Zugang zur Geschichte durch das authentische Objekt beziehen, folgen die Aussagen, die der Dimension *Charisma* zugeordnet werden können, einer irrationalen Argumentation. Authentischen Objekten wird eine gewisse „Aura“ zugesprochen, die nur durch das Original transportiert werden kann. Diese Aussagen bestätigen den Begriff der „Aura des Originals“, der von Walter Benjamin (1963) in seinem berühmten Essay „Das Kunstwerk im Zeitalter seiner technischen Reproduzierbarkeit“ geprägt wurde und in der Museumsliteratur seither vielfach zitiert wurde (z. B. te Heesen, 2012).

Die Dimension *Seltenheit* fasst Aussagen zusammen, in denen sich die Besucher auf die besondere Gelegenheit beziehen, ein seltenes oder gar einzigartiges Objekt zu betrachten. Das Wissen um die Einzigartigkeit und Besonderheit solcher Objekte wird oft durch die Berichterstattung in den Massenmedien befördert, die sich gerne auch seltenen Objekte widmet und diese dadurch mit Bedeutung auflädt (Cutting, 2003).

Die Bedeutung, die meistens mit der Seltenheit der Objekte einhergeht, wird in der Dimension *Prestige* erkennbar. Besucher, die sich auf diese Dimension beziehen, sprechen von der Aufwertung und der Steigerung der Reputation eines Museums durch die Ausstellung von Originalen. Genauso kann sich das Prestige aber auch auf die Besucher selbst beziehen, die sich durch das Betrachten der prestigeträchtigen Originale ebenfalls aufgewertet fühlen. Dieser Aspekt von Authentizität findet sich auch in Theorien zum Museum als Ort der sozialen Abgrenzung und der Identitätskonstruktion durch die Beschäftigung mit Objekten (Bourdieu, Darbel, & Schnapper, 1997; Karp & Lavine, 1991). Im Vergleich zu den anderen Dimensionen scheint dieser Aspekt vor allem bei Objekten von hoher historischer

Bedeutung eine Rolle zu spielen – wie bei einem echten Stück Mondgestein oder bei einem Raumanzug, die noch dazu als Meisterwerke ausgestellt werden. Denn dieser Aspekt kristallisierte sich so explizit nur in der Studie in der Abteilung „Raumfahrt“ heraus, bei der im Gegensatz zur Studie in der Ausstellung „Neue Technologien“ Objekte von besonders evidenter historischer Bedeutsamkeit im Fokus standen.

Schließlich wurde in den Interviews eine weitere Dimension von Authentizität erkennbar, die sich grundlegend von den bisher aufgeführten Dimensionen unterscheidet: die uneingeschränkte *Funktionalität* bzw. *Vollständigkeit*. Im Gegensatz zu den anderen Dimensionen, die sich alle auf die Identität eines Objekts beziehen, das bereits seit vielen Jahren existiert und eine wichtige Rolle in der Geschichte spielte, liegt dieser Dimension eine materialistischere Sicht auf die Authentizität von Objekten zugrunde. Aus dieser Perspektive kann nur ein Original, bei dem kein Detail fehlt, uneingeschränkt funktionieren, während eine Nachbildung niemals so detailgetreu gebaut sein kann, dass alles so funktioniert wie beim Original. Bemerkenswert ist in diesem Zusammenhang, dass keines der Objekte in Aktion gezeigt wurde und allein die Vorstellung, dass etwas nicht funktionieren könnte, einen Authentizitätsverlust zur Folge hätte.

Der Aspekt der Funktionalität spielte vor allem bei solchen Objekten eine Rolle, deren Funktionsweise von Interesse war. Bei Objekten wie beispielsweise einem Stück Mondgestein, bei denen es sich nicht um technische Instrumente oder andere *funktionierende* Objekte handelt, zeigte sich diese Dimension in einer etwas abgewandelten Form, nämlich als *Vollständigkeit*. Denn laut der Besucher, die sich auf diese Dimension bezogen, könne keine noch so gute Nachbildung 100-prozentig originalgetreu sein. Da es sich bei der 100-prozentigen Detailtreue um eine Voraussetzung der Funktionsfähigkeit eines Objekts handelt, kann die *Vollständigkeit* als Vorstufe der *Funktionalität* angesehen werden. Ob sich die zugrunde liegende Dimension als Vollständigkeit oder Funktionalität manifestiert, hängt demnach vom Objekttypus ab.

Beide Studien, in denen die Wirkung authentischer Objekte im Sinne von originalen Objekten von historischer Bedeutung mit der Wirkung identischer Nachbildungen verglichen wurde, brachten eine Vielzahl an Aspekten hervor, die mit der Wahrnehmung und Bewertung von Museumsobjekten in Verbindung stehen. Während aus Studie 2 in der Ausstellung Neue Technologien ein Set an Kriterien für die Bewertung von Museumsobjekten (*object evaluation criteria*) hervorging, brachte Studie 3 eine Liste an Dimensionen hervor, die ganz allgemein bei der Wahrnehmung von Originalen und Nachbildungen eine Rolle spielen (*perceived object qualities*).

5.4 Kriterien für die Bewertung von Museumsobjekten

Die insgesamt 12 Bewertungskriterien aus Studie 2 (vgl. Tabelle 3 in Anhang A 1.2) konnten zu drei übergeordneten Kategorien zusammengefasst werden. Eine dieser Kategorien war das Erscheinungsbild des Objekts (*appearance*), wobei vor allem der visuelle Eindruck eines berühmten, seltenen oder fremden Objekts eine übergeordnete Rolle spielt. Ebenfalls wichtig sind ästhetische Aspekte, die nicht nur mit der Schönheit eines Objekts verbunden sind, sondern auch mit der besonderen Begabung oder Fertigkeit des Herstellers oder einem besonders gelungenen Zusammenspiel von Design und Funktion, was vor allem bei technischen Objekten eine Rolle spielen dürfte. Entsprechend fanden auch Stich, Knäuper, Eisermann und Leder (2007), dass unterschiedliche Objekttypen nach unterschiedlichen ästhetischen Dimensionen bewertet werden.

Eine andere Hauptkategorie war die Vermittlung von Wissen durch das Objekt (*intellectual insights*). Hier bezogen sich die Besucher auf die Faszination der Technik, ihre historische Entwicklung und auf ihre Auswirkungen auf die Kultur und Gesellschaft. Zudem wurde großer Wert auf die verständliche Vermittlung der Funktionsweise der Objekte gelegt.

Die dritte Hauptkategorie umfasst Kriterien der Bewertung, die auf individuelle Eigenschaften der Besucher zurückgehen (*personal characteristics*). Die Kriterien bestätigen den in mehreren empirischen Studien gut überprüften Einfluss von Vorwissen und Interesse auf die Beschäftigung der Besucher mit Museumsobjekten oder anderen Ausstellungsgegenständen (Bell, Lewenstein, Shouse, & Feder, 2009). Allerdings zeigten sich diese beiden Variablen in der vorliegenden Studie etwas differenzierter. So konnte zwischen einem grundsätzlichen und vor allem theoretischen Interesse sowie einem sehr praktischen Interesse am Thema aufgrund seiner Alltagsrelevanz unterschieden werden. Auch das Vorwissen manifestierte sich in zwei unterschiedlichen Ausprägungen, nämlich einerseits als persönliche Erfahrung oder Vertrautheit mit dem Objekt und andererseits als Erfüllung der intellektuellen Voraussetzungen, um das Objekt zu begreifen.

5.5 Authentifizierung durch die Inszenierung im Museum

In den wahrgenommenen Objektdimensionen aus Studie 3 (vgl. Tabelle 1 in Anhang A 1.3) finden sich einige Bewertungskriterien aus Studie 2 wieder. So spielt das Erscheinungsbild der Objekte sowohl bei ihrer Wahrnehmung als auch bei ihrer Bewertung eine große Rolle. Von Bedeutung sind dabei die Besonderheit oder Fremdheit dieser Objekte, ihre Ästhetik und Inszenierung. Ein weiterer wichtiger Aspekt ist das Wissen, das über diese Objekte vermittelt wird – und zwar sowohl zur Historie dieser Objekte als auch zu ihrer Funktions-

weise. Bemerkenswert im Zusammenhang mit den Objektdimensionen war aber vor allem, dass sie – bis auf wenige Ausnahmen – gleichermaßen von Besuchern geäußert wurden, die dachten, sie hätten ein Original in der Vitrine gesehen, wie von Besuchern, die das Objekt für eine identische Nachbildung des Originals hielten. Obwohl eine Nachbildung zumeist nicht außergewöhnlich aufgrund ihrer Seltenheit oder besonderen Herkunft ist, übertrugen die Besucher diese Eigenschaften des Originals direkt auf die identische Nachbildung. So scheint es, dass die „Aura des Originals" tatsächlich auf die Nachbildung überzugehen scheint. Diesen Effekt beschreiben Latour und Lowe (2010) für eine Nachbildung des Gemäldes *Nozze di Cana* des Renaissance-Künstlers Paolo Veronese, das in einer toskanischen Villa als einziges Gemälde an einer großen Wand bei idealer Beleuchtung präsentiert wird. Dadurch bekommt diese Kopie eine stärkere Wirkung als das Original, das im Louvre von der berühmten *Mona Lisa* in den Schatten gestellt wird. Dieses Beispiel macht deutlich, dass die Inszenierung der Objekte einen größeren Effekt haben kann als ihre Authentizität (Kottasz, 2006). Eng verknüpft mit der Inszenierung eines Objekts ist auch der Kontext, in dem es präsentiert wird. So verleihen Museen mit einer weltweiten Reputation wie das *British Museum* sogar Fälschungen noch ein Gütesiegel der Authentizität (Lowenthal, 1992). Vor diesem Hintergrund verwundert es nicht, dass die Besucher der Studie in der Abteilung „Raumfahrt" des Deutschen Museums die Objekte oft nicht aufgrund ihrer Kennzeichnung als Originale oder Nachbildungen als solche einordneten, sondern eher aufgrund ihrer Präsentation in einem Museum.

5.6 Primat der Wissensvermittlung

Die Ergebnisse beider Studien zur Wirkung authentischer Objekte im Sinne von originalen Objekten mit historischer Bedeutung legen wiederholt nahe, dass die Originalität der ausgestellten Objekte eine nicht so große Rolle spielt wie oftmals angenommen wird. Wie in der Studie in der Ausstellung „Neue Technologien" deutlich wurde, werden Objekte höher bewertet, wenn sie technische Prozesse sichtbar machen können und wissenschaftliche Ergebnisse verständlich illustrieren. So äußern manche Besucher unter bestimmten Bedingungen ganz explizit den Wunsch nach Modellen, bei denen der Schwerpunkt auf der didaktischen Visualisierung wissenschaftlicher und technischer Zusammenhänge liegt und nicht auf einem möglichst authentischen Eindruck durch das originale, historisch bedeutsame Objekt (Lindgren-Streicher & Reich, 2007). Allerdings werden Objekte nicht nur nach ihrer Funktionalität bewertet, sondern die Funktionalität verleiht dem Objekt gleichzeitig Authentizität. Die historische Bedeutung spielt hingegen oft eine untergeordnete Rolle und

kommt erst dann zum Tragen, wenn die Unterscheidung zwischen Original und Nachbildung ausdrücklich thematisiert wird.

Auch wenn der hohe Stellenwert der Wissensvermittlung besonders bei technischen Instrumenten und im Umfeld einer Ausstellung mit dem Schwerpunkt auf (neuen) Technologien deutlich wird, zeigt sich die Fokussierung auf Funktionalität und Technikvermittlung auch in der Studie in der weniger nüchternen Raumfahrtausstellung mit mystischer Atmosphäre, wo der Raumanzug vor allem im Hinblick auf seine technischen Details wahrgenommen wird. Die Wichtigkeit der Funktionalität manifestierte sich hier auch durch die Argumente der Besucher, für die die Originalität der Objekte irrelevant war. Im Gegensatz zur Authentizität war für diese Besucher wichtig, dass das Objekt originalgetreu, funktionsfähig und anschaulich ist. Im Gegensatz zu den Besuchern, für die die Originalität des Objekts wichtig war, war für diese Besuchergruppe die Funktionalität also nicht mit einem originalen Objekt verbunden. Vielmehr war für diese Besucher von Bedeutung, dass sich das Objekt optisch nicht vom Original unterscheidet, also zu 100 Prozent originalgetreu ist. Neben der Detailtreue und der Funktionalität wird das Objekt in einer dritten Kategorie von Objekten nur noch als Anhaltspunkt angesehen, der den wissenschaftlichen Inhalt transportiert. Das Objekt selbst spielt hier nur noch eine untergeordnete Rolle. Gerade die letzte Kategorie korrespondiert mit der Annahme, dass Authentizität in der Wissenschaft eher mit Ideen und Theorien verknüpft ist als mit Objekten (Bain & Ellenbogen, 2002). In der Geschichte bedeutet Authentizität nach Bain und Ellenbogen (2002) hingegen die Legitimierung eines Objekts und seines historischen Kontextes. Die Ergebnisse der Studie in der Ausstellung „Raumfahrt“ lassen vermuten, dass sich das für die Geschichte geltende Authentizitätskonzept bei den Besuchern durchsetzt, für die die Originalität der Objekte relevant ist. Das Authentizitätskonzept der Wissenschaft scheint hingegen bei den Besuchern dominant zu sein, die die Originalität für weniger wichtig erachten.

5.7 Repräsentation ist nicht gleich Repräsentation – Unterschiede zwischen Nachbildungen und Fotografien

Die zweite und dritte Studie unterscheiden sich in einem wesentlichen Punkt von der ersten Studie. In der ersten Studie, in der echte Objekte mit Fotografien dieser Objekte verglichen wurden, ist der Unterschied zwischen Präsentation und Repräsentation noch mit bloßem Auge erkennbar. Auch ohne Hintergrundwissen zum Objekt kann der Gegenstand entweder als echtes Objekt oder als Fotografie eingeordnet werden. In den beiden darauf folgenden Studien, in denen historisch bedeutsame Originale identischen Nachbildungen gegenübergestellt wurden, kann die Klassifizierung des Objekts als Präsentation oder

Repräsentation hingegen erst erfolgen, wenn der Besucher das Objekt so weit verarbeitet hat, dass er den Status des Objekts überhaupt wahrnimmt. Der Unterschied zwischen Präsentation und Repräsentation ist hier wesentlich subtiler und kann nicht in einem so frühen Stadium erfolgen wie bei der Klassifizierung von Objekten und Fotografien (*early stage model*). Original und Nachbildung werden also bis hin zu ihrer Klassifizierung als Präsentation oder Repräsentation in gleicher Weise verarbeitet (*late stage model*). Die ähnliche Verarbeitung vermag auch zu erklären, warum Originale und Nachbildungen in den Studien ähnliche Gedanken und Gefühle hervorriefen. Denn selbst wenn das Objekt auf direktes Nachfragen später als Nachbildung eingestuft wurde, hatte es vermutlich bis zu diesem Zeitpunkt bereits etwas in den Besuchern ausgelöst, das im Nachhinein nicht revidiert wurde. Vor diesem Hintergrund verwundert es nicht mehr so sehr, dass auch nachgebildetem Mondgestein eine besondere Wirkung aufgrund seiner Herkunft vom Mond attestiert wurde und sogar sein Wert ähnlich eingeschätzt wurde. Den Weg für die vergleichbare Verarbeitung von Original und Nachbildung ebnet dabei die oben beschriebene Authentifizierung der Objekte durch ihre Inszenierung. Die Inszenierung vermag es, den Unterschied des ontologischen Status zwischen Originalen und Nachbildungen – zumindest für eine Weile – aufzuheben, nicht aber den Unterschied des ontologischen Status zwischen echten Objekten und Fotografien.

Die Funktionalität spielt ebenfalls eine wichtige Rolle für die Unterschiede zwischen den beiden Repräsentationstypen Nachbildung und Fotografie. Während es sich bei Nachbildungen um Repräsentationen eines authentischen Objektes handelt, die – zumindest theoretisch – funktionieren können, ist das bei einer Fotografie definitiv nicht der Fall. Eine Fotografie kann nicht für den Zweck eingesetzt werden, für den das abgebildete Objekt ursprünglich einmal vorgesehen war. Anders verhält es sich bei einer identischen Nachbildung, die bei 100-prozentiger Detailtreue die Funktion des authentischen Objekts präsentieren könnte. Bedenkt man den hohen Stellenwert der Funktionalität auch im Hinblick auf die Zuschreibung von Authentizität durch die Besucher, werden sowohl die gefundenen Verarbeitungsunterschiede zwischen echten Objekten und Fotografien als auch die wenig ausgeprägten Wahrnehmungs- und Bewertungsunterschiede zwischen Originalen und Nachbildungen erklärbar.

6 Fazit und Ausblick

Die der vorliegenden Arbeit zugrunde liegenden Studien zeigen, dass die Präsentation authentischer Objekte im Gegensatz zu Repräsentationen dieser Objekte auch aus der Perspektive der Museumsbesucher eine Rolle spielt. Allerdings werden differenzierte Effekte für unterschiedliche Arten von Repräsentationen deutlich. Während Fotografien im Vergleich zu echten Objekten tatsächlich weniger elaboriert verarbeitet wurden, waren die Unterschiede in der Wahrnehmung und Bewertung von Originalen und identischen Nachbildungen weniger auffällig. Dabei zeigte sich deutlich, dass aus der Perspektive der Besucher eines Museums für Wissenschafts- und Technikgeschichte der Fokus vor allem auf dem Erwerb von wissenschaftlichem und technischem Wissen liegt. Vor diesem Hintergrund kommt der Funktionalität als Authentizitätsdimension eine besondere Bedeutung zu. Objekte, die imstande sind, authentisches Wissen zu ihrer Funktionsweise zu vermitteln, stehen dabei meistens höher im Kurs als Objekte, die zwar eine Geschichte zu erzählen haben, aber keine wissenschaftlichen Zusammenhänge erklären.

Für die Bewahrung des wissenschafts- und technikhistorischen Erbes bleibt der Wert der Sammlungen an originalen, historisch bedeutsamen Objekten eines Museums jedoch unumstritten. Dennoch wird deutlich, dass der konservatorische Wert dieser authentischen Objekte nicht ohne Einschränkungen auf die Präsentation in den Ausstellungen übertragen werden kann. Denn für die Besucher haben Nachbildungen oder Modelle grundsätzlich keinen geringeren Stellenwert als Originale. Dabei hängt es stark vom einzelnen Objekt und den zu vermittelnden Inhalten ab, in welcher Form es präsentiert werden sollte. Insgesamt legen die Ergebnisse nahe, dass bei der Konzeption von Ausstellungen besonders darauf geachtet werden sollte, authentische Objekte mit anderen Ausstellungselementen wie Modellen oder digitalen Medienstationen zu kombinieren, die zusätzlich wissenschaftliche Informationen zum Objekt und seiner Funktionsweise liefern. Wie das authentische Objekterlebnis und die kognitiven Erfahrungen am erfolgreichsten miteinander verknüpft werden können, sollte in weiteren Studien erforscht werden. Neben Fotografien und Nachbildungen sollten dabei auch dreidimensionale digitale Abbildungen berücksichtigt werden, die im Gegensatz zu Fotografien auch im Hinblick auf die Funktionalität den gleichen Informationsgehalt wie Originale aufweisen, aber im Gegensatz zu Nachbildungen schnell als Repräsentationen entlarvt werden können.

Es ist anzunehmen, dass in anderen Museumstypen wie archäologischen, volkskundlichen Museen oder besonders in Kunstmuseen, die Authentizität der Objekte im Sinne von Originalität und historischer Bedeutung eine größere Rolle für die Besucher spielt als ihre Funktionsweise. Dennoch sollte in weiteren Studien kritisch hinterfragt werden, ob ein

originales Exponat in einer archäologischen Ausstellung tatsächlich anders wahrgenommen und bewertet wird als eine identische Nachbildung dieses Exponates. Äußerst erfolgreiche archäologische Ausstellungen, in denen ausschließlich Nachbildungen gezeigt werden, oder sogar Kunstmuseen, die ganz bewusst Fälschungen berühmter Kunstwerke ausstellen, zeigen, dass diese Frage nicht nur in Wissenschafts- und Technikmuseen schwer zu beantworten ist. Ob die Präsentation von Originalen in der Ausstellung tatsächlich nötig und nicht durch andere Vermittlungsformen ergänzt beziehungsweise ersetzt werden sollte, spielt dabei nicht nur aus der Perspektive der Besucher eine Rolle. Auch im Hinblick auf eine bestmögliche Bewahrung und Erforschung unseres kulturellen Erbes, die in den Ausstellungsräumen nicht immer gewährleistet werden können, sollten die Ergebnisse der vorliegenden Arbeit in weiteren systematischen Studien in anderen Museumstypen ausdifferenziert werden.

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8 Anhang

A 1 Publikationen

A 1.1 Publikation der ersten Studie

Schwan, S., Bauer, D., Kampschulte, L. & Hampp, C. (submitted). Representation equals presentation? Photographic depictions of objects receive less attention and are less well remembered than their real counterparts. *Cognition.*

Elsevier Editorial System(tm) for Cognition
Manuscript Draft

Manuscript Number:

Title: Representation Equals Presentation? Photographic Depictions of Objects Receive Less Attention and are Less Well Remembered Than Their Real Counterparts

Article Type: Full Article

Keywords: authenticity; object perception; photographs; object memory

Corresponding Author: Dr. Stephan Schwan,

Corresponding Author's Institution:

First Author: Stephan Schwan

Order of Authors: Stephan Schwan; Daniela Bauer, Dipl.Psych.; Lorenz Kampschulte, Dr.; Constanze Hampp, M.A.

Abstract: In four experiments, the notion was tested that real objects receive more attention and are better remembered than respective photographs of objects. Both objects and photographs were presented behind glass in display showcases in a museum and, hence, were largely equivalent in terms of providing visual information. Results of Experiments 1 and 3 indicate that participants tend to pay more attention to real objects than to respective photographs. In addition, Experiments 2 and 4 indicate that participants tend to retrieve more memory details about an object if they have seen it as a real object in comparison to a respective photograph. This study provides first evidence that observers take the different ontological status of photographs and real objects into account, processing the former less elaborately than the latter.

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While in many everyday circumstances photographs are routinely used as substitutes for real objects, experimental studies on possible differences in cognitive processing are scarce. While objects typically have an information advantage over photographs both due to their three-dimensionality and their haptic qualities, a theoretically interesting perspective is to inquire into the differences between objects and photographs under conditions providing roughly equal information. Under such conditions, objects and photographs differ in terms of their ontological status, because objects can be considered presentations (standing for themselves) whereas photographs can be considered representations. In the present paper, we show in four experiments that this ontological difference matters for viewers in terms of attention and memory for the re/presented objects.

We hope that our study will be considered for publication in Cognition.

Kind regards

Stephan Schwan, Daniela Bauer, Lorenz Kampschulte & Constanze Hampp

*Re*presentation Equals Presentation? Photographic Depictions of Objects Receive Less Attention and are Less Well Remembered Than Their Real Counterparts

Stephan Schwan[1], Daniela Bauer[1], Lorenz Kampschulte[2], and Constanze Hampp[2]

[1] Knowledge Media Research Center, Tübingen, Germany;

[2] Deutsches Museum, Munich, Germany;

The research was funded by the Deutsche Forschungsgemeinschaft (DFG), SPP 1409-SCHW 706/2-1. We thank Uta Karrer, Nicole Pertl, and Barbara Schorr for their help in conducting the experiments.

Word count: 6505

Correspondence concerning this article should be addressed to Stephan Schwan, Knowledge Media Research Center, Schleichstr. 6, D-72076 Tübingen, Germany. E-mail: s.schwan@iwm-kmrc.de

Abstract

In four experiments, the notion was tested that real objects receive more attention and are better remembered than respective photographs of objects. Both objects and photographs were presented behind glass in display showcases in a museum and, hence, were largely equivalent in terms of providing visual information. Results of Experiments 1 and 3 indicate that participants tend to pay more attention to real objects than to respective photographs. In addition, Experiments 2 and 4 indicate that participants tend to retrieve more memory details about an object if they have seen it as a real object in comparison to a respective photograph. This study provides first evidence that observers take the different ontological status of photographs and real objects into account, processing the former less elaborately than the latter.

1. Introduction

Be it on advertisement posters or in catalogues, in many everyday circumstances photographs are routinely used as substitutes for real objects. Particularly since the advent of Internet shopping, many customers base their shopping decisions solely on product depictions and descriptions without any direct experience with the real objects. Underlying this seems to be the implicit assumption that photos of objects and real objects are to a certain extent psychologically equivalent, thus being a convenient means for specification. This is even more evident in psychological research where an abundance of empirical studies have used photographs of scenes and objects as substitutes for real scenes and objects, allowing for better experimental control. On the other hand, experts in material culture have claimed that in terms of impact, real "authentic" objects make a great difference (Pearce, 1994). More specifically, experts from the field of museums and exhibitions have claimed that real objects are more valued by the visitors, leading to a deeper processing than their photographic counterparts (Pekarik, Doering, & Karns, 1999; Scholze, 2004). Also, scholars of humanities have argued that the increasing replacement of real objects with virtual renderings goes along with impoverished forms of experience (Baudrillard, 1972). Yet, to our knowledge, no study has addressed these notions on an empirical basis. Therefore, in the present study, we conducted four experiments in a museum setting in which we investigated the impact of real objects versus their photographs on attention and memory, providing first evidence that photographs of objects receive less attention and are less well remembered than their real counterparts.

1.1. Objects and Photographs: Perceptual Differences

From a perceptual and cognitive standpoint, objects and photographs differ in several respects. Real objects extend in three dimensions, disclosing more visual information to the observer than photographs that present objects as a two-dimensional projection. Second,

while photographs and objects are similar in their visual appearance, they are dissimilar with regard to other senses such as touch, smell, taste, and sound. They also differ in the type of material and, therefore, from a functional point of view, real objects offer opportunities for usage in service of goal achievement, which photos of objects do not provide. Thus, real objects and photographs differ in their ontological status because photographs are mere signs that stand for an object by reproducing it optically, but at the loss of all of its other relevant attributes, in particular its specific material structure. This is reflected by Magritte's famous dictum "Ceci n'est pas une pipe", meaning that a picture of a pipe is a picture and not a pipe (which can be used for smoking tobacco).

While confusing pictures and objects has been reported for young children, indicating that some pictorial experience is required for understanding the referential nature of pictures (DeLoache, Pierroutsakos, Uttal, Rosengren, & Gottlieb, 1998; Flavell, Flavell, Green, & Korfmacher, 1990), recent studies show that even 9-month-old infants are able to discriminate between real objects and realistic photos (Ziemer, Plumert, & Pick, 2012). Accordingly, adults typically have no problem distinguishing photographic depictions from real objects. Hence, the question arises if and in what ways the aforementioned differences between objects and photos affect cognitive processing. Certainly, due to their three-dimensional shape and their materiality, real objects offer a much richer array of information than photographs, and it would come as no surprise to find pronounced cognitive advantages in situations in which free, multisensory, and interactive scrutinizing of real objects is contrasted with the inspection of their photographic surrogates (Gibson, 1979).

In fact, studies that have contrasted objects with pictures in this manner have indeed reported respective processing advantages for real objects (e.g. Felix, Parker, Lee, & Gabriel, 2011; McWilliams, Hamilton, & Muncer, 1997). Some of these advantages even persist if instead of a real object, an interactive three-dimensional depiction, which allows for rotating and

zooming, is used and contrasted with a non-interactive digital photo (Daugherty, Li, & Biocca, 2008). For example, by comparing interactive three-dimensional product representations to traditional non-interactive product depictions in an Internet shop for electronic goods, Ozok and Komlodi (2009) found that users considered the former to be more detailed, easier, and more fun to use, resulting in higher satisfaction for the shoppers. Additionally, research has also shown that interactive 3D product depiction outperformed non-interactive 2D depictions in terms of brand knowledge, positive brand attitude, and attitude strength (Lee, Li, & Edwards, 2012; Li, Daugherty, & Biocca, 2002).

1.2. Real Objects and Photographs: Differences in Authenticity

While the mentioned studies confirm the cognitive advantage of information rich three-dimensional and freely explorable stimuli, a theoretically even more interesting perspective is to inquire into the differences between objects and photographs under conditions providing roughly equal information. That is, if objects are presented in a way that precludes interactive exploration and non-visual sensory stimulation and that also keeps the range of possible viewpoints at a minimum, do they nevertheless exert an effect on attention and memory that differs from photographs? Such conditions are not as rare as it would seem at first sight: Be it in shops, museums, or in private living rooms, objects are often displayed behind glass, preventing them from being used or touched while keeping the viewer at a distance that greatly reduces the range of possible viewpoints and hence the available visual information. Therefore, in these cases objects do provide roughly the same information as photographs while keeping their different status as presentation or representation, respectively.

Basically, there is a marked ontological difference between a real object and its photograph. To show a real object implies that it is presented, standing for itself. For example, it can be

taken out of the shop window display and, at least in principle, be used for its real, intended purpose. Similarly, in museum exhibitions, the presented objects are known to have indeed existed at a certain time or place in history. In contrast, photographs of objects can neither be used for the object's intended purpose nor have they necessarily existed at the portrayed object's time and place in history. Instead, they merely represent the object.

To be sure, the relation between presentation and representation is a complex one, as theories of art inform us (Benjamin, 1935/1980; Goodman, 1969). In particular, photographs themselves constitute objects in the sense that they also possess a certain materiality and can also be used in certain ways. Accordingly, a photograph can be considered an artistic object (e.g. a portrait done by Mapplethorpe). In this case, it not only represents the portrayed person, but simultaneously presents an authentic work of Mapplethorpe. In turn, material objects may also acquire a similar double status of presentation and representation, as Duchamp's readymades show. Further, due to the possibilities for mass reproduction and distribution, the relationship between presentation and authenticity becomes blurred (Benjamin, 1935/1980).

Nevertheless, outside the realm of art, the material manifestation of a particular object (the "thing" itself) can be considered a presentation, possessing qualities of being original or truthful, whereas a photographic depiction constitutes a representation that lacks these attributes. However, it should also be kept in mind that not all material things automatically qualify as presentations. In particular, again with regard to a specific object, certain classes of things such as models, replicas, and fakes of this object also do not qualify as presentations. Although being three-dimensional and material, they cannot be considered as the authentic object itself but, instead, as representations of it, again lacking the criteria of originality and truthfulness necessary for ascribing authenticity to them (Hampp & Schwan, 2014).

Research has shown that authenticity plays an important role for the evaluation of objects. Starting early in infancy, humans develop a strong preference for authentic objects, compared to the various kinds of reproductions (Frazier & Gelman, 2009; Hood & Bloom, 2008). This preference is also manifest in respective evaluations: Authentic objects are considered to be more valuable and evoke a higher desire for one to keep, possess, or touch them as well (Frazier, Gelman, Wilson, & Hood, 2009). Empirical research on this topic has mainly focused on comparisons of authentic objects to material replicas or fakes as well as on comparisons of celebrity items to noncelebrity items (Newman, Diesendruck, & Bloom, 2011). Yet, differences in evaluation should be even more pronounced when comparing real, authentic objects to their photographical reproductions because their different status as presentation or representation, respectively, is immediately visible.

But while research has demonstrated reliable effects of authenticity on evaluation, its possible impact on information processing has largely been ignored. With regard to the relation between information processing and identification of (re-)presentational status, two alternative models can be conceived. On the one hand, identification of (re-)presentational status may require elaborate scrutinizing, including intense inspection and cognitive processing. The outcome of this process is an attribution of authenticity (or of a lack thereof) and a corresponding evaluation in terms of relevance, liking, and value. In this "late stage model", both authentic presentations and non-authentic representations should be processed in a similar manner, with only the latest stage of ascribing authenticity differing. In contrast, in an "early stage model", attribution of authenticity is done heuristically at an early stage, thereby influencing amount and depth of subsequent stages of information processing, including inspection time and cognitive elaboration.

While to our knowledge, no empirical studies on this issue have been conducted to date, scholars from museology have opted for an early processing stage model. More specifically,

on a largely speculative basis, it has been argued that authentic objects are more "attractive" to visitors and should therefore receive more attention, evoke more associations and elaborations, and be better remembered than corresponding non-authentic representations (Pekarik et al., 1999; Scholze, 2004). For at least two reasons, the role of authentic objects is particularly relevant in museums and exhibitions. First, museums and exhibitions are seen as prototypical places for presentation of authentic objects, both on the part of the curators and of the visitors. For example, based on interviews and survey data, Pekarik, et al. (1999) identified "object experiences" as the most prominent reason for visiting a museum. According to Pekarik et al. (1999, p.157), object experiences include the appreciation of seeing the "real thing", seeing rare/uncommon/valuable things, or thinking what it would be like to own such things. Second, in exhibitions, visitors face a huge amount of exhibits and media from which they have to choose in a self-guided way (Falk & Dierking, 2000). According to Rounds (2004), visitors apply a number of heuristics in order to identify interesting spots in an exhibition with a minimum of cognitive resources. Because the experience of "real things" is often sought after, early and quick identification of authentic objects may play an important role for visitors' selection behavior. Therefore, putting the idea of "attractiveness" into more psychological terms, being a real object or a mere sign of an object should be identified at an early processing stage and then serve as a cue for deciding how much cognitive effort to invest in scrutinizing a given (re-)presentation, particularly in museum contexts.

While material, three-dimensional replicas may require elaborate processing before their representational status has been determined, the representational status of photographs is easily noticed. Therefore, in line with the assumptions from museology, particularly for photographs, the early stage model should apply. Accordingly, we hypothesized that due to their distinct (re-)presentational status, photos of objects should be processed less elaborately

than real objects, particularly in museum contexts where visitors have to choose among a large range of exhibits and media:

(H1) Realistic, life-size photographs of objects should receive less attention than the corresponding real object

(H2) Realistic, life-size photographs of objects should be less well remembered than the corresponding real object

2. Overview of the Experiments

Four experiments were conducted at the Deutsches Museum in Munich, the largest museum of science and technology in Germany. We designed three experimental display showcases for presentation in one of the museums' exhibition sections (see Figure 1). Each showcase introduced a certain topic (health technology, nanotubes, nanosilver) by presenting an array of exhibits, including two objects and their accompanying labels, along with texts, graphics, and pictures at the rear panel. The pairs of objects were chosen to illustrate the pros and cons of the respective topic, and included an artificial leg, a set of breast implants, a pair of handlebars, a microscope, a pair of lunchboxes, and two bottles of clearing sludge. Hence, care was taken to include a variety of objects that not only differ in topic but also in size and volume as well as in complexity of appearance. Also, a photograph of each object was produced. They were professionally photographed, neutrally lit reproductions of the objects preserving their original size.

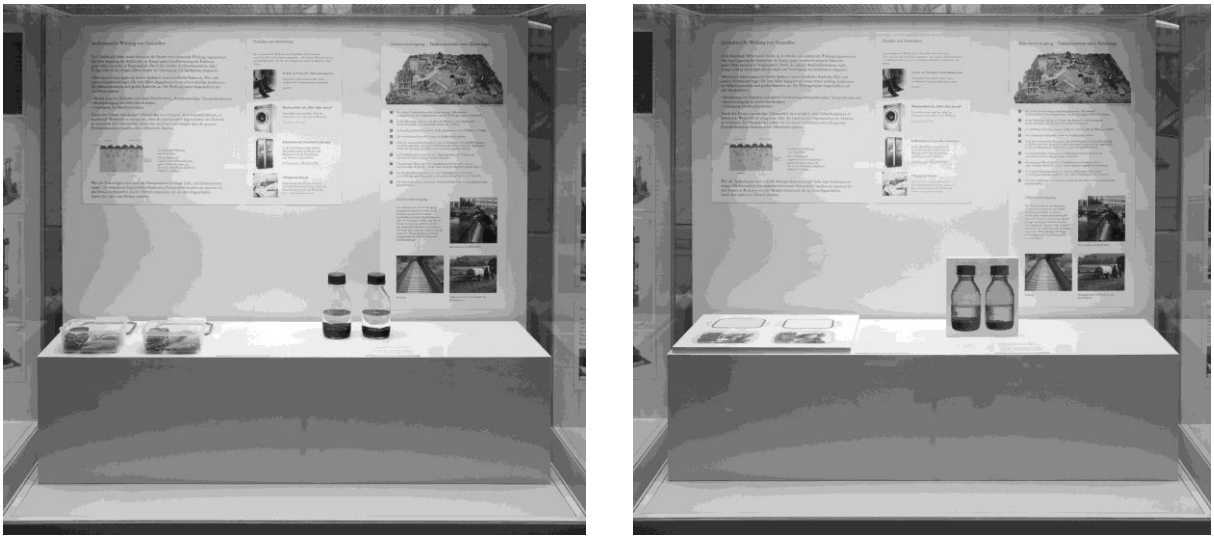

Figure 1: Experimental showcase with original objects (left) or photographs (right)

Because the real objects as well as the photographs were placed behind glass in the showcase, they could not be freely inspected from all sides. Instead, the viewing perspective was largely restricted to the front view, keeping the available visual information for the real object and the corresponding photograph largely similar. In order to disguise its experimental purpose, each showcase was flanked by two additional, similarly designed showcases presenting different topics.

Across participants, both the topic of the experimental showcase (health technology, nanotubes, nanosilver) as well as the ontological status of its objects was systematically varied. In Experiments 1 and 2, the experimental showcases presented one of the objects as a real object, while the other object was presented as a photograph. In Experiments 3 and 4, the experimental showcases presented either a pair of real objects or the respective pair of photographs. Experiments 1 and 3 were designed to test the hypothesis that photographs of objects receive less attention than real objects by means of eye-tracking. Complementary: Experiments 2 and 4 were designed to test the hypothesis that photographs of objects are less well remembered than real objects by measuring visitors' recall and recognition of the

exhibited objects. In all four experiments, participants were asked to fill out a questionnaire regarding their demographic data, involvement in natural science and new technologies, subjective estimation of prior knowledge, and the German ambiguity tolerance scale (Dalbert, 1999

2.1. Experiment 1

2.1.1. Participants

Fifty-five[1] visitors (23 women, mean age 29.2 years) were recruited in the entrance area of the exhibition of New Technologies at the Deutsches Museum. Participants had to be over 16 years old and not wearing glasses. From families and groups always only one person was selected and asked to take part in the study, while the others were asked to return after 15 minutes. On a seven-point-scale, participants indicated a medium level of prior knowledge (M = 3.6, SD = .99), a medium to high involvement (M = 4.0, SD = .85), and a medium ambiguity (M = 3.8, SD = .55).

2.1.2. Material

Visitors were presented a row of three display showcases as described in the overview of experiments section. The content of the middle showcase was systematically varied with regard to topic (health technology, nanotubes, nanosilver) and to a combination of real object and photograph, whereby one half of the visitors inspected a showcase with a real object illustrating a pro-argument and a photograph illustrating a con-argument associated with the topic, while for the other half of the visitors the order was reversed.

2.1.3. Procedure

Participants were fitted with a Locarna PT-Mini mobile eye tracker with an update rate of 30 frames per second and a 720x480 resolution color camera. After calibration, participants were asked to take a look at the showcases in a natural manner, that is, at their own pace and according to their own interests.

2.1.4. Results

Inspection times for objects: A fixation was defined by a minimum threshold of 5 frames (about 167 msec) and a maximum diameter of 50 pixel in the video recordings of the eye-tracker (Salthouse & Ellis, 1980). If eye gaze stayed within a circle of this specified diameter for at least the specified fixation time, a fixation would be logged. For each object, inspection times were calculated summing up the fixation times that fell within the objects' shape, be it either the shape of the real object or the object's shape on the photograph. A 2 x 3 x 2 ANOVA with the factors object type (real object vs. photo, within subjects), showcase topic (health technology, nanotubes, nanosilver, between-subjects) and allocation of real object to either pro-argument or con-argument (pro vs. con, between-subjects) showed no significant main effect of object type on inspection time, $F < 1$. Instead, there was a significant interaction between object type and allocation of real object, $F(1,49) = 16.08$, $p < .001$, $\eta^2 p = .25$. Bonferroni adjusted T-tests revealed that for showcases in which the pro-argument was exemplified by a real object and the con-argument by a photo, the real object was inspected significantly longer than the photo ($M_{real\ object-pro} = 3.6$ sec, $SD = 3.5$ vs. $M_{photo-contra} = 1.4$ sec, $SD = 1.7$), while for showcases in which the pro-argument was exemplified by a photo and the con-argument by a real object, no significant difference was found ($M_{photo-pro} = 3.4$ sec, $SD = 3.1$ vs. $M_{real\ object-con} = 2.0$ sec, $SD = 1.9$). This effect was independent of the

showcases' topic, with $p > .15$ for all topic-related effects. Thus, independent of object type, participants tended to inspect objects related to the pro-argument longer than those related to the con-argument, but the effect was less pronounced if the pro- argument was illustrated by a photo and the con-argument by a real object.

We also analyzed the video recordings of the eye-tracker for changes of viewing positions by the participants. More specifically, we were interested whether visitors tended to view the objects from one viewing position or whether they scrutinized it more actively by viewing it from two or more different viewing positions, particularly in the case of the three dimensional real objects. Accordingly, when the video recording indicated that a participant changed his or her position providing a different view of the object or photograph, this was rated as a position change. More precisely, each movement of the body to the right or left side as well as upward and downward while observing the object was rated as a position change, whereas movements backwards and forwards were not rated as position changes. Overall, the frequency of position changes was low. Only one participant out of 55 made a position change in front of a photograph, and 5 out of 55 participants made a position change in front of a real object. According to a McNemar test, frequency of position changes in front of photographs versus real objects did not significantly differ, $p > .05$. We also determined the rank of the different objects with regard to inspection time differences between its presentation as a real object versus as a photograph. The differences ranged between 0.38 sec and 1.62 sec, with clearing sludge and artificial leg showing the greatest, and handlebars, lunchboxes, and breast implants showing the least inspection time differences. Thus, the differences showed no systematic relation to objects' size, volume, or complexity, again indicating that they were not due to the simple advantage of real objects in terms of available visual information.

2.2. Experiment 2

2.2.1. Participants

Fifty-three[1] visitors (18 women, mean age 26.3 years) were recruited in the Deutsches Museum. Overall, participants indicated a medium level of prior knowledge (M = 3.5, SD = 1.1), a medium to high involvement (M = 3.9, SD = .77), and a medium ambiguity (M = 3.7, SD = .52).

2.2.2. Material and Procedure

The setup of showcases was similar to Experiment 1. Instead of wearing an eye-tracker, participants were instructed to freely explore the row of showcases at their own pace and according to their interests. After finishing exploration, they were asked to visit the other exhibitions of the museum for one hour. Then they were asked to describe the specific showcase as precisely as possible with regard to both its contents and its presentation. Reconstructions were audio-recorded and transcribed for analysis. All transcripts were coded by two independent raters who, as a first step of analysis, examined whether the presented objects were mentioned in the transcripts (interrater agreement = .95). As a second step, they identified single mentioned details of the presented objects (interrater agreement = .73). In the case of nonconformity, the decision was made by a third rater (ch). Finally, as a recognition test, a list of pictures of objects was presented to the participants who were asked to decide which objects they had seen in the showcase and whether they were presented as real objects or as photographs.

2.2.3. Results

Descriptions of showcase from memory: Although real objects were mentioned more often than their photographs, $M_{real\ object}$ = .58 (SD = .50) vs. $M_{photograph}$ = .38 (SD = .49), this difference failed to reach significance, F(1,47) = 3.85, p = .06, $\eta^2 p$ = .08, according to a 2 x 3

x 2 ANOVA with the factors object type (real object vs. photo, within subjects), showcase topic (health technology, nanotubes, nanosilver, between-subjects) and allocation of real object (pro vs. con, between-subjects). Instead, there was a significant interaction between object type and allocation of real object, F (1,47) = 6.02, p = .02, $\eta^2 p$ = .11. Bonferroni adjusted T-tests revealed that for showcases in which the pro-argument was exemplified by a real object and the con-argument by a photo, the real object was mentioned significantly more often than the photo ($M_{real\ object\ -\ pro}$ = .75, *SD* = .44 vs. $M_{photo\ -\ contra}$ = .32, *SD* = .48), while for showcases in which the pro-argument was exemplified by a photo and the con-argument by a real object, no differences between photo and real object were found ($M_{photo-\ pro}$ = .44, *SD* = .51 vs. $M_{real\ object\ -\ con}$ = .40, *SD* = .50). Again, this effect was independent of the topic of the showcases, with p > .20 for all topic-related effects.

Additionally, according to a 2 x 3 x 2 ANOVA with the factors object type, showcase topic and allocation of real object, participants did not report more details for real objects vs. photos, $M_{real\ object}$ = 1.9 (*SD* = 2.3) vs. M_{photo} = 1.2 (*SD* = 1.8), F(1,47) = 2.9, p = .10, $\eta^2 p$ = .06. Instead, there was a again significant interaction between object type and allocation of real object, F (1,47) = 9.07, p < .001, $\eta^2 p$ = .16. Bonferroni adjusted T-tests revealed that for showcases in which the pro-argument was exemplified by a real object and the con-argument by a photo, more details were reported for the real object than for the photo ($M_{real\ object\ -\ pro}$ = 2.9, *SD* = 2.5 vs. $M_{photo\ -\ contra}$ = 0.9, *SD* = 1.6), while for showcases in which the pro-argument was exemplified by a photo and the con-argument by a real object, no differences between photo and real object were found ($M_{photo-\ pro}$ = 1.4, *SD* = 1.9 vs. $M_{real\ object\ -\ con}$ = .9, *SD* = 1.6). While there was a main effect of showcase topic, F(2,47) = 3.3, p = .05, $\eta^2 p$ = .12, no interactions with the other factors were found, with all p > .15.

Independent of condition, the vast majority of presented objects was correctly recognized in the recognition test, *M* = .94, *SD* = .23. A 2 x 3 x 2 ANOVA with the factors object type,

showcase topic, and allocation of real object showed no significant effects for type of object, allocation of real object, nor for the showcase topic. However, there were significant interactions between the factors showcase topic and allocation of real object, $F(2,47) = 5.46$, $p < .01$, $\eta^2 p = .19$, between the showcase topic and the type of object $F(2,47) = 4.34$, $p < .05$, $\eta^2 p = .16$, and between the allocation of real object and the type of object, $F(1,47) = 5.70$, $p < .05$, $\eta^2 p = .11$. These effects can be attributed to the relatively low identification rates of the microscope in the photo condition (.63) and the two bottles of clearing sludge in the real object condition (.75).

In contrast, particularly the participants in the photograph condition were highly inaccurate with regard to the question whether an exhibit was presented as a real object or a photograph. The percentage of correct identifications was very high for real objects, $M = .88$ ($SD = .32$) and much lower for photographs, $M = .25$ ($SD = .44$). According to a 2 x 3 x 2 ANOVA with factors object type, showcase topic, and allocation of real object, this difference was significant, $F(1,46) = 83.28$, $p < .001$, $\eta^2 p = .64$. There was also a significant interaction between all three factors, $F(2,46) = 4.00$, $p < .05$, $\eta^2 p = .15$, indicating that while the difference between correct identification of real objects vs. photographs was present for all objects of the study, its degree differed from .87 to .31. There were no other significant main effects or interactions.

In sum, we found that for the combination of exemplifying a pro-argument with a real object and a con-argument with a photograph, the former tended to be mentioned more frequently and was also described in more detail than the latter. In contrast, for the reverse combination of exemplifying a pro-argument with a photograph and a con-argument with a real object, no differences with regard to frequency of mentioning or number of details were found. As in Experiment 1, the size of the differences between real objects and photographs was not systematically related to the volume or complexity of the objects. Surprisingly, even after a

short period of one hour, visitors were not able to remember whether an object had been presented to them as a real object or a photograph. Thus, although visitors seemingly assumed presentation of real objects as "default mode" for a renowned museum and showed a remarkable lack of source memory, the distinction between objects and photographs nevertheless exerted some influence on their memory.

Taken together, in both studies no main effect of object type was found. Instead, the impact of object type both on attention and memory was qualified by the specific combination of objects and photos. The results are compatible with a model where visitors gave more weight both to pro-arguments and to real objects. Hence, in the case of pairs in which the pro-argument was exemplified by a real object, while the con-argument was exemplified by a photo, both factors positively added in a way that the objects depicting a pro-argument were given substantially more attention and were substantially better remembered. In contrast, in case of pairs in which a pro-argument was exemplified by a photo and a con-argument by an object, the two tendencies of giving more weight to the pro-argument and to real objects tended to even out each other.

2.3. Experiment 3

We reran both experiments with showcases that either contained only real objects or only photographs. By means of this setup, we were able to directly compare inspection times for a given pair of real objects with their corresponding photographic counterparts in a between-subjects design.

Participants

Fifty-four[1] visitors (16 women, mean age 28.3 years) were recruited in the Deutsches Museum. Overall, participants indicated a medium level of prior knowledge (M = 3.8, SD =

.95), a medium to high involvement (M = 4.1, SD = .92), and a medium ambiguity (M = 3.6, SD = .50), with no significant differences between conditions, all p > .23.

2.3.1. Material and Procedure

The experimental setup was similar to Experiment 1 with the exception that the display showcases contained either a pair of real objects or a pair of photographs.

2.3.2. Results

Inspection times for object pairs: Inspection time for the objects was determined and analyzed in a 2 x 3 ANOVA with type of object (real object vs. photograph) and showcase topic (health technology, nanotubes, nanosilver) as between-subjects factors. Objects were inspected longer if they were presented as real objects instead of photographs, $M_{real\ objects}$ = 7.0 sec (SD = 4.4) vs. $M_{photographs}$ = 4.5 sec (SD = 3.9), F (1,48) = 5.24, p < .05, $\eta^2 p$ = .10. There was no main effect of showcase topic and also no interaction between type of object and showcase topic, both F < 1. Hence, in line with our hypothesis, visitors inspected photographs of objects considerably less than their real counterparts.

Similar to Experiment 1, we also analyzed the video recordings of the eye-tracker for changes of viewing positions by the participants. Again, frequency of position changes was low. None of the participants made a position change in front of a photograph, and three out of 22 participants made a position change in front of a real object. According to a Fisher exact test, frequency of position changes in front of photographs versus real objects did not significantly differ, p > .05.

2.4. Experiment 4

2.4.1. Participants

Fifty-three[1] visitors (23 women, mean age 26.0 years) were recruited in the Deutsches Museum. Overall, they indicated a medium to high level of prior knowledge (M = 3.9, SD = .89), a medium to high involvement (M = 4.1, SD = .87), and a medium ambiguity (M = 3.8, SD = .60), with no significant differences between conditions, all p > .06.

2.4.2. Material and Procedure

The experimental setup was similar to Experiment 2 with the exception that the display showcases contained either a pair of real objects or a pair of photographs. Similar to Experiment 2, transcripts were coded by two independent raters who, as a first step of analysis, examined whether the presented objects were mentioned in the transcripts (interrater agreement = .94). As a second step, they identified single mentioned details of the presented objects (interrater agreement = .75). In the case of nonconformity, the decision was made by a third rater (ch).

2.4.3. Results

Descriptions of the showcase from memory: In their memory-based descriptions of the display showcases, visitors did not mention real objects significantly more often than photographs. The respective 2 x 3 ANOVA with type of object (real object vs. photograph) and showcase topic (health technology, nanotubes, nanosilver) as between-subjects factors did not find a significant effect, F(1,47) = 2.99, p = .09, $\eta^2 p$ = .06, with $M_{real\ objects}$ = 1.26 (SD = .59) vs. $M_{photographs}$ = .92 (SD = .80). Also, neither the showcase topic (F(2,47) = 2.01, p > .10) nor the interaction between type of object and showcase topic (F < 1) were significant. Yet with regard to the number of object-related details that were mentioned in the memory-based descriptions of the showcases, a 2 x 3 ANOVA with type of object and showcase topic as

between-subjects factors showed that more details were mentioned if the objects were presented as real objects than as photographs, $M_{real\ objects}$ = 4.8 (*SD* = 3.7) vs. $M_{photographs}$ = 2.7 (*SD* = 3.2), F (1,47) = 7.43, p < 0.01, $\eta^2 p$ = .14, There was also a main effect of showcase topic, F (2,47) = 13.44, p < .001, η^2 = .36, with objects in the nanosilver showcases receiving the highest number of details (*M* = 6.69, *SD* = 3.86), followed by objects in the nanotubes showcase (*M* = 3.10, *SD* = 3.13) and the health technology showcase (*M* = 1.76, *SD* = 1.52). The interaction between the two factors was not significant, F < 1. Hence, while the status of an object's presentation mode had no influence on remembering it at all, the mode had a significant impact on the degree of detail with which an object was remembered, with photographs being remembered less detailed than real objects.

Object recognition: Independent of condition, the majority of presented objects was correctly recognized in the recognition test. Nearly all participants recognized both presented items, *M* = 1.98 (*SD* = .14). According to a 2 x 3 ANOVA with type of object and showcase topic as between-subjects factors neither the type of object (F(1,47) = 1.22, p >.10, $\eta^2 p$ = .03) nor the showcase topic (F(2,47) = 1.17, p >.10, $\eta^2 p$ = .05) were significant. Also, the interaction between the two factors was not significant (F(2,47) = 1.17, p >.10, $\eta^2 p$ = .05). In contrast, particularly the participants in the photographs condition were highly inaccurate with regard to the question whether an exhibit was presented as a real object or a photograph. The percentage of correct identifications was 96.5 percent (*M* = 1.93, *SD* = .27) for real objects and 32.5 percent (*M* = .65, *SD* = .85) for photographs. This difference was significant according to a 2 x 3 ANOVA with type of object and showcase topic as between-subjects factors, F(1,47) = 57.51, p < .001, $\eta^2 p$ = .55. Neither the factor showcase topic was significant, F(2,47) = 1.43, p > .10, $\eta^2 p$ = .06, nor the interaction between both factors, F(2,47) = 2.48, p = .10, $\eta^2 p$ = .10. Hence, the large proportion of confusing photographs with real objects replicate the findings of Experiment 2, indicating that the majority of visitors assumed that they were shown real objects as default presentation mode in museums.

3. General Discussion

Taken together, and in line with assumptions from museology (Pekarik et al., 1999; Scholze, 2004), the present four experiments provide first evidence that observers take the different ontological status of photographs as representations and real objects as presentations into account, processing the former less elaborately than the latter. In particular, results of Experiments 3 indicate that participants tended to pay more attention to real objects than to their respective photographs. Also, Experiment 4 indicates that participants were also able to retrieve more memory details about an object if they had seen it as a real object in comparison to its respective photograph. The effects were particularly pronounced in showcases that were homogenous, containing either two real objects or two photographs. In the mixed showcases of Experiments 1 and 2, it became obvious that real objects did not simply outperform photographs in terms of attention and memory but exerted their influence in concert with other factors (in the present case with argument direction: pro vs. contra).

How can these results be explained? While differences between real objects and photographs in the amount of visual information, which favors real objects, were certainly existent, they were reduced to a minimum by the setup of the showcases. In particular, because the exhibits were placed behind glass in the showcase, they could not be freely inspected from all sides. Instead, the viewing perspective was largely restricted to the front view. This was corroborated by an analysis of participants' changes of viewing positions in front of the exhibits, which were extremely low. Also, we found no systematic relation between volume, size or complexity, and the observed differences between real objects and their photographic counterparts, again indicating that an information advantage of three-dimensional objects over two-dimensional photographs played a minor role for the findings.

Besides minor differences in visual information, real objects and photographs clearly differed in their status as presentation or representation, respectively. Accordingly, the present findings are compatible with an early stage model, which assumes that attribution of authenticity is done heuristically at an early stage, thereby influencing amount and depth of subsequent stages of information processing, including inspection time and cognitive elaboration. More specifically, exhibits that had been classified as a presentation of a real thing received more attention and were memorized in more detail than exhibits that had been classified as a pictorial representation. The early stage model can also account for the apparently contradictory finding that although visitors seemingly assumed the presentation of real objects to be the "default mode" for a renowned museum and showed a remarkable lack of source memory, the distinction between objects and photographs nevertheless exerted some influence on their memory. In the early stage model, a quick, heuristic classification as presentation or representation forms the basis of subsequent processing, but its result is not necessarily fixed in memory. In contrast, in a late stage model, the categorization would have been the result of an elaborate scrutinizing, implying a much better retention of this categorization.

To our knowledge, this is the first set of experiments that has experimentally investigated the impact of presentations of real objects in comparison to their photographical representations on information processing. While the results provide first evidence for the notion of the psychological impact of a perceived ontological status, several limitations of the studies should be kept in mind. First, with regard to methodology, use of eye-tracking equipment may have reduced the external validity of the findings of Experiments 1 and 3 because it may have induced participants' consciousness of looking behavior, which is absent under normal viewing conditions. Current eye-tracking equipment consists of lightweight glasses that, after calibration, are not very noticable to participants (Eghbal-Azar & Widlok, 2013; Filippini-Fantoni, Jaebker, Bauer, & Stofer, 2013). Additionally, the similarities of the result patterns

of both eye-tracking studies (Exp. 1 and 3) and memory studies without use of eye-tracking equipment (Exp. 2 and 4) further speak for a sufficient external validity of Experiment 1 and 3. Nevertheless, future studies on this topic should include additional, non-reactive measures of focus of attention.

Also, while particular care was taken to minimize possible differences between real objects and photographs in the amount of information provided, accordant minor variations certainly cannot be ruled out completely as a contributing factor for the observed differences in inspection time and memory. Therefore, future studies should try to further disentangle the possible effects of ontological status and the amount of available information. For example, differences in the amount of available information could be minimized by using objects that are mainly flat in nature, such as manuscripts, coins and medals, or engravings. Also, besides photographs, both material replicas, 3D prints and 3D digital depictions are currently routinely used as substitutes for authentic objects. Although they may be equivalent in terms of visual information (e.g. if the digital depiction is based on high-resolution 3D scanning and presented autostereoscopically), and also both qualify as representation, they may nevertheless be processed differently because they differ in the ease with which their status is recognized by viewers. In the case of a digital 3D depiction, its status as a representation can be instantly recognized, implying that it is processed according to the early stage model. In contrast, identifying that a replica is a replica requires elaborate scrutinizing, implying that it is processed according to the late stage model. Particularly due to the growing use of 3D printing technology, the question of material replicas has recently become more prominent. 3D prints differ from 3D graphics because details from replicas or 3D prints should not only be better remembered than from digital 3D depictions, but source memory should also be better for the former. To make matters even more complicated, these differences should vanish if the viewers are informed beforehand that an object is a replica because, in this case, the early stage model should apply again. Overall, these examples demonstrate that the notion

of ontological status may open up new venues of research, shedding new light on the distinction between the real and the virtual.

Footnotes

[1] Due to organizational restrictions of conducting a field experiment in a large museum, number of participants was uneven across the cells of the experimental design. Additionally, due to technical problems with the eye-tracking device, data of 14 participants in Experiment 1 and 14 participants in Experiment 3 had to be excluded.

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A 1.2 Publikation der zweiten Studie

Hampp, C., & Schwan, S. (2014). The Role of Authentic Objects in Museums of the History of Science and Technology: Findings from a visitor study, *International Journal of Science Education, Part B: Communication and Public Engagement,* DOI: 10.1080/21548455.2013.875238

International Journal of Science Education, Part B: Communication and Public Engagement
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/rsed20

The Role of Authentic Objects in Museums of the History of Science and Technology: Findings from a visitor study

Constanze Hampp[a] & Stephan Schwan[b]
[a] Deutsches Museum, Research Institute, Munich, Germany
[b] Knowledge Media Research Center, Cybermedia Lab, Tuebingen, Germany
Published online: 08 Jan 2014.

To cite this article: Constanze Hampp & Stephan Schwan , International Journal of Science Education, Part B (2014): The Role of Authentic Objects in Museums of the History of Science and Technology: Findings from a visitor study, International Journal of Science Education, Part B: Communication and Public Engagement, DOI: 10.1080/21548455.2013.875238

To link to this article: http://dx.doi.org/10.1080/21548455.2013.875238

International Journal of Science Education, Part B, 2014
http://dx.doi.org/10.1080/21548455.2013.875238

The Role of Authentic Objects in Museums of the History of Science and Technology: Findings from a visitor study

Constanze Hampp[a*] and Stephan Schwan[b]
[a]*Deutsches Museum, Research Institute, Munich, Germany;* [b]*Knowledge Media Research Center, Cybermedia Lab, Tuebingen, Germany*

One characteristic of science centers and science museums is that they communicate scientific findings by presenting real scientific objects. In particular, science museums focus on the historical context of scientific discoveries by displaying authentic objects, defined as original objects that once served a science-related, real-world purpose and bear some significance for the history of science. However, almost nothing is known about the respective role of authentic objects. By displaying a set of objects either as originals or replicas in a large museum of the history of science and technology, we examined the relevance of authentic objects for museum visitors. An extensive set of interviews unveiled four dimensions of authenticity, interestingly not only connected with the historical significance of the objects but also with their science-related functionality. Furthermore, it revealed a multitude of criteria for the evaluation of objects that were mostly independent of authenticity but instead referred to the objects' provision of insights into scientific and technological principles. Thus, the study shows that it should be of great importance to complement authentic objects with features that provide additional science-related information. How this connection can be most successful requires further research.

Keywords: *Informal science learning; Authentic objects; Replica; Science museum; Visitor studies*

One major characteristic of science museums and science centers is their widespread use of objects for presenting and communicating scientific findings. For example, in Germany's largest science museum, the *Deutsches Museum* in Munich, an estimated 28,000 objects are on display. Accordingly, and in line with the general emphasis of

*Corresponding author. Deutsches Museum, Research Institute, Museumsinsel 1, Munich 80538, Germany. Email: constanze.hampp@gmail.com

museology on material exhibits (Hein, 2007), the role of various kinds of objects for stimulating interest, facilitating science comprehension, as well as meaning-making and critical reflection, has been an important research topic in the past decade (Paris, 2002). In particular, it has been found that objects not only possess a high degree of attraction and holding power (Boizvert & Slez, 1995; Sandifer, 2003), but that they also may trigger meaning-making-related communication between visitors, particularly in family groups and between parents and their children (Leinhardt & Crowley, 2002; Sanford, 2010), thereby facilitating comprehension of scientific findings and research principles (Zimmerman, Reeve, & Bell, 2009).

Yet, at a closer look, respective research in science museums and science centers has mainly focused on particular types of objects, namely interactive 'hands-on' exhibits as well as models and demonstrations. Hands-on exhibits allow visitors to touch or manipulate an artifact, thereby providing opportunities for exploration and inquiry. Models and demonstrations aim at visualizing scientific phenomena and principles that are often not directly perceivable because they operate on very small or very large temporal and/or spatial scales, for example, atoms or galaxies. For both types of exhibits, several studies have analyzed visitor's patterns of interaction and communication and have found that the educational success of such exhibits depends on the selection and design of experiences that they provide (Afonso & Gilbert, 2007; Allen & Gutwill, 2004; Falk, Scott, Dierking, Rennie, & Jones, 2004). Interestingly, several studies reported that irrespective of the type of presentation—real objects versus digitally simulated objects—interactive exploration was equally successful for science learning (Olympiou & Zacharia, 2011; Triona & Klahr, 2003).

However, empirical evidence for the learning implications of authentic objects that are not placed in experimentation-based environments, but are presented just to be observed, is almost non-existent. Against the backdrop of the emphasis that museums place on authentic objects, this lack of research is rather surprising. According to the International Council of Museums (ICOM, 2007), it is the museum 'which acquires, conserves, researches, communicates and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment'. This is particularly true for museums of the history of science and technology which, in contrast to science centers, often consider authentic objects as the centerpieces of their exhibitions. Thus, emphasis is placed on presenting 'original' objects instead of replicas, displaying them behind glass so that they cannot be manipulated or even touched and therefore can only be looked at by the visitors. Nevertheless, research on satisfying museum experiences has shown that visitors consider the opportunity to have a look at renowned authentic objects as a particularly satisfying element of their museum trip (Kirchberg & Tröndle, 2012; Pekarik, Doering, & Karns, 1999). Additionally, it is also assumed that taking a closer look at authentic remains of important scientific endeavors helps visitors in developing a more elaborate understanding of science (Evans, Mull, & Poling, 2002).

Yet despite this emphasis on authenticity, there is no empirical research regarding the question whether authentic objects indeed are perceived differently from non-authentic objects. However, if this were so, authentic objects would also be able to

increase science learning, as it is assumed that exciting experiences in informal environments lead to intrinsically motivated learning (Bell, Lewenstein, Shouse, & Feder, 2009). In order to clarify whether authentic objects have advantages for the transfer of scientific knowledge and which other factors beyond authenticity are relevant in this context, we shall discuss different notions of authentic objects and describe the present state of empirical research in the field before we report on the results of a study in which an extensive set of visitor interviews on the topic was conducted in a large museum of the history of science and technology.

Facets of Authentic Objects

What is considered to be an *authentic object* has been subject to some discussion (Evans et al., 2002; Gurian, 1999), but it is generally agreed upon that the authenticity of an object indicates its relation to the world outside of the museum. Facets of this relation have been discussed under the rubrics of originality, significance, and uniqueness.

In its broadest definition, an object is considered authentic if it has evolved in the real world or has been produced for certain real-world purposes (Evans et al., 2002; Gurian, 1999), with examples ranging from plant specimens to machines and scientific instruments. In contrast, according to this definition, objects that have been crafted specifically for the purpose of a museum exhibit do not count as authentic objects. This includes not only all types of replicas or reproductions but also models and simulations. In this sense, the term *authentic* is used interchangeably with the term *original*.

In a second definition, attribution of authenticity is restricted to those real-world objects that were once in touch with relevant historical events, developments or persons, thus being of high significance for the public (Frazier, Gelman, Wilson, & Hood, 2009). Typical examples of significant objects are the remains of a prehistoric catastrophe, instruments that have been possessed by famous scholars, or inventions that have marked important historical scientific events.

Finally, 'uniqueness' is another facet of authenticity. Here, an object is considered authentic if it is a single, individual specimen for which no (or just a few) copies exist (Newman & Bloom, 2012). Often significance and uniqueness are strongly related. A typical example of a unique exhibit from the field of the history of science is the setup of Otto Hahn's experimental assembly on nuclear fission exhibited in the Deutsches Museum in Munich.

For the present purposes, we have adopted the aforementioned definitions of authentic objects being both original and significant, encompassing those kinds of objects that once served a real-world purpose and bear some historical significance as well. Hence, it corresponds well to the demarcation line drawn by curators between pieces belonging to the museum's collection and the exhibition's presentation tools, such as replicas, models, or facsimiles, which normally are not considered as being part of the museum's collection.

Surprisingly, although the central role of authentic objects has been emphasized in museology, there is no empirical research regarding this topic. Admittedly, there are some empirical studies on this issue that have been conducted outside of the museum context. Here, research has mainly focused on the difference between

significant objects and their non-significant counterparts in everyday life and has shown that people consider authenticity in the sense of relevance and uniqueness to be important attributes of objects and possessions (Frazier et al., 2009; Hood & Bloom, 2008; Newman, Diesendruck, & Bloom, 2011).

In the context of science museums, Lindgren-Streicher and Reich (2007) compared the use of original artifacts to physical and digital models in both an engineering design task and an exhibit interpretation task, finding different usage preferences, attitudes, and learning gains. Eberbach and Crowley (2005) compared living, model, and virtual plants in a botanical garden and found that the living plants gave rise to more references to everyday experience, whereas models and virtual plants gave rise to more process explanations.

However, whereas both Lindgren-Streicher and Reich (2007) and Eberbach and Crowley (2005) again focused on hands-on tasks and experimentation, exhibits that display authentic scientific objects of some historical significance typically use presentation modes that do not allow for touching or interacting. Here, observed differences between authentic objects and their replicas cannot be attributed to possible advantages in handling, but instead, have to be related to the mechanisms of attribution and interpretation similar to those that have been described for everyday situations outside the museum (Frazier et al., 2009; Newman et al., 2011). Yet with regard to this mode of presenting authentic scientific objects, empirical studies are almost absent. The present study aims to fill this gap investigating the perception of authentic objects and the associated scientific knowledge acquisition by visitors in one of the largest museums of the history of science and technology worldwide, the Deutsches Museum. Further it aims to unveil other relevant factors beyond authenticity that influence the perception of science-related museum objects. The study is based on the following research questions:

(1) How does authenticity affect the perception of objects among visitors in museums of science and technology?
    (a) Do visitors evaluate authentic objects, defined as original objects that once served a science-related, real-world purpose and bear some significance for the history of science, higher than indistinguishable replicas?
    (b) Which dimensions of authenticity can be distinguished?
(2) What are other relevant factors—beyond authenticity—that affect the perception of objects among visitors in museums of science and technology?

Description of the Study

Setup of the Study

The study was conducted at the Deutsches Museum in Munich, Germany, one of the largest museums of the history of science and technology worldwide. In the exhibition area of bio- and nanotechnology, visitors were exposed to two different setups displaying two different scientific issues, nanotechnology and medical technology. Each setup

consisted of three experimental showcases that were arranged in a row. In the center of each of the two exterior showcases, an object was presented accompanied by texts and pictures on the back wall of each showcase. In the nanotechnology setup, the objects represented contemporary developments in technology from two different perspectives. In one of these showcases, the first scanning tunneling microscope (STM) constructed by Binnig and Rohrer was on display, surrounded by texts and pictures that described the object from a mere functional perspective. The other showcase approached the topic from a sociocultural perspective, displaying the Nobel Prize medal that Binnig received for the development of the STM, accompanied by information about the Nobel Prize in general and the founder, Alfred Nobel. The second setup did not show contemporary developments but made an excursion to the beginning of medical technology. Similar to the nanotechnology setup, the focus of one of the exterior showcases was on the technology of early prosthetics displaying the wooden leg of a famous seventeenth-century pirate. The other exterior showcase presented the corset of the heroine Scarlett O'Hara in the US-Movie *Gone with the wind*, worn by the actress Vivien Leigh in 1939, discussing health effects of early beauty treatments from a sociocultural perspective.

The status of authenticity of the objects of the two exterior showcases was systematically varied by presenting one and the same object alternately either as original or as replica. This was accomplished by changing the information on the object label. While one half of the visitors could read on the label that they were standing in front of an original, the other half could read that there was a replica on display.

In addition to the two exterior showcases described above, the middle showcase of the setup presented two ordinary objects without any historical link that instead presented possible applications of the technology. In the nanotechnology setup, this showcase contained everyday nanoproducts (e.g. lunch boxes, handlebars, etc.). In the medical technology setup, a contemporary leg prosthesis and breast implants, also without any historical meaning, were displayed in the supplementary showcase. Table 1 shows a list of the tested objects, including the variations of their label inscriptions.

Data Collection

A total of 56 semi-structured interviews were conducted. Interviewees were visitors of the exhibition area of bio- and nanotechnology who had looked at the experimental showcases by choice and who were asked after they had passed by the showcases whether they would take part in the study. In each condition, seven participants had been exposed to one of eight different possible permutations of the setup of the experimental showcases. The permutations resulted from three different variables with two manifestations each: status of object in the showcase with functional context (original vs. replica), status of object in the showcase with sociocultural context (original vs. replica), and scientific issue (nanotechnology vs. medical technology).

The interviews started with a warming up phase asking for personal data and the circumstances of the museum visit. Then, participants were asked to rank the

Table 1. Tested objects and the variations of their label inscriptions

		Label inscriptions	
		Label inscription when displayed as original	Label inscription when displayed as replica
Setup 1: contemporary developments (nanotechnology)	Showcase with technical/ functional focus: STM	The world's first STM, 1981, built by Gerd Binnig and Heinrich Rohrer In 1986, Binnig and Rohrer received the Nobel prize in physics for developing this STM Inv.-Nr.: 1993/432	1:1 replica of the world's first STM built by Gerd Binnig and Heinrich Rohrer in 1981 In 1986, Binnig and Rohrer received the Nobel prize in physics for developing this STM Inv.-Nr.: 1993/432
	Showcase with sociocultural focus: Nobel Prize medal	Nobel Prize medal, 1986, awarded to Gerd Binnig This medal was awarded to Gerd Binnig in Stockholm on 10 December 1986 by the King of Sweden On loan from Gerd Binnig, Munich	Replica of the Nobel Prize medal awarded to Gerd Binnig in 1986 The medal was awarded to Gerd Binnig in Stockholm on 10 December 1986 by the King of Sweden Inv.-Nr.: 1995/254
	Supplementary showcase: everyday nanoproducts	Information regarding the way everyday products function based on nanotechnology such as lunch boxes, handlebars, etc.	

(*Continued*)

Table 1. Continued

		Label inscriptions	
		Label inscription when displayed as original	Label inscription when displayed as replica
Setup 2: technological beginnings (medical technology)	Showcase with technical/ functional focus: wooden leg	Wooden leg, sixteenth century, worn by the pirate François Le Clerc The French pirate ship captain wore this wooden leg after his leg had to be amputated following a naval battle in 1549 On loan from the National Maritime Museum, London	Wooden leg, 1:1 replica of the prosthesis worn by the pirate François Le Clerc, sixteenth century The French pirate ship captain wore this wooden leg after his leg had to be amputated following a naval battle in 1549 Inv.-Nr.: 2000/168
	Showcase with sociocultural focus: corset	Corset, 1939, worn by the US actress Vivien Leigh The actress wore this corset in a scene of the Hollywood film *Gone with the wind* which was awarded several Oscars On loan from the Hollywood Museum, Los Angeles	1:1 Replica of a corset worn by the US actress Vivien Leigh, 1939 The actress wore this corset in a scene of the Hollywood film *Gone with the wind* which was awarded several Oscars Inv.-Nr.: 1998/173
	Supplementary showcase: prosthesis and breast implants	Information regarding the opportunities and risks of modern medical technology and plastic surgery	

three-dimensional objects in the showcases, starting with the object they liked most. For each object they were asked to justify their ranking. After they had been asked if they had seen originals or replicas in the showcases, they had to explain what would change if the objects were replicas instead of originals or vice versa. Participants' responses were clarified and elaborated by non-directive probing. In the end, participants were informed about the correct status of the displayed objects. Interviews were audio-recorded and transcribed for the analysis.

Data Analysis

Data were analyzed both quantitatively and qualitatively. The quantitative data of the ranking of the objects were analyzed statistically, considering the differences between the ranks of originals and replicas. For this purpose, we performed two separate 2 × 2 × 2-analyses of variances (ANOVAs) with either the rank of the object in the showcase with functional focus or with the rank of the object in the showcase with sociocultural focus as dependent variables. As the participants were exposed to four objects in total, the ranks could amount to between one and four. Independent variables were the status of the object (original vs. replica) in the showcase in question (functional or sociocultural), the status of the competing meaningful object (original vs. replica) in the other exterior showcase (sociocultural or functional) and the scientific topic of the showcases (nanotechnology vs. medical technology).

Reasons and explanations for the ranking results as well as the other parts of the interviews were analyzed qualitatively using the software MAXQDA. In the course of the qualitative content analysis of the interviews, transcripts were divided into meaningful text segments. Only text segments having relevance to the research questions entered into the analysis. On average, interviews contained 13 relevant text segments, ranging from 3 to 40 segments. These segments were then assigned to one of two categories, arising from the research questions, namely *dimensions of authenticity* and *relevant factors in the perception of objects,* where also data concerning the middle showcase with the objects without historical link were taken into account. Next, the text segments of each category were structured inductively. For this purpose, the single text segments were assigned to codes outlining the basic message of the statements. These codes were then split into subordinated codes and/or condensed into main codes according to whether the following text segments provided evidence for maintaining, broadening, or differentiating the code. The emerging pattern of codes was constantly enriched, modified, and specified during the process of analysis (Mayring, 2010; Miles & Huberman, 1994).

Results

Characteristic of the Participants

Participants were 29 men and 27 women with a mean age of 36.2 years (SD = 15.8). Many of the participants (59%) had a technical background consisting of employed

people working in technical professions as construction engineers, electrical engineers, and so forth, (29%) and students who reported science and technology as their area of main interest (30%). The remaining 41% were employees in administrative occupations (16%), in social or teaching professions (14%), or pursued a trade (11%). More than half of the participants (56%) visited the museum together with their family or friends. Twenty-three percent belonged to a group visiting the museum in the context of a school trip or an advanced training course. Only 21% visited the museum unaccompanied.

Authenticity and the Evaluation of Objects

Both for the showcase with a technical focus and for the showcase with a sociocultural focus, two separate 2 × 2 × 2 ANOVAs with status of the object in the exterior showcase in question (original vs. replica), status of the competing meaningful object in the other exterior showcase (original vs. replica), and the scientific topic of the showcases (nanotechnology vs. medical technology) as between-subjects factors, showed no significant differences between the rankings of the originals and those of the replicas, with $M_{\text{original}} = 1.92$ (SD = .89) vs. $M_{\text{replica}} = 2.28$ (SD = 1.65), $F(1,43) = .23$, $p = .64$, $\eta^2 = .01$ for the showcases with a technical focus and $M_{\text{original}} = 2.00$ (SD = .98) vs. $M_{\text{replica}} = 2.04$ (SD = 1.02), $F(1,41) = .01$, $p = .95$, $\eta^2 = .00$ for the showcases with a sociocultural focus. In the case of the showcases with a technical focus, neither the status of the competing meaningful object nor the scientific topic of the showcases showed any significant effects on the ranking of the showcase. Also, there were no significant interactions between all factors (all $p > .10$). In the case of the showcases with a sociocultural focus, again the status of the competing meaningful object had no influence on the ranking of the object in the showcase ($p > .10$); however, the difference between the two scientific topics was significant with the nanotechnology objects achieving higher rankings than the medical technology objects, $M_{\text{nano}} = 1.76$ (SD = .93) vs. $M_{\text{med}} = 2.29$ (SD = 1.00), $F(1,41) = 5.96$, $p < .05$, $\eta^2 = .13$. There was also a significant interaction between the status of the competing meaningful object and the scientific topic of the showcases, $F(1,41) = 4.56$, $p = .04$, $\eta^2 = .10$.

The results of the ranking task indicate that participants did not evaluate objects presented as originals higher than objects presented as replicas. Also, the status of the competing meaningful object had no influence on the object ranking. Only for the showcase with a sociocultural focus did the topic have an influence on the ranking because the Nobel Prize medal was by far more favored than the corset.

Dimensions of Authenticity

As can be expected from the ranking task, participants did not refer to differences in perceived authenticity spontaneously when asked for explanations for their rankings. Instead, in justifying their rankings, they provided a multitude of criteria not directly related to the authenticity of the objects, which will be discussed in the next section.

When directly asked if they had seen originals or replicas, many interviewees declared that they had not paid attention to the authenticity of the objects (35 participants). Most of them did not question the status of the objects as they considered the display of originals to be customary in the museum.

> Because we are at the museum. Because it is on display at the museum. That's why, actually. (MedTech_17, 112)

Thus, the notion of authenticity is not completely unimportant for visitors of a science museum. The analysis of those parts of the interview which addressed the status of the objects directly revealed that various aspects of authenticity should be distinguished. The explanations of the participants for what exactly would make the difference between an original and a replica were categorized into four dimensions of authenticity (Table 2).

History (31 participants). The ability to establish a connection with history is the facet of authenticity which was mentioned most often by the interviewed visitors. What made the original objects special to the visitors is that a part of history still adhered to them—as far as traces of usage are concerned, even in the true sense of the word.

> Well I think the real medal may be scratched, or it may just have patina, and so you're thinking, hmm, how did it get scratched. [. . .] I mean there is a small difference between the real medal and a replica. (NanoTech_20, 69–117)

In addition to the visible traces of the object's history—the patina—the knowledge that the object was an original opened the visitors' minds up to invisible traces of the object's history. Both visible and invisible traces were able to build a connection between past and present and in this way contributed to the impression that the object offers direct access to history.

Table 2. Dimensions of authenticity (with the number of interviewees who had mentioned them in parentheses)

Dimension	Description	Example
History (31)	Authentic objects establish a connection with history	That I imagined who might have worn this [corset]. [. . .] If it is a replica, nobody has actually worn it (MedTech_24, 162)
Charisma (8)	Authentic objects emanate a certain *aura*	I could feel something like an aura. Or so I imagined (NanoTech_21, 138)
Rarity (15)	Authentic objects are rare or even unique	Uniqueness worldwide (NanoTech_29, 123)
Functionality (12)	Authentic objects function properly and without limitations	One thinks that it is hundred percent like it is in reality. And the copy could perhaps lack a detail. And then it does not work anymore (NanoTech_2, 69)

> Because you can imagine that it [STM] was actually used, that is, was once in the context of researchers and scientists. This opens up the perspective, unlike a replica, where I would imagine that someone made it so it would look like the original object. (NanoTech_18, 55)

Charisma (8 participants). The historic background of the original objects not only facilitated imagination and the access to history for the participants but also provided the objects with a certain *aura*. A few participants not only stated that original objects provide the visitors with stories and history that can provoke imagination, but they went even further: In their statements, a certain kind of irrational superiority or supersensual power found expression. This irrationality in argumentation distinguished them clearly from those participants who referred to the visible and invisible traces of the object's history in a more rational manner. Accordingly, to the question what would change if the Nobel Prize medal was an original instead of a replica, one participant replied:

> One would probably tremble with amazement a bit more. (NanoTech_16, 154)

Another participant assigned 'more aura' to the displayed corset believing that it was an original in contrast to the other exhibits:

> This [corset] had more of an aura, in some way, a kind of charisma. But not the other things. (MedTech_16, 139)

Closely connected to this phenomenon of the *aura of the original* were statements of some of the participants who explained that it would give them an elevating sensation if they could touch the original.

> If I could touch it [Nobel Prize], that would of course be brilliant, exactly this medal he got, to be able to hold it once in my hands: that's a bit of a sensation. (NanoTech_8, 73)

Rarity (15 participants). Some participants considered the rarity of an object crucial regarding the question of what constitutes an original object. Given the opportunity to see objects that are scarce and which cannot be manufactured anymore in the same way as before was a valuable experience for many visitors.

> Because of the rarity value. I don't think there are many of those left. (MedTech_22, 110)

Even though rare objects are already impressive in themselves, uniqueness is considered even more sensational as it finds expression in the following statement regarding the wooden leg:

> I would have rated it [the original] higher because I would have said that this is probably the only wooden leg which has been preserved for four or five hundred years. (MedTech_6, 137)

The appreciative and reverent tone of voice that can be heard when the museum visitors are talking about rare or unique originals shows that for many people this rarity or uniqueness seems to be a material and an ideal value: an idea which is

promoted in particular by the mass media. Visitors usually know about many of these meaningful objects from TV or film. Then seeing the originals directly in front of them instead of just virtually constitutes an extraordinary experience for them.

> And even if one has seen it on TV, I have never had it [STM] in front of my very own eyes in 3-D. (NanoTech_8, 87)

Functionality (12 participants). Finally, for some of the museum visitors interviewed, authenticity, especially regarding technical objects, had a further dimension, namely unrestricted functionality, which is fundamentally different from the aspects of originality mentioned above. According to this view, only an original object that has no single detail missing would function properly and without any limitations.

> Then I know that it [STM] is working. That it is exactly like that, like in physics where functionality is always top priority. If it works and if it is some kind of reproduction or if something is missing, then it's not logical; then something must be wrong; I do want to have the real thing. (NanoTech_29, 139)

According to the last statement, the unrestricted functionality of an original instrument is mainly a matter of belief since it cannot be directly verified by the visitor when the object is behind glass. Therefore, even if the visitors cannot verify whether a technical instrument such as the first STM works or not, it would make a difference for some of the visitors if the STM is not 'real'.

> Yes, for such a device, I think it would be relevant whether it is the real thing. [. . .] I just think that maybe some things are omitted from such a complex machine because otherwise it would be too expensive. I think this would be a pity, even if I didn't notice it. (NanoTech_107, 113)

Relevant Factors in the Perception of Objects

As mentioned above, when asked for explanations for their rankings, participants provided a multitude of criteria not directly related to the authenticity of the objects. These explanations were categorized into 12 criteria which could be grouped into 3 main categories (Table 3).

Appearance (42 participants). Many explanations of the participants for the object ranking were related to the outward appearance of the objects. Besides being able to look at an authentic, valued object, this also meant appreciating its esthetic appearance, its workmanship, as well as its design and function.

The most frequently mentioned reasons referred to the *exceptionality of having the opportunity to look at a famous object* whose concrete appearance is not known because it usually cannot be seen in everyday life (33 participants).

Table 3. Object evaluation criteria (with the number of interviewees who had mentioned each criterion in parentheses)

Main criteria	Sub-criteria	Description	Example
Appearance (42)	Exceptionality of having the opportunity to look at a famous object (33)	Object cannot be seen in everyday life	The corset was the most interesting object for me. Just because I thought it was great to see it like that. Because you normally can't see those things anymore (MedTech_20, 41)
	Esthetic appearance (12)	Object is seen as piece of art	More from an aesthetic viewpoint. It is really beautiful somehow as an exhibit, just the way it looks . . . it just looks round and perfectly shaped (NanoTech_14, 96)
	Extraordinary workmanship (8)	Object is made with exceptional accuracy and skillfulness	Because it is a beautiful piece of craftsmanship (MedTech 16, 33)
	Design and function (8)	The design of the object is closely related to its function	The design isn't just for aesthetic purposes here, but the functionality of technology is based particularly on this design (MedTech 6, 89)
Intellectual insights (35)	Fascination by technology (22)	Object is fascinating because of its sophisticated technology	This is so impressive, how you see leg prostheses nowadays. This represents a giant quantum-leap for development, doesn't it? And that's impressive, impressive (MedTech_10, 70)
	History of technological development (15)	Object makes the technological development clear	The comparison of the prototypes [of the scanning tunneling microscope] with the final product. The way to get there. The enormous difference (NanoTech_21, 83)
	Implications for society (11)	Object explains the implications for society caused by the technological progress	Mainly because you get yourself ill because you are obsessed with beauty. [. . .] But I thought it was interesting to show it to the children, that this is not a good thing (MedTech_ 25, 43–45)
	Functional comprehensibility (8)	The functionality of the object is comprehensible	I think there should have been more notes stuck to it, so you can see on the model what every part does (NanoTech_29, 35)

(*Continued*)

Table 3. Continued

Main criteria	Sub-criteria	Description	Example
Personal characteristics (33)	Personal experiences/familiarity with the subject (22)	Object can be related to personal experiences	[. . .] Also because I practically already knew it (NanoTech_22, 59)
	Interest in the subject (12)	Object refers to an interesting subject	Because the scanning tunneling microscope interested me very much (NanoTech_8, 43)
	Intellectual requirements (11)	Object provides an intellectual challenge without demanding too much	The first object was much too complicated, one had never seen it before. But the microscope was familiar to me in some way and that motivated me to have a closer look at it (NanoTech_27, 60)
	Relevance for everyday life (10)	Object is pertinent to everyday life	Because it was about a rather practical subject. Something that is implementable and where I can see the benefit for mankind. (NanoTech_17, 29)

> Well, usually they only tell you that the Nobel Prize has been awarded, great. Now I can finally see what it actually looks like. (NanoTech_19, 82)

Other participants treated the objects like pieces of art and judged them by their *esthetic appearance* (12 participants).

> It [Nobel Prize] is really beautiful somehow as an exhibit, just the way it looks. It just looks round and perfectly shaped. (NanoTech_14, 96)

Closely related to the esthetic value was the appreciation of *extraordinary workmanship* of some of the objects. Interestingly, this criterion was not only applied to authentic objects such as the STM which had been designed by brilliant scientists. Instead, a similar argument was also given for artificial objects that were created by the modelers of the Deutsches Museum for illustrative purposes (8 participants).

> I can see the whole business. The bolting together and just the whole conception and testing and then it doesn't work. And then changing it again. [. . .] And a lot of money and nerves and many nights and all that work and racking your brain; all this is in there. (NanoTech_6, 134)
> I would say the bread bin because someone really made that; he had to think how do I picture mould, what does mould look like, that it has to last a while, it has to look genuine, so that is also almost like a piece of art. (NanoTech_18, 113)

Some participants gave a high ranking to an object if its *design was closely related to its function* (8 participants). In contrast to the participants quoted above who referred only to esthetic appearance, they also took the special purpose of the design into account.

> Yes, it [prosthesis] has also got something from an esthetic point of view, hasn't it: the design and something like that. The design isn't just for esthetic purposes here, but the functionality of technology is based particularly on this design. (MedTech_6, 89)

Intellectual insights (35 participants). Another set of explanations, being completely independent of the authentic status of a given object, pertains to the intellectual insights imparted by it. This can be decomposed into several categories, including being *fascinated by sophisticated technology*, becoming aware of the *history of technological development*, reflecting on the *implications of a technological or scientific discovery for society*, and the impression of *functional comprehensibility* (or a lack of it).

Accordingly, objects achieved high rankings when the participants were *fascinated by the sophisticated technology* that became apparent through the object (22 participants).

> If you really think about that, that you can actually manipulate real atoms; that's what I find exciting. Or the microscopic level you are entering. Where they work with that. That you can really shift individual atoms, that's really fascinating. (NanoTech_11, 45)

Many participants appreciated the *history of technological development* that became obvious by the contrasting juxtaposition of objects from different ages (15 participants).

> If you look at the difference between the two prostheses, the wooden leg and the leg prosthesis, you can easily imagine that there is a huge difference. One is really just a stick which you tie to the leg stump, and the other is really something which is totally sophisticated and which adapts to the human body. (MedTech_23, 90)

Closely related to the technological development were its *implications for society* which were often mentioned together with the technological progress as can be seen in terms of the modern leg prosthesis (11 participants).

> You can see how much research has been done in this area and how much these people are progressing due to this research. Someone who had a prosthesis in those days [of the wooden leg] would never have been able to be a top athlete. The young man [with the modern leg prosthesis] does that. He runs—long-distance, short distance, whatever. [. . .] People wearing leg prostheses can go skiing these days. In those days, this would have been unthinkable. (MedTech_12, 40)

Finally, it was striking that some visitors complained of the lack of *functional comprehensibility* of some objects. In fact, they proposed that didactically designed models should be displayed in place of authentic objects because it would help them to understand the way the object functions (8 participants). In this case, authenticity was seen as a hindrance for comprehension and thus served as an argument *against* giving it a high ranking for preference.

> I actually think it would be more helpful to cut it [STM], and if it's too small, which is surely going to be the case, to enlarge it. That would be a lot more helpful. (NanoTech_21, 113)

Personal characteristics (33 participants). A third set of arguments for the rankings relates to the individual characteristics of the participants, including *personal experiences and prior knowledge*, *interest in the subject*, *intellectual challenges*, and perceived *relevance for everyday life*.

Accordingly, objects achieved higher rankings when they could be related to *personal experiences* or when the participants were *familiar with the subject* (overall 22 participants).

> When I was a child, we had a neighbor who had had his leg amputated. [. . .] In our street he was only known as 'Click-clack'; when he walked, the knee, it really went click-clack, and I think this is really fascinating, how science has progressed and is able to help these people. (MedTech_3, 49)

Frequently, the *interest in the subject* (12 participants) was a reason for the high ranking of an object. If interest was low, on the other hand, the object was ranked accordingly lower.

> I see, okay, then it really is the Nobel Prize medal, I would say, the best really because I thought it was really the most interesting object. (NanoTech_15, 92)
> Well, the other one, that would just be the corset, and I have never been interested in corsets. So this doesn't interest me here either. (MedTech_5, 37)

Related to the participants' cognitive characteristics were the perceived *intellectual requirements of the objects* (11 participants). Here, those objects that challenged the

participants intellectually without demanding too much of them obtained high rankings. Hence, one and the same object could be both a stimulating intellectual challenge for one participant or much too demanding and frustrating for another participant, as evidenced by the following two statements regarding the STM:

> I liked the modern microscope most. [. . .] At the very beginning, I looked at it and I thought, what's this? Then I looked at the title and I read what it was, and then I tried to study it from the bottom to the top and so on, and how it could work. (NanoTech_22, 63)
>
> This [STM] is too complicated, too technical. I can't keep up with it. I can read it, but the head is still empty . . . That's stupid. I don't get it. (NanoTech_19, 66)

Additionally, objects obtained higher rankings when the knowledge imparted by them was considered to be *pertinent to everyday life* of the participants and correspondingly lower rankings when it was not (10 participants).

> One can always use Tupperware boxes. So you need to know what's in it. I am not building a microscope and I won't get the Nobel Prize either. So this is why it is not really my world. (NanoTech_19, 50)

Discussion

The goal of this study was to investigate the role of authentic objects, defined as original objects that once served a science-related, real-world purpose and bear some significance for the history of science in museums with an emphasis on the history of science and technology. Further we aimed to identify relevant factors beyond authenticity in the perception of objects of science and technology.

Contrary to our expectations, the quantitative analysis of the evaluation of originals and replicas showed that authenticity of the objects does not play a prominent role for the visitors. However, authenticity was not completely unimportant to the visitors who distinguished between four different dimensions of authenticity: *history*, *charisma*, *rarity*, and *functionality* of the object. The mentioned ability of originals to connect visitors with *history* is in line with the considerations of many museum professionals regarding the nature of authentic museum objects. Accordingly, Korff (2002) sees the nature of original museum objects in their capacity as witnesses of a time period, mediating between contemporary proximity and historical distance. The statements that refer to the *charisma* of authentic objects show that the concept of the 'aura of the original' that was coined by Benjamin (1963) and since then often cited by museum professionals is also expressed by museum visitors. As the statements regarding the *rarity* of an object show, this dimension is not only a consequence of the display of the object in the museum context but is also supported by the media coverage (Cutting, 2003). Being able to look at objects that have been charged with importance by the mass media may well be a kind of a sensation for some visitors. Moreover, the special status of these meaningful objects spreads to its viewers who also might feel a bit more important. As viewing meaningful and famous objects is a kind of cultural capital that serves the purpose of distinction for

persons of higher social status, for some visitors viewing these objects might give them the feeling of upgrading their social position (Bourdieu, 1983; Bourdieu, Darbel, & Schnapper, 1997).

Whereas the first three dimensions share one crucial factor, namely the identity of an object that already existed in former times and played an important role in history, the fourth dimension, *functionality*, reflects a more materialist view on authenticity. It mainly played a role for those objects whose mode of function was important. This aspect might be typical for science museums, as the objects on display do not just serve to provide an opportunity to experience the past directly. Often the focus of technical objects is more on the way they work or what they produce. Like the STM, these objects are not only witnesses of a historical event, but at the same time, they represent a complex technology that establishes advanced solutions for certain problems. In this case, a necessary precondition of authenticity is not only the object's appearance at the surface, but also of its 'inner life'. Accordingly, the object would not only *be* authentic, but also—at least in principle—be able to *behave* authentically.

In addition to the dimensions of authenticity, the interviews unveiled a multitude of criteria for the evaluation of objects that were mostly independent of authenticity. One of the three main categories was the outward *appearance* of an object that may be appreciated in different ways by the visitors. Besides the opportunity to get a visual impression of a famous object, which seems to be one of the main reasons for appreciating objects, esthetic aspects play an important role. In line with recent findings that different classes of objects are evaluated on different esthetic dimensions (Stich, Knäuper, Eisermann, & Leder, 2007), these are not only related to the beauty of the object but also to the skillfulness of the producer of the object and to the interplay of design and function.

Another set of arguments that were grouped into the main category, *intellectual insights*, was predominantly related to the meaning represented by an object and to its wider implications. As the objects of this study stood mainly for scientific or technical content, the participants attributed both to the fascination of technology, its historical development, as well as to its effects on culture and society. Yet, the participants' emphasis on functional comprehensibility of the objects indicates that most participants prioritized learning about the functionality of technical instruments over their historical significance.

The arguments that were assigned to the third main category referring to the *personal characteristics* of the participants corroborate the empirically well-established influence of previous knowledge and personal interest on engaging museum visitors with museum objects and other exhibits (Bell et al., 2009). The statements of the participants of this study showed a nuanced manifestation of these two variables: Interest was split into a fundamental and often more theoretical interest in the subject and a very practical interest in the subject because of its relevance for everyday life. Also, previous knowledge falls into personal experiences or familiarity regarding the object and the intellectual demands of the subject matter, as the experience of the visitors is often independent of their cognitive ability to understand a complex topic. The

latter is in line with the notion that an intermediate level of complexity is beneficial for the development of epistemic curiosity, which in turn leads to heightened interest and extended exploration (Berlyne, 1966).

Thus, in general, the findings of our study repeatedly suggest that the majority of visitors of a museum of the history of science and technology tend to evaluate the displayed objects according to an insight provided into scientific or technological principles. The better an object makes technical processes visible and scientific findings comprehensible, the higher it is evaluated by the visitors. That implies that under certain circumstances models with a mere didactic focus that are able to visualize scientific and technical findings are preferred to authentic objects (Lindgren-Streicher & Reich, 2007). Correspondingly, it happens that authentic objects are evaluated according to their functionality—or rather, the authenticity of the objects is ascribed to their functionality. The historical significance of an original object, in contrast, seems to play a subordinated role and only becomes manifest when the distinction between original and replica is explicitly addressed.

By exploring satisfying experiences in various museum types, Pekarik et al. (1999) found a 'mutual exclusivity between a preference for object experiences and a preference for cognitive experiences'. As far as experiences with authentic objects are concerned, the present study confirms these results, as the acquisition of knowledge ran like a thread through the argumentation patterns of the visitors, whereas the appreciation of authentic objects took a back seat. Nevertheless, the outward appearance of objects in general, independent of their authenticity, played a quite noticeable role. In this context, the object experience was strongly linked with cognitive aspects such as the harmonious interplay of design and function or the extraordinary workmanship that is reflected by the object. Thus, it can be assumed that in museums of the history of science and technology, the appreciation of authentic objects with historical significance stands back in favor of the gain of knowledge. However, the knowledge gain turns out to be intertwined with the object experience as far as the object is able to impart knowledge about technical principles and its functionality.

Conclusion

From the viewpoint of the visitors, this study confirms that the focus in museums of the history of science and technology is more on the acquisition of scientific and technical knowledge than on authenticity in the sense of historical significance. However, from a conservational perspective, the museum collections are undisputedly of great value for the preservation of our scientific and technical heritage. It becomes clear that the high conservational value of authentic objects cannot simply be transferred to their presentation in the exhibition, as replicas or models are definitely no less appreciated than authentic objects for the visitors in a science exhibition.

The present study further reveals that it should be of great importance for the conception of exhibitions to complement authentic objects with features such as models or digital media stations that provide additional science-related information regarding the object. In this way, experience with the object and cognitive experience could be

connected in terms of an enriched scientific understanding. How this connection can be most successful requires further research. From the viewpoint of science education, the question arises whether looking at historically significant science-related objects improves the understanding of science and technology. This opens up a research area that complements the work that has been done recently regarding the role of historical narratives on science comprehension in school education (Arya & Maul, 2012; Hong & Lin-Siegler, 2012).

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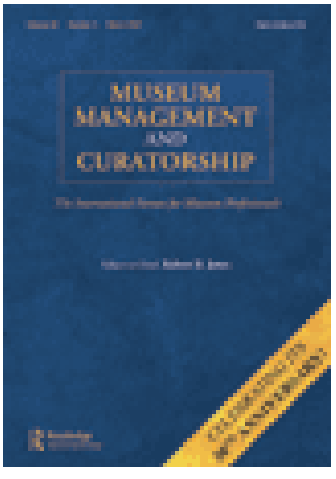
A 1.3 Publikation der dritten Studie

Hampp, C., & Schwan, S. (2014). Perception and evaluation of authentic objects: Findings from a visitor study. *Museum Management and Curatorship*. DOI: 10.1080/09647775.2014.938416



Museum Management and Curatorship
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/rmmc20

Perception and evaluation of authentic objects: findings from a visitor study

Constanze Hampp[a] & Stephan Schwan[b]

[a] Research Institute, Deutsches Museum, Museumsinsel 1, 80538 Munich, Germany

[b] Cybermedia Lab, Knowledge Media Research Center (IWM-KMRC), Schleichstraße 6, 72076 Tuebingen, Germany

Published online: 28 Jul 2014.

To cite this article: Constanze Hampp & Stephan Schwan (2014): Perception and evaluation of authentic objects: findings from a visitor study, Museum Management and Curatorship, DOI: 10.1080/09647775.2014.938416

To link to this article: http://dx.doi.org/10.1080/09647775.2014.938416

Museum Management and Curatorship, 2014
http://dx.doi.org/10.1080/09647775.2014.938416

Routledge
Taylor & Francis Group

Perception and evaluation of authentic objects: findings from a visitor study

Constanze Hampp[a]* and Stephan Schwan[b]

[a]*Research Institute, Deutsches Museum, Museumsinsel 1, 80538 Munich, Germany;* [b]*Cybermedia Lab, Knowledge Media Research Center (IWM-KMRC), Schleichstraße 6, 72076 Tuebingen, Germany*

(*Received 8 October 2013; accepted 5 March 2014*)

Authentic objects, defined as original objects that once served a real-world purpose and bear historical significance, are very important to the collections of museums, as they increase any museum's prestige, have high economic value, and allow for historical research. Previous findings indicate that the importance of authentic objects for presentation in an exhibition should be challenged. To investigate the perception and evaluation of authentic objects of high historical significance, we presented two different 'masterpiece' objects either as originals or as replicas in a space flight and astronautics exhibition. An extensive set of interviews ($N = 115$) revealed that visitors consider authentic objects in equal shares either as relevant or as irrelevant. The interviews both confirmed and expanded an existing set of dimensions of authenticity. The results of a supplementary questionnaire showed that whenever visitors feel that authenticity is of high relevance they also evaluate objects more highly – independently from the state of authenticity.

Keywords: authentic objects; original; replica; visitor study; science museum

Introduction

Museums have always placed great importance on authentic objects. In its latest statutes, the International Council of Museums (ICOM 2007) defines a museum as an institution 'which acquires, conserves, researches, communicates and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment.' Since authentic objects represent both a tangible and an intangible heritage, they are essential for the collections of museums, as they help to increase any museum's prestige, have high economic value, and allow for historical research. However, the question as to whether the relevance of authentic objects also applies to their presentation in exhibitions, and whether the display of authentic objects plays an important role for visitors, is a rather difficult one to answer and must be examined carefully.

For quite some time, authenticity was seen by heritage management and preservation sectors from a rather materialist perspective. An artifact or a monument was considered authentic when it possessed certain 'objective and measurable attribute[s] inherent in the material fabric, form and function' (Jones 2010, 182). In recent work from various academic fields, by contrast, the concept of authenticity has been approached from a

*Corresponding author. Email: constanze.hampp@gmail.com

constructivist perspective, where authenticity is not considered to be inherent in the object, but instead comes to life through specific interactions between people and material things (Lindholm 2008; Jones and Yarrow 2013). This constructivist view gives rise to the concept that any high-quality reproduction should be able to render the same power of authenticity as originals – as long as the visitors do not even realize that they are reproductions (Holtorf 2005). In contrast, there are case studies of heritage sites or exhibits that have enchanted visitors even though these visitors knew that the objects on display were not authentic (Lowenthal 2008; Young 2012). So it seems that whenever reproductions are treated in the same way as originals, they are able to appear with the same level of authenticity.

On the whole, there is almost no empirical evidence regarding the question of whether authentic objects, defined as original objects that have evolved in the real world or have been produced for certain real-world purposes (Evans, Mull, and Poling 2002; Gurian 1999) and additionally bear some historical significance (Frazier et al. 2009), are indeed perceived and evaluated differently from nonauthentic objects. Most empirical studies have been conducted outside of the museum context. This research has focused mainly on the difference between historically significant objects and their nonsignificant counterparts in everyday life. The research has shown that people, whenever they are not in a museum, consider authenticity in light of originality and historical relevance as an important attribute attached to objects and possessions (Frazier et al. 2009; Hood and Bloom 2008; Newman and Bloom 2011).

In the context of museums, research on satisfying museum experiences has shown that visitors consider the opportunity to have a look at renowned authentic objects as a particularly satisfying element of their museum trip (Pekarik, Doering, and Karns 1999; Kirchberg and Tröndle 2012). Similarly, a survey among students unveiled 'seeing the authentic object' as one of 10 triggers for transformational museum experiences 'that profoundly change individuals' attitudes, interests, appreciation, beliefs, or values' (Soren 2009, 235). Focusing on the mystical character of authentic objects, Latham investigated numinous experiences of visitors with museum objects. Referring to Maines and Glynn (1993), she characterizes numinous objects by 'their association, real or imagined, with some person, place, or event endowed with special sociocultural magic' (Latham 2007, 250). In a phenomenological investigation, she found that 'a numinous museum encounter is a complex, personal, multidimensional experience' that is 'spiritual in character' (Latham 2013, 16). These experiences are interpreted as mystical flow experiences that are differentiated from traditional learning experiences.

The role of authenticity for the evaluation of objects in museums

In her discussion of numinous experiences, Latham (2013) urged empirical researchers to perform a systematical investigation of the relation between different types of objects, different contexts (i.e. types of museums), and visitor characteristics. In line with her arguments, a recent visitor study addressed the link between the perceived authenticity of objects and their evaluation in an exhibition of nano- and biotechnology at the Deutsches Museum, a large museum of the history of science and technology in Munich, Germany (Hampp 2012; Hampp and Schwan 2014). This study challenged the assumption that authenticity is particularly important for the visitors' perception and evaluation of museum objects. It revealed that visitors evaluate objects of science and technology in a very sophisticated way. Contrary to what one would expect, the authenticity of objects did not

play a prominent role. Instead, the criteria for the evaluation of objects could be grouped into three main categories, with authenticity constituting just one aspect among others: *outward appearance of an object*, *intellectual insights imparted by an object*, and *individual characteristics of the participants*. Also, with regard to authenticity, four different dimensions became apparent: *history*, *charisma*, *rarity*, and *functionality*. Whereas the first three dimensions refer to the historical significance of authentic objects, the fourth dimension, *functionality*, reflects a more materialistic view of authenticity. This dimension shows that authentic objects in science history museums not only serve to provide an opportunity to experience the past directly, but their presentation is also expected to give insight into the way they function or what they produce.

Two specifics of the study may have contributed to the surprising finding that authenticity plays only a peripheral role in the evaluation of exhibits. One aspect is the context of a science history museum, and the other relates to the selection of objects that were predominantly 'mundane' or 'unspectacular.' With regard to the type of museum, the exhibition's topic of bio- and nanotechnology may have influenced visitors to expect they would learn about and comprehend new technologies more than see historically significant objects. Similar to this, presenting – for laypersons – unspectacular objects may also have caused visitors to consider authenticity to be less relevant.

Accordingly, the present study was conducted in order to test whether the finding of a mostly marginal role of authenticity in a science history museum can also be applied to highly significant exhibits of iconic value. Its aim was to examine the effects of objects that are not only of great historical significance but also are presented in a context that focuses more on history, myths, and uniqueness than on the context of new technologies, in which the functionality of objects is the center of attention. More specifically, it investigated famous objects, called 'masterpieces,' in the exhibition area of space flight and astronautics, which per se is a very emotionally charged topic full of myths, displaying 'numinous' (Latham 2007, 2013) objects. The study is based on the following research questions:

(1) Do visitors *perceive* authentic objects, defined as original objects that bear high historical significance, differently from identical replicas?
   (a) Do visitors notice the indicated state of authenticity of the displayed objects?
   (b) Do visitors report different qualities of perception evoked by authentic objects or identical replicas?
(2) Do visitors *evaluate* authentic objects differently from identical replicas?
   (a) For what reasons do visitors (not) evaluate authentic objects more highly than identical replications?
   (b) Do visitors evaluate authentic objects more highly than identical replicas in terms of the responses they evoke, including the desire to touch and to own the object, or the economic value of the object?

Description of the study

Setup of the study

The study was conducted at the Deutsches Museum in Munich, Germany, one of the largest museums for the history of science and technology worldwide. In the Museum's exhibition area of space flight and astronautics, we selected two authentic objects with evident historical significance: a piece of moon rock and a space suit. The moon rock was

picked up by the astronaut and geologist Harrison Schmitt, one of the last two people who walked on the moon during the last Apollo-17 mission. It was given to the German people by American President Richard Nixon in 1972, together with a German flag which had been taken to the moon during the mission. The Russian space suit Sokol KV-2 was worn by the German astronaut Klaus-Dietrich Flade during the flight to the Mir space station in March 1992. The space suit comes with numerous technical details about how it protected astronauts from an extremely hostile environment. Whereas the significance of the piece of moon rock is completely determined by its origin and the history of its travel to earth, the space suit is significant because of two different aspects: its scientific and technical function can be explored by the visitors by examining the exhibit, and it is significant due to its use in space.

To vary the state of authenticity of the objects systematically, we presented the objects either as originals or as identical replicas. To present the objects as replicas, we set a poster right beside the object that informed the visitors that, due to conservation reasons, the original had been replaced by an identical replica that was on display at the moment. As the objects are in fact originals and are normally presented as such, and since the majority of visitors assume that originals are on display in museums unless they are not labeled as replicas (Hampp 2012), we only needed to remove the poster when presenting the objects as originals (see Figures 1 and 2).

Data collection

A total of 120 participants (71 men and 49 women with a mean age of 31.8 years, SD = 13.0) took part in the study. They were recruited in the exhibition area of space flight and astronautics at the Deutsches Museum after they had had a close look lasting at least

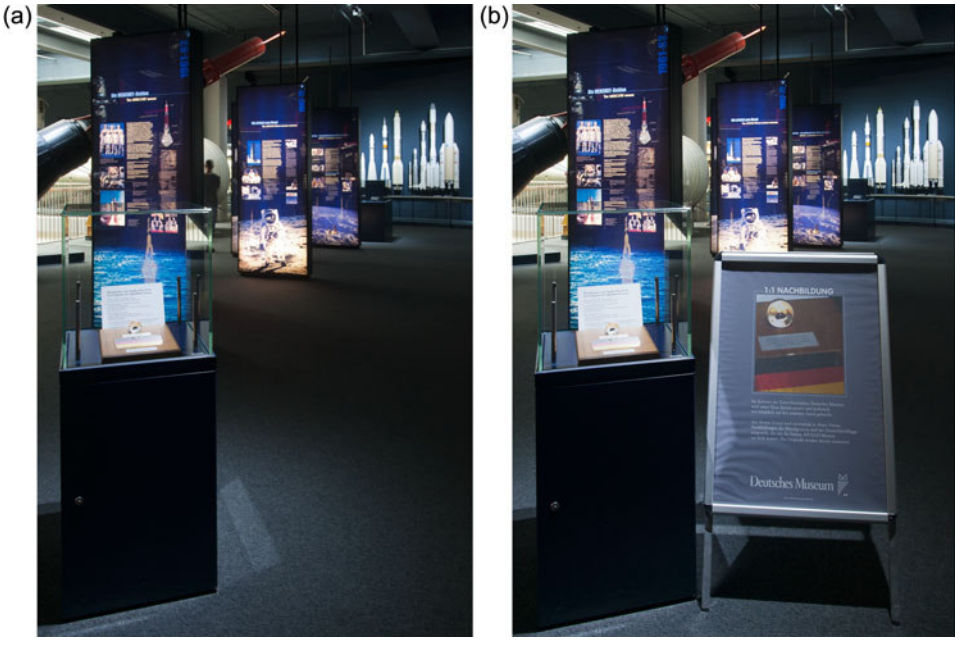


Figure 1. Moon rock, presented as original (a) and as replica (b).

Figure 2. Space suit, presented as original (a) and as replica (b).

30 seconds either at the piece of moon rock (n = 60) or at the space suit (n = 60). Both the moon rock group and the space suit group consisted of two subgroups each that were exposed either to the original (n = 30) or to the replica (n = 30). When the object was presented as replica, only those visitors were approached who had also examined the poster with the information about the replica on display. Visitors were asked to follow the examiner to a separate room to fill in a questionnaire and to be interviewed.

Questionnaire

First, participants received a questionnaire that contained questions regarding their evaluation of the displayed object, their estimated previous knowledge and interest in space flight, as well as some sociodemographic data. Questions concerning the displayed object – either the moon rock or the space suit – included how much participants would be willing to touch and to own the object (1 = 'is definitely not the case' to 7 = 'is definitely the case'), along with an estimation of the value of the object (also on a seven-point scale: midpoint moon rock = 'about 50,000 Euro,' midpoint space suit = 'about 100,000 Euro,' 1 = 'considerably less than 50,000/100,000 Euro,' 7 = 'considerably more than 50,000/100,000 Euro'). Sociodemographic data included age, sex, and educational level.

Interview

With the exception of five participants, all participants (n = 115) agreed to give an interview subsequent to the questionnaire. After a warming-up phase with a few general

questions concerning the museum visit, the interviews were based on the following questions:

(1) While responding to the questions in the questionnaire, you probably have already noticed that the focus is on the moon rock/the space suit on display. Could you please describe which thoughts crossed your mind and what it felt like when you were standing in front of the showcase?
(2) The questionnaire referred to originals and replicas. Was the object on display an original or a replica? Why do you think so? [The participant was corrected if he or she misidentified the object as an original or replica when in fact it was the reverse.]
(3) What would change if I told you that the object on display was not an original/a replica but a replica/an original? Would your experiences with the object that you described previously still be true? Why (not)?

Visitors' responses were clarified and elaborated upon by nondirective probing. Interviews were audio-recorded and transcribed for analysis.

Data analysis

Interviews were analyzed qualitatively using the software MAXQDA. In the course of the qualitative content analysis of the interviews, transcripts were divided into meaningful text segments. Only text segments having relevance to the research questions were included into the analysis. On average, interviews contained 15 relevant text segments, ranging from 2 to 33 segments. All text segments were first assigned to three predefined categories, corresponding to the three main questions in the interview, namely, *thoughts and feelings while looking at the object*, *classification of the object as an original or a replica*, and *reactions and comments if the state of the object's authenticity were to change*. Next, text segments of each category were structured inductively by developing subcategories for each of the main categories. The emerging pattern of categories was constantly enriched, modified, and specified during the process of analysis (Mayring 2010; Miles and Huberman 1994). Subcategories concerning the *reasons for the classification of the objects* were divided into *classification as original* and *classification as replica*. Accordingly, subcategories concerning the *relevance of authenticity* (reactions and comments if the object's state of authenticity were to change) were divided into *arguments for the relevance of authenticity* and *arguments for the irrelevance of authenticity.* All of the transcripts were analyzed by two independent coders. In cases of inconsistency, the passage in question was discussed and the more suitable option was chosen (Mayring 2010).

Finally, the initial three main categories were consolidated into two different categories: *perception of authenticity*, including the classification of the objects and the perception qualities of originals and replicas, and *relevance of authenticity*, including arguments for the relevance of authenticity and arguments for the irrelevance of authenticity.

The quantitative data of the questionnaire were analyzed statistically, taking into consideration the differences among several responses to the presentation of originals and replicas that have been reported in the literature on authenticity (Newman and Bloom 2011). Also taken into account were the object type (moon rock vs. space suit) and how

relevant participants thought the object's state of authenticity was (relevant vs. irrelevant) as derived from the analysis of the interviews.

Results

Characteristics of the participants

Participants reported a medium level of estimated prior knowledge ($M = 3.4$, SD = 1.2) and a medium-to-high involvement ($M = 4.3$, SD = 1.1). Regarding the evaluation criteria of the objects, participants indicated a medium desire to touch the objects ($M = 3.7$, SD = 2.2), a low-to-medium desire to own the objects ($M = 2.3$, SD = 1.9), and a medium-to-high estimation of the value of the object ($M = 4.5$, SD = 1.9).

Perceived state of authenticity

As a manipulation check, participants were asked whether the object in question was an original or a replica. The results of the questionnaire showed that in both the group with an original on display and the group with a replica on display, more than 25% of the participants responded incorrectly (object displayed as original: 26.7%; object displayed as replica: 28.3%). These false attributions were confirmed and clarified in the interviews later. Surprisingly, whether the objects were classified as originals or replicas hardly ever resulted from the information accompanying the objects.

Classification as original

The most important evidence for the authenticity of the objects was for many participants the fact that they were on display in a *museum context* (21 participants). Participants who stated that there was an original on display mainly argued that they expected originals in museums – unless they are labeled as replicas:

> Well I'm in a museum so I assume that some of the exhibits are originals. (S01, 32)

> Because it wasn't written that it was not an original. At least I didn't see that. (M05, 27)

Furthermore, the *staging or the appearance of the object* (17 participants) played a role in how it was classified. In this context, the participants referred to the presentation of the objects, i.e. whether they were displayed behind glass or whether they looked very old with signs of prolonged use that made participants assume that there was an original on display:

> Because this cabinet looked as if it contained something special. So therefore I thought it was an original. (M26, 35)

> And now for that suit, I thought it was an original because it also looks used. You can almost sense how they sweated in there. At least that's how it appeared to me. (S09, 26)

Classification as replica

Those participants who stated that there was a replica on display indeed often referred to the *information on the poster* beside the display case (15 participants):

> I read on the sign that it is a replica. (M17, 24)

However, slightly more participants stated other possible reasons such as *the need for preservation*, or that the object was *not available* or *the high value of the object* (17 participants):

> Just because it is too dangerous, because it could maybe get damaged or stolen or something like that. If this was my responsibility, I think I would exhibit a replica. (M41, 18)

> I don't know where the original is. I think it's probably in Moscow. (S58, 24)

> I think if it was real moon rock, it would be very valuable and I don't really believe it would be on display here. (M41, 16)

Taken together, these findings suggest that the classification of the objects as originals or replicas is somewhat more strongly based on personal assumptions and on the previous knowledge of the visitors than on the information accompanying the objects.

Perceived qualities of originals and replicas

The participants expressed a multitude of thoughts and feelings that had come into their minds while they were standing in front of the object. These perception qualities can be grouped into 10 clusters that are listed in Table 1, together with the number of participants who mentioned them at least once. Because of the high number of incorrect answers concerning the authenticity of the object, and because the participants often assigned the state of authenticity of the object to other reasons than the accompanying information, we decided to base our analysis on the visitor's *perceived* authenticity of an object.

When taking a closer look at Table 1, it becomes evident that the majority of the different thoughts mentioned were expressed equally both by participants who believed that an original was on display and by participants who believed that a replica was on display. The findings suggest that the kind of thoughts and feelings induced by the objects is more dependent on the type of object than on the authenticity of each object. In particular, the space suit evoked a considerably higher number of thoughts associated with the *functionality of the exhibit* (space suit: 24 participants vs. moon rock: 7 participants). Also, participants who had seen the space suit *empathized both physically and mentally* with the astronaut (space suit: 32 participants vs. moon rock: 3 participants) and tried to imagine how it would feel to wear the space suit. The moon rock by contrast induced thoughts about the *exceptional character* of the exhibit (moon rock: 32 participants vs. space suit: 4 participants). Also, seeing such a rare piece of moon rock often led to *expressions of emotion*, as the participants were fascinated, impressed, or even deeply moved (moon rock: 12 participants vs. space suit: 3 participants).

The fact that authenticity plays a minor role is at least partly comprehensible when we consider the space suit where viewers empathized with the astronaut. Here the focus is mainly on the technical and functional details of the space suit and how they affect the person who is wearing the suit. There is no greater difference between originals and replicas when it comes to these technical details. In contrast, it is surprising that participants who thought that they had seen an original moon rock as well as participants

Table 1. Perceived qualities of originals and replicas with number of participants who mentioned them at least once.

		Number of mentions					
		Perceived as original			Perceived as replica		
Perceived quality (overall mentions)	Description	Moon rock	Space suit	Total	Moon rock	Space suit	Total
Empathy (40)	Participants empathize physically and/or mentally with the people who were in contact with the object.	2	17	19	1	15	16
Exceptional character (39)	Participants refer to the exceptional character, rarity, or foreignness of the object.	15	0	15	17	4	21
Functionality (35)	Participants refer to the fascinating technology, materiality, or functionality of the object.	4	10	14	3	14	17
Authenticity (19)	Participants express thought regarding the state of authenticity of the object.	3	0	3	10	4	14
Emotions (15)	Participants express positive emotions regarding the object (deeply moved, impressed, fascinated, etc.)	6	2	8	6	1	7
Appearance (15)	Participants mention aspects of the physical appearance of the object.	1	5	6	4	4	8
Indifference (12)	Participants indicate indifference regarding the object.	5	4	9	2	0	2
Provenance (11)	Participants think about the origin of the object and how it found its way into the museum.	8	0	8	3	0	3
Staging (9)	Participants refer to the staging of the object in the display case and/or in the exhibition.	2	1	3	4	1	5
Comparison (8)	Participants compare the object with other (museum) objects.	1	3	4	1	3	4

who thought that they had seen a replica of a moon rock equally referred to the exceptionality and rarity of the exhibit.

The only exceptions to this common pattern of thoughts expressed were those regarding the *authenticity* of the displayed object (original: 3 participants vs. replica: 14 participants), where it mainly seems to play a role when the object does not have the expected state of being the original object for most of the visitors:

> At first I was quite fascinated until I saw the sign just now which said that it was a replica. It would feel a bit more exciting, of course, if it was real moon rock. (M18, 13–15)

Another association that was expressed primarily by one of the two groups was their *indifference* to the displayed object (original: 9 participants vs. replica: 2 participants). Surprisingly, this indifference was expressed by those participants who had classified the object as original. The reason for this might be that the majority of visitors usually do not expect a replica to impress anyone. The lack of a strong impression is more considerable and noticeable when the object is original:

> I wasn't awe-inspired or something like that. OK, this is moon rock, but for me, that's not something exceptional. It's just a piece of rock. Whether it's a rock from earth or a meteorite – for me, this would make no difference. (M6, 21)

Also, especially the original caused thoughts regarding its *provenance* or the modalities of how the object found its way into the museum (original: 8 participants vs. replica: 3 participants). As a replica normally does not come from such an extremely remote place and is produced for the purpose of being displayed in a museum, this question is only relevant for the original:

> First I wondered how it got here, how this is distributed and all. (M27, 14)

Relevance of authenticity

For most of the participants (93%), whether the authenticity of the object was relevant or irrelevant for them could be elicited in the interview. All of the participants who mentioned some advantages of originals over replicas were assigned to the group of visitors for whom the authenticity was relevant (46%). By contrast, we assigned all participants to a second group who clearly expressed that the authenticity of the displayed object was completely irrelevant. This group contained almost the same number of participants as the first group (47%).

Arguments for the relevance of authenticity

Participants who distinguished between original and replica gave different arguments that can be grouped into five different patterns: arguments related to the history of authentic objects, to their charisma, to their rarity, to their prestige, as well as to their completeness (Table 2).

History (43 participants). Most of the participants who referred to the significant history of the original object pointed out the *distant or significant origin* (30 participants) of the object, because it actually was in use in outer space or even on the moon. A replica,

Table 2. Arguments for the relevance of authenticity/dimensions of authenticity.

Dimension (number of mentions)	Description	Example
History (43)	Authentic objects establish a connection with history.	It is actually a bit different if you know it has traveled a few thousand kilometers from earth and has experienced something (S51, 34).
Charisma (25)	Authentic objects emanate a certain *aura*.	It is awe-inspiring, it does something to me, mentally (S02, 31).
Rarity (15)	Authentic objects are rare or even unique.	They are unique, these originals from a long time ago (S43, 33).
Prestige (10)	Authentic objects aggrandize both the museum and its visitors.	Well prestige is if the museum can say, this is an original; we have the original and not just a replica (M02, 40).
Completeness (8)	Authentic objects do not lack any detail.	I think it is only how it is if it is the original (M21, 28).

by contrast – even if 100% true to the original – does not possess this specific advantage, because it originates from earth:

> This is very exciting, of course. It is actually a bit different if you know it has travelled a few thousand kilometres from earth and has experienced something. (S51, 34)

> Yes, because it (the replica) doesn't have anything special. It may well be a replica which is true to the original, but it didn't really come from the moon. It's actually just a rock from earth. (M58, 27)

A large number of participants were also able to explain the effects of the distant origin, or the link with a historically significant person such as the astronaut, or the event itself, namely, the space flight, which was connected to the original. They argued that originals would enable them to *participate in history* (15 participants). Even if they were aware that they never would experience anything like a space trip in real life, the participants had the impression that they were given the opportunity to get a feeling for how it could be by looking at the original objects displayed:

> It's just knowing that this thing, for example the space suit, has been up there in space. I also wanted to go there, but I think now I am a bit too old for that. Maybe it's that you somehow think you can be part of it yourself. (S02, 28)

Another argument mentioned often was that originals are able to arouse *a greater interest in history* or to give a *better understanding of history* (8 participants) than replicas, due to some 'ancient charm':

> They have this ancient charm about them, so that you look at it and think: 'What's the background of this object, who used it, who saw it, how old is it, and what has happened with it?' And if it's a replica which is two years old and which was made in a factory in Munich, it may look exactly the same and you know what it represents. But it doesn't have this charm and it can't tell this story. (S46, 62)

Charisma (25 participants). Another important aspect of the special role that originals play is a certain charisma, or 'wow-effect,' which emanates from them. For many participants, originals – in contrast to replicas – radiated a subtle charm or aura, or were able to induce a deep respect reminiscent of the 'numinous museum experiences' described by Latham (2013):

> It's beautiful because it makes you feel different. You think 'wow!,' he was in there. It's nice to see a replica, too. But the 'wow'-effect is probably stronger if it's the original. (M57, 37)

> It is awe-inspiring: it does something to me, mentally. (S02, 31)

Rarity (15 participants). The present study also showed that the rarity or even uniqueness of originals is an important dimension of authenticity. There is the idea of elusiveness that especially applies to objects originating from space or from the moon that repeatedly played an important role in this context:

> They are unique, these originals from a long time ago. (S43, 33)

> It is just something completely different, just special. Normal people can't achieve this: it's difficult to get to the moon. This is what makes it so special. (M18, 30)

Prestige (10 participants). Some participants also argued that it is important to have originals on display, as they help to increase the prestige of a museum. On top of that, they also upgrade the prestige of the visitors themselves, who can pride themselves on having seen the original:

> Property economics, prestige … Well prestige is if the museum can say, this is an original, we have the original and not just a replica. (M02, 40)

> It's difficult to describe, but if I know that it is an original, then it's not for everyone to have: it is exclusive. Only a few people in the world or now here in Germany have seen that. If I talk about that to someone, I can say, yes I have seen that here and there. (M24, 36)

Completeness (8 participants). The completeness of the original that, compared to a replica, does not lack any detail was another aspect of authenticity mentioned:

> I think it is only how it is if it's the original. (M21, 28)

> Because I just believe that it is very difficult to replicate exactly, if you are interested in details; it is better for triggering your imagination, and I think you can recognize more than with a replica. (S34, 25)

Arguments for the irrelevance of authenticity

Arguments of participants for whom the state of authenticity was completely irrelevant can be grouped into three patterns: the fact that the replica is true to the original, the primacy of functionality, and the concept of objects as mere reference points (Table 3).

True to original (50 participants). Many of those participants who did not care whether an original or a replica was on display explained that there would not be any difference if the replica looked exactly like the original and it was completely true to the

Table 3. Arguments for the irrelevance of authenticity.

Dimension	Description	Example
True to original (50)	Objects that are 100% true to the original are sufficient.	Nowadays, you can actually make replicas which are so precise that you can no longer make out any differences between the original and the replica (M25, 38).
Primacy of functionality (30)	Objects should mainly impart technological and scientific knowledge.	Well for me it is more interesting to know how something works than to see the original (M30, 44).
Reference points (16)	Objects serve as reference points and illustrate the story behind them.	Whether this is an original or a replica does not matter at all. The only interesting thing is the story behind it, is not it? That is how I see it, actually (M34, 39).

original. They trusted in modern reproduction technology and assumed that the replica was 100% true to the original, contrary to the participants that emphasized the completeness of originals and had stated that only originals do not lack any detail:

> If it is not a falsified replica but if they really paid attention to detail, then I don't care whether this is the original or not. I just want to see it, all the diverse aspects of it. But it doesn't really matter who actually wore it. So it could even be a ready-made suit which has never been worn by anyone. (S44, 19)

Some participants stated more precisely that they had no preference for the original because they could not recognize the difference between original and replica because they are not experts in that area (9 participants):

> As a layperson, I don't think I could make out the difference anyway, whether it's an original or a replica. So it doesn't matter. (S37, 36)

Primacy of functionality (30 participants). The focus of another subset of those participants who did not place great value on seeing originals was more on the transfer of knowledge than on detailed replicas. The participants expressed that it was far more important to them to learn about the function and technology of the objects than to have originals on display. Some of those participants added that they even prefer partial objects when they are able to transport knowledge better than detailed replicas:

> I'm just interested in the technology. I think whether this is an original doesn't really matter as far as the technology is concerned. (S24, 26)

> No, it's not important at all because a true replica may be more descriptive than the original. If a technical part is damaged or soiled which explains a function, then it's probably easier to understand it with a replica which is fully functional. (S53, 63)

Reference points (16 participants). Whereas the patterns of arguments described so far referred to physical aspects of the objects themselves, another subset of participants considered the displayed objects as mere reference points that can be used to tell stories

and are able to exalt the imagination of the visitors. They argued that the most important thing is the story behind the object, which can be transmitted by a replica just as well as by an original:

> Whether this is an original or a replica doesn't matter at all. The only interesting thing is the story behind it, isn't it? That's how I see it, actually. (M34, 39)

> For us, the visitors of the museum, it's really just a reference point. For me, it is not important whether this is the actual original which has been somewhere or whether it's a replica. It's the same for me because then I find out what happened with it. (R07, 29)

Evaluation of originals and replicas

As a final step of the analysis, we investigated how both the perceived authenticity of an object (original vs. replica) and the perceived relevance of this difference (relevant vs. irrelevant) influenced several responses evoked by the displays (Newman and Bloom 2011).

The results indicate that there are almost no differences in responses concerning objects perceived as originals and objects perceived as replicas. An unexpected exception was that participants tended to have the desire to touch replicas more than they wanted to touch originals. However, significant differences became apparent between the participants who considered authenticity as relevant and those who considered it as irrelevant. Participants for whom the object's authenticity was relevant had significantly higher scores on the desire to touch the object and on the desire to own the object than participants for whom the state of the object was irrelevant. It was surprising to find that the question as to how relevant authenticity was for participants did not have any influence on the perceived state of authenticity. We had instead expected to receive significant differences in the reactions between the groups with a high and those with a low relevance of authenticity. Detailed results of the statistical analyses are presented in Appendix.

Discussion

The goal of this study was to investigate the perception and evaluation of authentic objects, defined as original objects that evolved in the real world or once served a real-world purpose and bear high historical significance. It was designed to clarify whether the effects of authentic objects with obvious significance – which is also revealed to visitors without great interest or previous knowledge – are more significant than the effects of authentic objects with a more mundane character and that have a historical significance that requires a certain amount of previous knowledge (Hampp 2012; Hampp and Schwan 2014).

The study showed very balanced results regarding the relevance of authenticity. Approximately 50% of the visitors considered authenticity as a relevant factor in the perception of objects, nearly the same number of visitors considered it irrelevant. Thus, authenticity seems indeed to be an important factor in the perception of objects with high historical significance, even though that seemed to be the case for some of the visitors only.

The reasons given by the participants for whom the authentic state of the displayed objects was important confirm the already existing set of special characteristics of authentic objects, consisting of *history*, *charisma*, *rarity*, and *functionality* (Hampp 2012; Hampp and Schwan 2014). The first three aspects, history, charisma, and rarity, which refer to the historical significance of the object, were expanded by one further aspect: the *prestige* of authentic objects, which not only aggrandizes the museum displaying them but also the visitors observing them. This finding corresponds with theories of the museum as a place of social distinction and as a place for constructing identities through the appreciation of objects (Bourdieu, Darbel, and Schnapper 1997; Karp and Lavine 1991). This new aspect seems to play a role mainly for objects of high historical significance displayed as 'masterpieces,' such as the moon rock and space suit used in our investigations, as it was not the case for authentic objects with lower historical significance displayed in the context of new technologies (Hampp 2012; Hampp and Schwan 2014). Also the fourth, more materialistic aspect of *functionality* appeared in the present study, even though in the slightly modified form of the *completeness* of the original, since a replica can never be 100% true to an original. Considering that the presence of every single detail was often associated with unrestricted functionality (Hampp 2012; Hampp and Schwan 2014), the completeness of the original can be interpreted as a preliminary stage of unrestricted functionality. It can be assumed that it has to do with the object, whether the participants mention the completeness of the original or its unrestricted functionality. Objects, such as a piece of moon rock, that in contrast to technical instruments do not have any functional principle, are instead evaluated based on the presence of every single detail, an expectation which the replica is unable to fulfill.

Arguments of the participants for whom authenticity was not relevant confirm the parallel focus on the acquisition of scientific and technical knowledge of visitors in museums of the history of science and technology (Hampp and Schwan 2014). Instead of being authentic, it was more important that the object was true to the original, that it functioned properly, and that it illustrated the scientific content. Thus the unrestricted functionality of an object was not linked to an original object, whereas the arguments of the participants with high relevance of authenticity suggest that the opposite was true for them. For the participants with low relevance of authenticity, a replica that is 100% true to the original is as functional as the original. Whereas in the first two sets of arguments, trueness to the original and functionality, are still related to the object, in the third set of arguments, where the object is seen as a mere reference point illustrating scientific content, the object itself is only a peripheral matter. These findings correspond to the assumption that authenticity in science is related to ideas and theories more than to objects (Bain and Ellenbogen 2002).

Surprisingly, objects perceived as replicas were able to induce similar thoughts and feelings of excitement as objects perceived as originals. Although the replica of a moon rock is definitely not extraordinary because of foreignness or rarity, these attributes are directly transferred from the original. Thus, it seems as if the 'aura of the original' indeed is able to devolve upon the replica, as described by Latour and Lowe (2010). They observed that the replica of the painting *Nozze di Cana* of the Renaissance painter Paolo Veronese, lit by natural light and displayed only as a painting on a big wall, had by far a stronger effect than the original in the Louvre Museum, presented between two doors in a huge frame overshadowed by the famous *Mona Lisa*. This example from art also makes it clear that the way objects are presented may have a greater effect than their authenticity

(Kottasz 2006). The reputation of the institution where objects are exhibited has a similar effect on the perception of visitors. Hence, museums with a worldwide reputation, like the British Museum, are able to confer even to fakes 'an imprimatur of authenticity' (Lowenthal 1992, 2008). Accordingly, in the study presented here, the participants' classification of the objects as originals or replicas did not happen due to the label inscriptions of the objects, but were instead the result of the museum context or how the objects were presented. These findings support the constructivist position that authenticity is rather a matter of the relationship between the object and the person who is observing the object in a specific context rather than an objective and measurable attribute of the object itself (Jones 2010).

The missing or even reverse effects on reactions of viewers to any differences between originals and replicas can be ascribed to existing museum rules. Common rules widely effective in museums such as the prohibition to touch originals seem to have a stronger impact on visitors than the impulse to touch it. The rather limited desire to own the objects might be attributed to a social background, as it is generally accepted that historically significant objects belong in museums. Many of the interviewed visitors even showed understanding for the display of replicas, in that it either served a good purpose such as the preservation of cultural heritage, or because there was only one original. Presumably, participants did not want to complain about the presented exhibition due to the effects of social desirability (Barton 1958), that is, the visitors did not want to criticize the museum publicly. The initiators of the study, for example, were employees of the museum itself. Also the theory of cognitive dissonance can be applied, as most of the participants were really impressed by the Deutsches Museum and probably did not want to find anything that would destroy their own glorified image of the Museum (Festinger 1957).

Even more unexpected than the missing differences regarding emotional reactions to originals and replicas was the missing influence of the relevance of authenticity on these differences. One would expect significant differences between the group with high and the group with low relevance of authenticity, with a corresponding notable difference between original and replica in the group for whom relevance was important and no difference in the group for whom relevance was not important. Instead, visitors who belonged to the group with high relevance of authenticity generally evaluated objects more highly, independently of their state of authenticity. Thus it can be assumed that visitors with a sense for authenticity generally evaluate objects more highly than visitors without a sense for authenticity – independently of the objects' actual state of authenticity. One speculative explanation could be a higher estimation of the materiality per se, even of a well-done replica, while visitors without a sense for authenticity would focus more on the immaterial, conceptual aspects of an exhibit. However, from the viewpoint of material culture studies, the materiality of an object 'is about not solely meaning nor simply physical form, but the dynamic interaction of both with our sensory experience' (Dudley 2010, 8). Thus, the interaction with the physical form of a well-done replica could have provoked thoughts of the history of the original, and so could have provided the replica with the meaning of the original. Assuming that visitors with a strong sense for authenticity interacted more intensively with the objects, this also could explain their higher scores in their evaluation of both originals and replicas.

Conclusion

Taken together, the findings of this study corroborate the constructivist view on authenticity, as it clearly demonstrates that authenticity indeed is not inherent in the object, but emerges instead through specific interactions between the visitor and the object (Jones 2010; Jones and Yarrow 2013). The results also suggest that in museums for the history of science and technology, two concepts of authenticity should be distinguished that correspond to the different meanings of authenticity in history and in science formulated by Bain and Ellenbogen (2002). Whereas authenticity in history 'involves determining an object's legitimacy and creating its historic context,' authenticity in science 'is related to ideas and theories more than to objects' (Bain and Ellenbogen 2002, 155–156). In this study, the concept of authenticity in history seems to apply more strongly for visitors who consider authenticity highly relevant, whereas the concept of authenticity in science seems to apply for visitors who consider authenticity less relevant.

It can be assumed that in museums of other domains such as archeology, ethnology, or especially art, the focus is more on the origin and the legitimacy of the objects than on how they work. But is the importance of authenticity in the sense of historical significance actually dependent on the domain? Do visitors of an archeology museum really perceive and evaluate an original hand ax differently from a replica? Taking the results of this study into account, which show that visitors with a sense for authenticity appreciate originals and well-done replicas in an equal manner, and considering the backdrop of successful archeological exhibitions that merely consist of replicas, or even art museums that purposely acknowledge forgers by exhibiting their works, these questions cannot be answered easily and require further research.

Acknowledgments

The authors wish to thank Malgorzata Stefanowicz and Andrea Weniger for their support in conducting, transcribing, and analyzing the interviews. They also thank the team of the exhibition area of space flight and astronautics in the Deutsches Museum for their kind cooperation. And last but not least, thanks to all the participants of the study for taking the time to be interviewed.

Funding

This work was supported by the German research foundation (DFG) [Special Priority Program 1409: Science and the General Public: Understanding Fragile and Conflicting Scientific Evidence].

Notes on contributors

Constanze Hampp is a research scientist and Ph.D. student at the Deutsches Museum, Munich, Germany.

Stephan Schwan is a principal research scientist and deputy director of the Knowledge Media Research Center, Tuebingen, Germany, as well as university professor for research on teaching and learning.

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Appendix

We performed three 2 × 2 × 2-ANOVAs with desire to touch the object, desire to own the object, and value of the object as dependent variables. Between-subject factors were perceived state of the object (original vs. replica), object type (moon rock vs. space suit), and relevance of the object state (relevant vs. irrelevant).

Regarding the perceived state of an object, we found no significant main effects both on the desire to own the object and on the value of the object (all $p > .30$). The desire to touch the object failed to reach significance, different from our expectation with higher scores for the replica, $M_{replica} = 4.30$ (SD = 2.31) vs. $M_{original} = 3.36$ (SD = 1.98), $F(1, 95) = 3.24$, $p = .08$, $\eta^2 = .03$.

Regarding the relevance of the object state, a significant main effect was found on the desire to touch the object, with $M_{relevant} = 4.39$ (SD = 2.24) vs. $M_{irrelevant} = 3.25$ (SD = 2.00), $F(1, 95) = 5.20$, $p = .03$, $\eta^2 = .05$. Also the desire to own the object was significantly higher in the group of the participants for whom the state of the objects was relevant than in the group of the participants for whom the state of the objects was irrelevant, $M_{relevant} = 2.86$ (SD = 2.10) vs. $M_{irrelevant} = 1.97$ (SD = 1.64), $F(1,95) = 4.03$, $p = .048$, $\eta^2 = .04$. The difference between objects perceived as originals and objects perceived as replicas failed to reach significance regarding the value of the object, with $M_{relevant} = 4.73$ (SD = 1.78) vs. $M_{irrelevant} = 4.58$ (SD = 1.82), $F(1, 95) = 2.57$, $p = .11$, $\eta^2 = .03$.

The object type had no significant effects (all $p > .30$) except on the desire to own the object, with $M_{moonrock} = 2.93$ (SD = 2.17) vs. $M_{spacesuit} = 1.63$ (SD = 1.14), $F(1,95) = 11.97$, $p = .001$, $\eta^2 = .11$. Finally, there were no significant interactions between all factors (all $p > .14$).

A 2 Material

A 2.1 Übersicht über die getesteten Objekte inklusive ihrer Beschreibungen auf dem Label (Studie 1)

Themenbereich	Objektpaare	
	Pro-Argument	Contra-Argument
Bodyenhancement – Maßnahmen zur Verbesserung bzw. Verschönerung des menschlichen Körpers	Oberschenkel-Sportprothese: Mit speziellen Prothesen laufen beinamputierte Sportler auf den Paralympics beinahe genauso schnell wie nicht behinderte Sportler. 	Silikongel-Brustimplantate: Die Größe der Brustimplantate bei Schönheitsoperationen steht oft in keinem Verhältnis mehr zum Körperbau. Die Folge sind enorme gesundheitliche Schäden. 
	Neurostimulator mit Elektrode und Programmiergerät: Durch die Stimulation bestimmter Bereiche im Gehirn kann Patienten mit neurologischen Erkrankungen geholfen werden. 	Metamphetamine in unterschiedlichen Formen: Verursachen Euphorie und steigern die Leistungsfähigkeit, können aber auch zu einer starken psychischen Abhängigkeit führen 
Nanotubes – Besondere Materialeigenschaften von Kohlenstoff-Nanoröhrchen	Fahrradlenker im Gewichtsvergleich: Die Verarbeitung von Kohlenstoff-Nanoröhrchen reduziert das gewicht bei gleich bleibender Stabilität deutlich. 	Geschädigtes Lungengewebe unter dem Mikroskop: Kohlenstoff-Nanoröhrchen können in die Lunge eindringen und stellen somit ein Gesundheitsrisiko dar. 
	Eishockeyschläger nach Schlagtest: Die Bruchgefahr verringert sich durch verstärkende Nanostruktur deutlich. 	Warntafel für Asbestbaustellen, Schutzmaske: Kohlenstoff-Nanoröhrchen ähneln Asbestfasern in ihrer Struktur und könnten daher auch ähnliche Gesundheitsrisiken bergen. 
Nanosilber – Antibakterielle Wirkung von nanosilberhaltigen Materialien	Frischhalteboxen nach einer Woche Lagerung bei Zimmertemperatur: Lebensmittel sind in der Box mit Silber-nanopartikeln durch antimikrobielle Wirkung länger haltbar. 	Laborflaschen mit Klärschlamm aus der Kläranlage: Silber-Nanopartikel im Schmutzwasser reduzieren den Klärschlamm und somit auch dessen reinigende Wirkung. 
	Fassadenfarbe mit und ohne Silber-Nanopartikel: Keine Entstehung von Algen, Moosen und Schimmelpilzen durch antimikrobielle Wirkung von Silber-nanopartikeln 	Pricktest (Allergietest)-Kasten: Silber-Nanopartikel stehen im Verdacht, Allergien auszulösen und könnten bald Bestandteil dieses Tests sein. 

A 2.2 Übersicht über die getesteten Objekte inklusive ihrer Beschreibungen auf dem Label (Studie 2)

<table>
<tr><th>Themen-bereiche</th><th colspan="2">Objekt in Vitrine 1</th><th colspan="2">Objekt in Vitrine 2</th></tr>
<tr><td rowspan="2">Aufbau 1:

Nano-technologie</td><td colspan="2">  </td><td colspan="2">  </td></tr>
<tr><td>Labeltext Original:

Erstes Rastertunnelmikroskop, von Gerd Binnig und Heinrich Rohrer (Original)

Für die Entwicklung dieses Rastertunnelmikroskops erhielten Binnig und Rohrer 1986 den Nobelpreis für Physik.

Inv.-Nr.: 1993/432</td><td>Labeltext Nachbildung:

Erstes Rastertunnelmikroskop von Gerd Binnig und Heinrich Rohrer (Nachbildung)

Für die Entwicklung des Rastertunnelmikroskops erhielten Binnig und Rohrer 1986 den Nobelpreis für Physik.

Inv.-Nr.: 1993/432</td><td>Labeltext Original:

Nobelpreismedaille von Gerd Binnig (Original)

Diese Medaille wurde Gerd Binnig am 10. Dezember 1986 vom schwedischen König in Stockholm verliehen.

Leihgeber: Gerd Binnig, München</td><td>Labeltext Nachbildung:

Nobelpreismedaille von Gerd Binnig (Nachbildung)

Diese Medaille wurde Gerd Binnig am 10. Dezember 1986 vom schwedischen König in Stockholm verliehen.

Inv.-Nr.: 1995/254</td></tr>
<tr><td rowspan="2">Aufbau 2:

Medizin-technologie</td><td colspan="2">  </td><td colspan="2">  </td></tr>
<tr><td>Labeltext Original:

Original-Holzbein des Piraten François Le Clerc, 16. Jhdt.

Der französische Kaperkapitän trug dieses Holzbein nach einer Beinamputation infolge einer Seeschlacht im Jahre 1549.

Leihgeber: National Maritime Museum, London</td><td>Labeltext Nachbildung:

Holzbein des Piraten François Le Clerc, 16. Jhdt. (Nachbildung)

Der französische Kaperkapitän trug das Holzbein nach einer Beinamputation infolge einer Seeschlacht im Jahre 1549.

Inv.-Nr.: 2000/168</td><td>Labeltext Original:

Original-Mieder der US-Schauspielerin Vivien Leigh, 1939

Die Schauspielerin trug dieses Mieder in einer Szene des mit mehreren Oscars ausgezeichneten Hollywood-Films „Vom Winde verweht“.

Leihgeber: Hollywood Museum, Los Angeles</td><td>Labeltext Nachbildung:

Mieder der US-Schauspielerin Vivien Leigh, 1939 (Nachbildung)

Die Schauspielerin trug das Mieder in einer Szene des mit mehreren Oscars ausgezeichneten Hollywood-Films „Vom Winde verweht“.

Inv.-Nr.: 1998/173</td></tr>
</table>

A 3 Instrumente

A 3.1 Wiedererkennungstest (Studie 1)

Nr.: _____

Fragebogen „Neue Technologien“

Bitte kreuzen Sie alles an, was Sie in den Experimentalvitrinen gesehen haben.

Unterscheiden Sie dabei, ob Sie die Gegenstände als dreidimensionales Objekt oder als Abbildung gesehen haben.

☐ 3D-Objekt
☐ Abbildung

☐ 3D-Objekt
☐ Abbildung

☐ 3D-Objekt
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☐ Abbildung

☐ 3D-Objekt
☐ Abbildung

A 3.2 Fragebogen (Studie 1)

Nr.: _____

Fragebogen zum ZNT-Experiment

I. Angaben zu Ihrer Person

1. Ich bin ☐ männlich.
   ☐ weiblich.
2. Ich bin _____ Jahre alt.
3. Welchen Bildungsabschluss haben Sie oder streben Sie derzeit an?
   Bitte das aktuell Zutreffende angeben.

   ☐ Hauptschule / Volksschule
   ☐ Realschule / Mittlere Reife
   ☐ Lehre / Ausbildung
   ☐ Abitur / (Fach-)Hochschulreife
   ☐ Studium
   ☐ Promotion
   ☐ Sonstiges _____

II. Inwieweit treffen die folgenden Aussagen auf Sie zu?

		Trifft gar nicht zu					Trifft völlig zu
1.	Die Beschäftigung mit naturwissenschaftlichen Themen macht mir Spaß.	1	2	3	4	5	6
2.	Es macht mir Freude, mich mit naturwissenschaftlichen Problemen zu beschäftigen.	1	2	3	4	5	6
3.	Ich bin daran interessiert, etwas über Naturwissenschaften zu lernen.	1	2	3	4	5	6

III. Wie häufig machen Sie die folgenden Dinge?

		Sehr selten					Sehr häufig
1.	Ich sehe mir Fernsehsendungen über Naturwissenschaften an.	1	2	3	4	5	6
2.	Ich lese etwas über naturwissenschaftliche Themen in Magazinen, Zeitungen, Büchern oder im Internet.	1	2	3	4	5	6
3.	Ich besuche naturwissenschaftliche Vorträge und Veranstaltungen.	1	2	3	4	5	6

IV. Inwieweit treffen die folgenden Aussagen auf Sie zu?

		Trifft gar nicht zu					Trifft völlig zu
1.	Ich habe schon viel über neue Technologien gehört.	1	2	3	4	5	6
2.	Ich bin an neuen Technologien interessiert.	1	2	3	4	5	6
3.	Neue Technologien beeinflussen unser Leben positiv.	1	2	3	4	5	6

V. Inwieweit treffen die folgenden Aussagen auf Sie zu?

		Trifft gar nicht zu					Trifft völlig zu
1.	Die Beschäftigung mit geschichtlichen Themen macht mir Spaß.	1	2	3	4	5	6
2.	Es macht mir Freude, mich mit Problemen der Geschichte zu beschäftigen.	1	2	3	4	5	6
3.	Ich bin daran interessiert, etwas über Geschichte zu lernen.	1	2	3	4	5	6

VI. Wie häufig machen Sie die folgenden Dinge?

		Sehr selten					Sehr häufig
4.	Ich sehe mir Fernsehsendungen über Geschichte an.	1	2	3	4	5	6
5.	Ich lese etwas über geschichtliche Themen in Magazinen, Zeitungen, Büchern oder im Internet.	1	2	3	4	5	6
6.	Ich besuche Vorträge und Veranstaltungen zum Thema Geschichte.	1	2	3	4	5	6

VII. Wie groß schätzen Sie Ihre Kenntnisse in den folgenden Bereichen ein?

		Sehr gering					Sehr hoch
1.	Naturwissenschaften allgemein	1	2	3	4	5	6
2.	Neue Technologien	1	2	3	4	5	6
3.	Geschichte	1	2	3	4	5	6

IIX. Inwieweit treffen die folgenden Aussagen auf Sie zu?

		Trifft gar nicht zu					Trifft völlig zu
1.	Ich probiere gerne Dinge aus, auch wenn nicht immer etwas dabei herauskommt.	1	2	3	4	5	6
2.	Ich beschäftige mich nur mit Aufgaben, die lösbar sind.	1	2	3	4	5	6
3.	Ich mag es, wenn unverhofft Überraschungen auftreten.	1	2	3	4	5	6
4.	Ich lasse die Dinge gerne auf mich zukommen.	1	2	3	4	5	6
5.	Ich habe es gerne, wenn die Arbeit gleichmäßig verläuft.	1	2	3	4	5	6
6.	Ich warte geradezu darauf, dass etwas Aufregendes passiert.	1	2	3	4	5	6
7.	Wenn um mich herum alles drunter und drüber geht, fühle ich mich so richtig wohl.	1	2	3	4	5	6
8.	Ich weiß gerne, was auf mich zukommt.	1	2	3	4	5	6

A 3.3 Interviewleitfaden (Studie 2)

INTERVIEWLEITFADEN

1. **Warm-Up**
   Soziodemographische Daten
   - Warum sind Sie heute im Deutschen Museum?
   - Sind Sie in Begleitung hier?
   - Wie oft waren Sie im vergangenen Jahr im Museum? Welche Museen?
   - Darf ich Sie nach Ihrem Beruf fragen? Bzw. Schulabschluss?
   - Alter?

2. **Objekte**
   Werden authentischen Objekten (Originale) eher Eigenschaften zugeschrieben, die auf Ihre Herkunft hinweisen als Repliken? Was haben die Objekte im Besucher ausgelöst? Wie hängt die Wahrnehmung der Objekte mit Einstellungen und Vorwissen des Besuchers zusammen?
   - In den Vitrinen befanden sich mehrere Ausstellungselemente (z.B. Texte, Bilder, Grafiken und Objekte). Im Folgenden soll es um die (dreidimensionalen!) Objekte / Exponate gehen: An welche Objekte können Sie sich erinnern?
     [Werden nicht alle Objekte erinnert, fehlende Objekte aufzählen!]
   - Welches dieser Objekte fanden Sie persönlich am besten? Warum?
     [Vpn so viel wie möglich selbst erzählen lassen. Bei interessanten Aspekten nachfragen.]
   - Objekt Nr. 2?
   - Objekt Nr. 3?
   - Objekt Nr. 4?

3. **Authentizität**
   Sind sich die Vpn der Unterscheidung Original-Replik bewusst? Welchen Unterschied würde es machen, wenn ein und dasselbe Objekt eine Replik (ein Original) wäre? An welchen Faktoren meinen die Vpn, ein Original oder eine Replik zu erkennen (neben dem Label)?
   - In Museen werden ja nicht nur Originale ausgestellt. Manchmal findet man auch Nachbildungen in den Vitrinen. Was haben Sie in den drei Vitrinen gesehen?
   - Woher wussten Sie, ob es sich bei den Exponaten jeweils um ein Original oder eine Replik handelte?
   - Gab es noch andere Hinweise außer dem Label (falls genannt)?
   - Stellen Sie sich vor, Objekt Nr. 1 wäre eine Replik (ein Original) gewesen. Wäre Ihr Urteil anders ausgefallen? Warum (nicht)?
   - Objekt Nr. 2?
   - Objekt Nr. 3?
   - Objekt Nr. 4?

4. **Aufklärung der Vp und Frage, ob die Täuschung erkannt wurde**

A 3.4 Fragebogen (Studie 3)

Nr.: _____

Fragebogen Raumfahrt

I. Inwieweit treffen die folgenden Aussagen auf Sie zu?

		Trifft gar nicht zu						Trifft völlig zu
1.	Im Museum möchte ich Ausstellungsstücke sehen, die eine besondere Geschichte zu erzählen haben.	1	2	3	4	5	6	7
2.	Ich möchte erfahren, wie die Ausstellungsstücke konstruiert sind und wie sie funktionieren.	1	2	3	4	5	6	7
3.	Ich möchte Ausstellungsstücke sehen, die ich im alltäglichen Leben nicht sehen kann.	1	2	3	4	5	6	7
4.	Ich möchte Ausstellungsstücke sehen, die mich durch ihr besonderes Aussehen faszinieren.	1	2	3	4	5	6	7
5.	Ich möchte Ausstellungsstücke sehen, die mich an Menschen, Dinge oder Ereignisse aus meinem eigenen Leben erinnern.	1	2	3	4	5	6	7
6.	Ich möchte Ausstellungsstücke sehen, die mit berühmten Persönlichkeiten in Verbindung waren.	1	2	3	4	5	6	7
7.	Ich möchte Ausstellungsstücke sehen, die von besonderen Orten kommen.	1	2	3	4	5	6	7
8.	Ich möchte Ausstellungsstücke sehen, die mit besonderen Ereignissen verknüpft sind.	1	2	3	4	5	6	7
9.	Ich möchte Ausstellungsstücke sehen, die etwas mit meinem Alltag zu tun haben.	1	2	3	4	5	6	7
10.	Ich möchte Ausstellungsstücke sehen, die eine faszinierende wissenschaftliche oder technische Entwicklung zeigen.	1	2	3	4	5	6	7
11.	Ich möchte Ausstellungsstücke sehen, die mir wissenswerte Inhalte gut vermitteln können.	1	2	3	4	5	6	7
12.	Ich möchte Ausstellungsstücke sehen, die mir die Fortschritte zeigen, die in Wissenschaft und Technik über die Zeit hinweg stattgefunden haben.	1	2	3	4	5	6	7

II. Inwieweit treffen die folgenden Aussagen auf Sie zu?

		Trifft gar nicht zu						Trifft völlig zu
1.	Ich gehe davon aus, dass die Ausstellungsstücke im Museum Originale sind, wenn sie nicht ausdrücklich als Modelle oder Nachbildungen gekennzeichnet sind.	1	2	3	4	5	6	7
2.	Im Museum ist es mir wichtig, Originale zu sehen.	1	2	3	4	5	6	7

3.	Ein Original zeichnet sich dadurch aus, dass es voll funktionsfähig ist.	1	2	3	4	5	6	7
4.	Ein Original zeichnet sich dadurch aus, dass es eine besondere Geschichte zu erzählen hat.	1	2	3	4	5	6	7
5.	Ein Original zeichnet sich dadurch aus, dass es sehr selten oder gar das Einzige seiner Art ist.	1	2	3	4	5	6	7
6.	Ein Original zeichnet sich dadurch aus, dass es besonders aussieht.	1	2	3	4	5	6	7
7.	Ein Original zeichnet sich dadurch aus, dass es sehr alt ist.	1	2	3	4	5	6	7
8.	Ein Original zeichnet sich dadurch aus, dass es sehr wertvoll ist.	1	2	3	4	5	6	7
9.	Ein Original zeichnet sich dadurch aus, dass es viele Menschen besitzen möchten.	1	2	3	4	5	6	7
10.	Ein Original zeichnet sich dadurch aus, dass es mit einer berühmten Persönlichkeit in Verbindung war.	1	2	3	4	5	6	7
11.	Ein Original zeichnet sich dadurch aus, dass es von einem besonderen Ort kommt.	1	2	3	4	5	6	7
12.	Ein Original zeichnet sich dadurch aus, dass es mit einem besonderen Ereignis verknüpft ist.	1	2	3	4	5	6	7

III. Beim ausgestellten Mondgestein / Raumanzug in der Raumfahrt handelt es sich um

☐ ein Original. ☐ eine 1:1-Nachbildung.

IV. Inwieweit treffen die folgenden Aussagen auf Sie zu?

		Trifft gar nicht zu						Trifft völlig zu
1.	Ich würde das Mondgestein / den Raumanzug gerne anfassen.	1	2	3	4	5	6	7
2.	Kurze Begründung:							
3.	Ich würde das Mondgestein / den Raumanzug gerne selbst besitzen.	1	2	3	4	5	6	7

		Sehr viel **niedriger** als 50.000,- Euro			Ungefähr 50.000,- Euro			Sehr viel **höher** als 50.000,- Euro
V.	**Wie hoch schätzen Sie den Wert des ausgestellten Mondgesteins / Raumanzugs ein?**	1	2	3	4	5	6	7

VI. Inwieweit treffen die folgenden Aussagen auf Sie zu?

		Trifft gar nicht zu						Trifft völlig zu
1.	Die Beschäftigung mit dem Thema Raumfahrt macht mir Spaß.	1	2	3	4	5	6	7
2.	Es macht mir Freude, mich mit dem Thema Raumfahrt zu beschäftigen.	1	2	3	4	5	6	7
3.	Ich bin daran interessiert, etwas über Raumfahrt zu lernen.	1	2	3	4	5	6	7

VII. Wie häufig machen Sie die folgenden Dinge?

		Sehr selten						Sehr häufig
1.	Ich sehe mir Fernsehsendungen über das Thema Raumfahrt an.	1	2	3	4	5	6	7
2.	Ich lese etwas über das Thema Raumfahrt in Magazinen, Zeitungen, Büchern oder im Internet.	1	2	3	4	5	6	7
3.	Ich besuche Vorträge und Veranstaltungen zum Thema Raumfahrt.	1	2	3	4	5	6	7

VIII. Wie groß schätzen Sie Ihre Kenntnisse in den folgenden Bereichen ein?

		Sehr gering						Sehr hoch
1.	Naturwissenschaften allgemein	1	2	3	4	5	6	7
2.	Raumfahrt	1	2	3	4	5	6	7

IX. Inwieweit treffen die folgenden Aussagen auf Sie zu?

		Trifft gar nicht zu						Trifft völlig zu
1.	Selbst wenn ich hungrig wäre, würde ich meine Lieblingssuppe nicht essen, wenn sie mit einer gründlich gereinigten Fliegenklatsche umgerührt worden wäre.	1	2	3	4	5	6	7
2.	Es würde mir schwer fallen, in einem schönen Hotelzimmer zu schlafen, wenn ich wüsste, dass in diesem Zimmer eine Nacht zuvor jemand an einem Herzinfarkt gestorben ist.	1	2	3	4	5	6	7
3.	Wenn mir ein Freund ein Stück einer neuen Schokolade anbieten würde, die wie ein Hundehaufen geformt ist, würde ich keinen Bissen essen.	1	2	3	4	5	6	7

X. Zum Abschluss möchten wir Sie noch um ein paar Angaben zu Ihrer Person bitten:

1. Ich bin ☐ männlich.
   ☐ weiblich.
2. Ich bin _____ Jahre alt.
3. Welchen Bildungsabschluss haben Sie oder streben Sie derzeit an?
   Bitte das aktuell Zutreffende angeben.

   ☐ Hauptschule / Volksschule
   ☐ Realschule / Mittlere Reife
   ☐ Lehre / Ausbildung
   ☐ Abitur / (Fach-)Hochschulreife
   ☐ Studium
   ☐ Promotion
   ☐ Sonstiges _____

A 3.5 Interviewleitfaden (Studie 3)

Interviewleitfaden Raumfahrt

1. *Abteilung Raumfahrt*

   - Warum sind Sie heute im Deutschen Museum?
   - Wie oft gehen Sie pro Jahr ca. ins Museum? Welche Art von Museen besuchen Sie?
   - Warum sind Sie in der Abteilung Raumfahrt?
   - Wie gefällt Ihnen die Abteilung? Warum?

2. *Objektwirkung*

   - Sie haben ja im Fragebogen schon gemerkt, dass es um die Vitrine mit dem Mondgestein / mit dem Raumanzug des Astronauten Klaus-Dietrich Flade geht. Können Sie beschreiben, was in Ihnen vorgegangen ist bzw. was Sie gedacht und gefühlt haben, als Sie vor der Vitrine mit dem Mondgestein / mit dem Raumanzug standen?
   - Warum? *(Warum war das Mondgestein beeindruckend, faszinierend, langweilig etc.?)*
     - *Persönlicher Bezug: Verbinden Sie damit irgendetwas?*
     - *Interessante Information*
     - *Faszinierende Technologie*
     - *Spektakulär*
     - *Selten*
     - *Historischer Bezug etc.*

3. *Original versus Nachbildung*

   - Im Fragebogen war ja von Original und Nachbildung die Rede: War das Mondgestein / der Raumanzug jetzt im Endeffekt eigentlich echt, also ein Original? Was haben Sie angekreuzt?
     (Bei falscher Beantwortung aufklären!)
   - Was würde in Ihnen vorgehen, wenn ich Ihnen jetzt sage, dass in der Vitrine gar kein Original gelegen hat, sondern eine 1:1-Nachbildung *(oder umgekehrt)*?
   - Gilt das, was Sie vorher über das Mondgestein / den Raumanzug gesagt haben, dann immer noch? Was würde sich verändern?
   - Wenn sich etwas verändern würde: Aus welchem Grund würde es sich verändern?

4. *Aufklärung*