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Verbal proficiency as fitness indicator:
Experimental and comparative research on the evolutionary psychology of language and verbal displays

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Foreword

The current studies are an attempt to fill research gaps pertaining to the sexual selection of language. To my knowledge, neither a study confirming experimentally the causal relation between verbal proficiency and attractiveness, nor a study showing that verbal displays pay off regarding mating and reproductive success exists. Several works, especially those by Miller (1999, 2000a, 2000b, 2002), suggest that these studies are worthwhile to be conducted. Moreover, already the main work on sexual selection theory (Darwin, 1871) gives hints which make it obvious for an evolutionary scientist to examine the above mentioned aspects. As surprisingly, no such studies seem to exist, they should be provided by this doctoral thesis. Hopefully, this work will be of interest not only for evolutionary psychologists, but also for any psychologist, as well as for linguists, literary scientists, communication and media scientists, biologists, anthropologists and anyone interested in interdisciplinary research or in language in general.

As an evolutionary perspective will be taken, language will be deemed as something especially worthy to be studied in a natural scientific framework rather than as merely a topic in humanistic disciplines. Hopefully, the reader will agree with German linguist August Schleicher (1863/1977), who expressed his conviction to his dear friend Ernst Haeckel that the study of language should belong to the natural sciences.

Summary

Recent research on the evolution of language and verbal displays (e.g., Miller, 1999, 2000a, 2000b, 2002) indicated that language is not only the result of natural selection but serves as a sexually-selected fitness indicator that is an adaptation showing an individual's suitability as a reproductive mate. Thus, language could be placed within the framework of concepts such as the handicap principle (Zahavi, 1975). There are several reasons for this position: Many linguistic traits are highly heritable (Stromswold, 2001, 2005), while naturally-selected traits are only marginally heritable (Miller, 2000a); men are more prone to verbal displays than women, who in turn judge the displays (Dunbar, 1996; Locke & Bogin, 2006; Lange, in press; Miller, 2000a; Rosenberg & Tunney, 2008); verbal proficiency universally raises especially male status (Brown, 1991); many linguistic features are handicaps (Miller, 2000a) in the Zahavian sense; most literature is produced by men at reproduction-relevant age (Miller, 1999). However, neither an experimental study investigating the causal relation between verbal proficiency and attractiveness, nor a study showing a correlation between markers of literary and mating success existed. In the current studies, it was aimed to fill these gaps. In the first one, I conducted a laboratory experiment. Videos in which an actor and an actress performed verbal self-presentations were the stimuli for counter-sex participants. Content was always alike, but the videos differed on three levels of verbal proficiency. Predictions were, among others, that (1) verbal proficiency increases mate value, but that (2) this applies more to male than to female mate value due to assumed past sex-different selection pressures causing women to be very demanding in mate choice (Trivers, 1972). After running a two-factorial analysis of variance with the variables sex and verbal proficiency as factors, the first hypothesis was supported with high effect size. For the second hypothesis, there was only a trend going in the predicted direction. Furthermore, it became evident that verbal proficiency affects long-term more than short-term mate value. In the second study, verbal proficiency as a menstrual cycle-dependent mate choice criterion was investigated. Basically the same materials as in the former study were used with only marginal changes in the used questionnaire. The hypothesis was that fertile women rate high verbal proficiency in men higher than non-fertile women because of verbal proficiency being a potential indicator of "good genes". However, no significant result could be obtained in support of the hypothesis in the current study. In the third study, the hypotheses were: (1) most literature is produced by men at reproduction-relevant age. (2) The more works of high literary quality a male writer produces, the more mates and children he has. (3) Lyricists have higher mating success than non-lyric writers because of poetic language being a larger handicap than other forms of language. (4) Writing literature increases a man's status insofar that his offspring shows a significantly higher male-to-female sex ratio than in the general population, as the Trivers-Willard hypothesis (Trivers & Willard, 1973) applied to literature predicts. In order to test these hypotheses, two famous literary canons were chosen. Extensive biographical research was conducted on the writers' mating successes. The first hypothesis was confirmed; the second one, controlling for life age, only for number of mates but not entirely regarding number of children. The latter finding was discussed with respect to, among others, the availability of effective contraception especially in the 20th century. The third hypothesis was not satisfactorily supported. The fourth hypothesis was partially supported. For the 20th century part of the German list, the secondary sex ratio differed with high statistical significance from the ratio assumed to be valid for a general population.

Zusammenfassung

Neuere Forschung zur Evolution der Sprache und sprachlicher Darbietungen (z.B. Miller, 1999, 2000a, 2000b, 2002) legte nahe, dass Sprache nicht nur Ergebnis natürlicher Selektion ist, sondern auch als sexuell selektierter Fitnessindikator fungiert, d.h. als Anpassung, die die Angemessenheit eines Individuums als Reproduktionspartner signalisiert. Sprache wäre demnach im Bereich von Konzepten wie dem Handicap-Prinzip (Zahavi, 1975) anzusiedeln. Für diese Position existieren verschiedene Gründe: Zahlreiche sprachliche Merkmale sind hoch erblich (z.B. Stromswold, 2001, 2005), während natürlich selektierte Merkmale eher gering erblich sind (Miller, 2000a). Männer neigen stärker zu sprachlichen Darbietungen als Frauen, die diese Darbietungen dafür beurteilen (Dunbar, 1996; Locke & Bogin, 2006; Lange, in Druck; Miller, 2000a; Rosenberg & Tunney, 2008). Sprachliche Gewandtheit erhöht kulturuniversal insbesondere männlichen Status (Brown, 1991). Zahlreiche linguistische Merkmale sind Handicaps (Miller, 2000a) im Zahavi'schen Sinn. Ein Großteil der Literatur wird von Männern im reproduktionsrelevanten Alter geschaffen (Miller, 1999). Es existierte jedoch weder eine experimentelle Studie, die die kausale Beziehung zwischen sprachlicher Gewandtheit und Attraktivität untersucht hätte noch eine Studie, die eine Korrelation zwischen Markern für literarischen Erfolg und solchen für Paarungserfolg belegt hätte. In Form der vorliegenden Studien wurde versucht, diese Lücken zu füllen. In der ersten Studie führte ich ein Laborexperiment durch. Videos, in denen sich ein Schauspieler und eine Schauspielerin jeweils sprachlich präsentierten, dienten als Stimuli für die gegengeschlechtlichen Versuchspersonen. Der Inhalt war immer gleich, jedoch variierten die Videos in Form dreier Stufen sprachlicher Gewandtheit. Die Vorhersagen waren u.a., (1) dass sprachliche Gewandtheit den Partnerwert erhöht, aber dass dies (2) stärker auf männlichen als auf weiblichen Partnerwert zutrifft, und zwar wegen angenommener vergangener geschlechtsdifferenter Selektionsdrücke, aufgrund derer Frauen sehr wählerisch bei der Partnerwahl sind (Trivers, 1972). Eine zwei-faktorielle Varianzanalyse mit den Variablen „Geschlecht" und „sprachlicher Gewandtheit" als Faktoren wurde durchgeführt, wodurch die erste Hypothese mit großen Effektstärken belegt wurde. Hinsichtlich der zweiten Hypothese zeigte sich nur ein Trend in die vorhergesagte Richtung. Außerdem wurde deutlich, dass sprachliche Gewandtheit den Partnerwert als Langzeitpartner stärker beeinflusst als den als Kurzzeitpartner. In der zweiten Studie wurde sprachliche Gewandtheit als menstruationszyklusabhängiges Partnerwahlkriterium untersucht. Dafür wurden die gleichen Materialien wie in der vorherigen Studie verwendet; lediglich der Fragebogen wurde leicht verändert. Die Hypothese lautete, dass fertile Frauen der sprachlichen Gewandtheit eines Mannes eine größere Bedeutung beimessen als nicht-fertile Frauen, da sprachliche Gewandtheit als Indikator für „gute Gene" aufgefasst werden könnte. Allerdings gab es in der vorliegenden Studie kein signifikantes Ergebnis, das die Hypothese belegte. In der dritten Studie waren die Hypothesen: 1. Ein Großteil der Literatur wird von Männern im reproduktionsrelevanten Alter geschrieben. 2. Je mehr Werke von hoher literarischer Qualität ein männlicher Schriftsteller produziert, desto mehr Partner und Kinder hat er. 3. Lyriker haben einen größeren Paarungserfolg als Nicht-Lyriker, da lyrische Sprache ein größeres Handicap darstellt als andere Sprachformen. 4. Das Schreiben von Literatur erhöht den Status eines Manns derart, dass unter seinem Nachwuchs ein zugunsten des männlichen Geschlechts signifikant höherer Geschlechterproporz zu finden ist als in der Normalbevölkerung, wie die Trivers-Willards-Hypothese (Trivers & Willard, 1973) bei Anwendung auf Literatur vorhersagt. Um diese Hypothesen untersuchen zu können, wurden letztlich zwei sehr bekannte Literaturkanons ausgewählt. Umfangreiche biografische Recherche wurde durchgeführt, um für jeden Autor möglichst alle Paarungserfolge in Erfahrung zu bringen. Die erste Hypothese wurde bestätigt, die zweite, mit Lebensalter als Kontrollvariable, hinsichtlich Partnerzahl, aber nicht durchgehend hinsichtlich Kinderzahl. Letzteres wurde u.a. mit Bezug auf die Verfügbarkeit effektiver Kontrazeptiva, insbesondere im 20. Jahrhundert, diskutiert. Die dritte Hypothese wurde nicht zufriedenstellend bestätigt. Die vierte Hypothese wurde teilweise bestätigt. Im deutschen Kanon des 20. Jh. war der sekundäre Geschlechterproporz zugunsten des männlichen Geschlechts signifikant höher als der für die Normalbevölkerung angenommene.

Acknowledgements

1. Introduction

The origin of language as a defining feature of the human species is one of the most discussed topics in the history of science and "remains the Big Question in human evolution" (Miller, 2002, p. 79). Non-biological approaches consider language as a cultural invention and merely as the result of environmental factors. As Pinker (1994) and others show, this perspective can not be valid. Naturalistic approaches for which language qualifies as an evolutionary by-product of another adaptation are not plausible either, as language is too complex and functionally too valuable to be a mere by-product (Pinker, 1994, 2003; Pinker & Bloom, 1990). There is much evidence available for being critical towards any nonadaptationist and generally any radically non-biological view on language: the astonishingly fast and autonomous language acquisition in children, which obviously follows a maturational timetable (e.g., Chomsky, 1959, 1975, 1980, 1986); the creolization of pidgin languages (e.g., Bickerton, 1984); language universals (e.g., Brown, 1991; Chomsky, 1965; Foley, 1997; Greenberg, 1963; Wildgen, 2004; but see Evans & Levinson, 2009, for the most recent controversy on this topic); language impairments and pathologies which all cluster in families and are most likely caused by genetic factors (Aitchison, 2008; Jenkins, 2000; Smith, Pennington, & DeFries, 1996); language impairment as a result of a mutation of the FOXP2 gene, which is therefore in its intact version essential for proper language development (Lai et al., 2000; Lieberman, 2003; Pinker, 2001); comparatively high estimations of heritability of single linguistic traits, such as lexicon size (Bratko, 1996; Miller, 2000a; Niyogi, 2006; Stromswold, 2001, 2005); the probably large number of genes necessary for language (Jenkins, 2000; Lieberman, 2000; Pinker, 2003); specialization of certain brain areas for language (Ahlsén, 2006; Aitchison, 2008).

Therefore, the adaptationist view of evolutionary psychology and evolutionary biology, as basically founded by Darwin (1859, 1871) and extended by several scientists (e.g., Dawkins, 1976; Trivers, 1972; Williams, 1966; Wilson, 1975), seems most promising to illuminate how language evolved and for which reasons. From this perspective, language must have been strongly selected for in the course of human evolution and is thus an innate and genetically determined trait, a so-called evolved psychological mechanism or an evolutionary adaptation (Miller, 2000c; Miller & Todd, 1998; Pinker, 1994).

Many adaptationist works on language have focused on natural selection, the evolutionary process favoring traits which promote survival (Darwin, 1859). Although these works (e.g., Pinker, 1994, 2003; Pinker & Bloom, 1990; MacNeilage & Davis, 2005) are

major advances in studying the evolution of language, they mostly neglect that a number of verbal abilities show considerable variance among individuals and are furthermore substantially heritable, whereas naturally-selected traits tend to show only small variance and heritability (Miller, 2000a). These approaches which focus on natural selection can also not explain, why there are sex differences in communicative behavior which match the expectations made from the perspective of sexual selection theory or why language is strongly relevant for mate choice (Buss, 2003; Miller, 2000a) or the fact that many linguistic features are not economic but costly and thus handicaps (Miller, 2000a; Zahavi & Zahavi, 1997). If language evolved mainly for sharing important information, as could be claimed from the perspective of natural selection, there would be no reason for it being more elaborate than a pidgin language[1] (Burling, 1986, 2005; Miller, 2000a). Hence, this doctoral thesis is concerned with language as a sexually-selected trait, especially with the question whether verbal proficiency serves as a mate choice criterion that is, to be precise, as a fitness indicator and is thus potentially relevant for reproduction.

The weaknesses of the perspective of natural selection towards language have already lead to numerous approaches on the sexual selection (Darwin, 1871) of language and moreover literature as a means of verbal display. Miller (1998, 2000a, 2002) plausibly showed that especially men benefit from high verbal proficiency in mate choice and that language qualifies for being sexually-selected. However, he did not present any experimental data which show that there is a causal relation between verbal proficiency and mate value. This gap should be filled by experimental research, which will be done in Study 1 (Chapter 3). The hypothesis is that verbal proficiency increases mate value, but male more than female mate value due to assumed past sex-different selection pressures causing women to be more demanding in mate choice than men (Trivers, 1972, 1985). In Study 2 (Chapter 4), it is experimentally tried to examine verbal proficiency as a menstrual cycle-dependent mate choice criterion. The hypothesis is that fertile women rate high verbal proficiency in men higher than non-fertile women because of verbal proficiency being an indicator of "good genes". The results of other studies (e.g., Haselton & Miller, 2006) suggest that this hypothesis is worthwhile to be examined, which has not been done yet.

Regarding the evolution of literary production, Miller (1999) showed that most literature is produced by men at reproduction-relevant age, which gives a hint that literary production is sexually-selected. However, no research exist which shows that producing

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[1] Pidgins are auxiliary languages which are limited and unstable with respect to vocabulary and rudimentary especially with respect to grammatical structure and, thus, lack the complexity of normal languages (Bickerton, 1984).

literature is linked to actual mating or reproductive success. It is tried to fill these lacks of data in Study 3 (Chapter 5). The hypotheses are that (1) most literature is produced by men at reproduction-relevant age, (2) the more works of high literary quality a male writer produces, the more mates, affairs, girlfriends, romances, and children he should have, (3) lyric-poets have higher mating success than non-lyric writers because of poetic language being a larger handicap than other forms of language (Miller, 2000a) and (4) that writing literature increases a man's status insofar that his offspring shows a significantly higher male-to-female sex ratio than in the general population, as the Trivers-Willard hypothesis (Trivers & Willard, 1973) applied to literature predicts.

Before presenting this empirical research, the theoretical background is layed down briefly in Chapter 2, first of all the basics of evolutionary psychology. After this, approaches on the natural and especially the sexual selection of language and literature are critically summarized in order to justify the above mentioned hypotheses in detail.

2. Theoretical background

First, the basics of evolutionary psychology will be presented. Focus will be on aspects which are especially relevant for this doctoral thesis, such as elaborating the idea of traits serving as fitness indicators. Topics which are basically important in evolutionary psychology, such as kinship, but do not primarily contribute to the understanding of language as a fitness indicator will be disregarded. Hence, this overview will be very basic. However, more specific aspects of evolutionary psychology will be elaborated throughout this doctoral thesis. Right after presenting the foundations of evolutionary psychology, the current state of research regarding the evolution of language is presented, as this provides the starting point for the empirical research which will be described from Chapter 3 on.

2.1 Basics of evolutionary psychology

Evolutionary psychology aims to explain the existence and specific characteristics of psychological traits as the result of natural and sexual selection (Buss, 2008; Confer et al., 2010; Cosmides & Tooby, 1987; Pinker, 1997; Tooby & Cosmides, 2005). Traits, if some sort of genetic mechanism is involved, exist because they have been beneficial to survival and reproduction in the past. All of our direct ancestors survived long enough to have at least one child. Thus, these traits evolved to solve recurrent problems of survival and reproduction by enabling those individuals who possessed the trait, that is, the respective phenotype, to have children who inherited the alleles of the associated genotype. Evolved psychological mechanisms can, therefore, be considered special modules for special evolutionary problems (Buss, 2008; Confer et al., 2010; Pinker, 1997; Tooby & Cosmides, 2005).

One distinction must be made, namely between proximate and ultimate mechanisms. The proximate level of explaining is the most common one in most social sciences and asks how a certain trait functions. It is concerned with mechanisms and their ontogeny (Buss, 2008; Confer et al., 2010; Tinbergen, 1952, 1963). Several areas of proximate mechanisms can be distinguished: motivational, cognitive or biological (e.g., in terms of behavioral genetics that is molecular and quantitative genetics, endocrinological and neurological). The ultimate explanations are concerned with the question, why these proximate mechanisms exist in the first place that is with their function and phylogeny (Buss, 2008; Confer et al., 2010; Tinbergen, 1952, 1963). This ultimate perspective is, therefore, the evolutionary perspective itself (Buss, 2008).

2.1.1 Natural selection

Natural selection is the process covering the evolution of traits which promoted survival (Darwin, 1859). There are several preconditions for natural selection to work, namely over-population, variation, selection and inheritance. Due to selection, that is differential survival because of inter-individual differences in the respective heritable traits, features which help individuals to survive become more common in the next generation of a population and will accumulate over successive generations. The selection of traits will then result in adaptations to the evolutionary problems which generated the selection pressure under which the individuals with beneficial traits were evolutionary favored (Mayr, 2001). Such adaptations are generally considered to be economical (not too costly), reliable (all members normally evolve the trait), and efficient (the trait solves an adaptive problem well) (Williams, 1966).

In case of natural selection, individuals – to be precise their allele configuration and the corresponding phenotypes – are selected by environmental conditions, such as climate, but also by members of one's own social group, as long as survival is concerned (Darwin, 1859; Dunbar, 2007). For instance, cheating might be beneficial, but avoiding being cheated as well, amounting in a tit-for-tat reciprocity or in reciprocal altruism, in which individuals help each other and return favors on later occasions (Trivers, 1985; Williams, 1966). Many scientists (e.g., Aitchison, 2000; Bickerton, 2000a, 2000b; Cappella, 1995; Dunbar, 1996; Pinker, 1994, 1997; Smith, 2010) have emphasized that language in a social context is a verbally played tit for tat or simply verbally practiced reciprocal altruism and thus a social regulative.

2.1.2 Sexual selection

Sexual selection differs mainly from natural selection in terms of which entity is selecting. In sexual selection members of one's own species but of *different sex* are selecting, which is the case for one subtype of sexual selection, namely intersexual selection, which can simply be referred to as mate choice. The other subtype, that is intrasexual selection, refers to the competition of members of the same sex in order to gain sexual access to the opposite sex (Darwin, 1871). Again, each trait which is beneficial for succeeding in both processes will be more frequent in the future generation (Andersson, 1994; Darwin, 1859, 1871).

While natural selection reduces variation among individuals (Fisher, 1930), sexually-selected traits show comparably high variance (Miller, 2000a, 2000c). This difference is due

to the fact that natural selection eliminates individuals who are maladaptive in terms of survival. As the challenges pertaining to survival are basically the same for all individuals, natural selection does not create high variance but acts on the variance created by mutation and sexual selection. On the contrary to natural selection, sexual selection requires comparably high variance among individuals and amplifies it so that different traits in a potential mate can be judged. Otherwise any sort of choice would be senseless (Miller, 2000a). Thus, sexually-selected traits tend to be more heritable[2] than naturally-selected ones (Miller, 1998, 2000a, 2000c; Miller & Todd, 1998), because naturally-selected traits yet genetically determined and inherited are only marginally heritable, as they show only small variance among individuals (Fisher, 1930; Miller, 1998, 2000a). Therefore, as this doctoral thesis focuses on language as a sexually-selected trait, especially those linguistic traits, which are substantially heritable, will be in the scope of the experimental research presented in Chapter 3.

Furthermore, sexual selection generates sex differences, at least in non-monogamous species, due to sex differences in reproductive conditions. First, the sexes differ pertaining to obligatory initial investment in offspring, basically starting with different gamete sizes with females having larger and fewer gametes (Bateman, 1948). In addition to this anisogamy, there is a higher obligatory maternal investment in offspring postnatally, especially in mammalian species – basically due to internal fertilization and furthermore due to female lactation (Trivers, 1972). As a result of this, reproductive effort for females is largely parental effort (Mealy, 2000).

For male individuals, on the contrary, the obligatory investment is not as high as for females. They could not keep up with females' high ability for investment via lactation, anyway. Male reproductive success is only constrained by the number of fertile females they are able to gain as sexual mates. Male reproductive effort should therefore be largely mating effort (Bateman, 1948; Buss, 2008; Mealy, 2000; Trivers, 1972). Hence, sex-different selection pressures can be assumed which caused a disruptive selection towards the existing behavioral and somatic sex differences. Nonetheless, there is a higher male than female variance regarding mating strategies, especially in the human species. Instead of maximizing mate number, men can concentrate on paternal investment in children. As relative differences between species regarding reproduction can be described by using the terms K-selection (quality) or r-strategy (quantity) (Pianka, 1970; Wilson, 1975), one can also use them to

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[2]   "Heritability" (h^2) is a common term in behavioral genetics and defined as the phenotypic *variance* in a population which is attributable to genotypic variance in the sense of additive allelic variation among individuals (Falconer & Mackay, 1996; Plomin, DeFries, McClearn, & Rutter, 2001).

distinguish between the sexes within a species. Following this idea, men, even though capable of following a K-strategy, have the option of an r-strategy, especially because their reproduction potential is higher compared to women and thus their opportunity costs for parental investment are higher than those of women, who, on the contrary, are restricted to K-strategy, not least because their maximum number of children is strongly limited (Mealy, 2000). As a result of these circumstances, there is higher choosiness in women than in men and furthermore polygyny, higher reproduction variance and thus higher intrasexual competition in the male sex (Buss, 2008; Daly & Wilson, 1983; Pianka, 1970; Trivers, 1972; Wilson, 1975).

As another result of these conditions, there is female choice of appropriate males (Darwin, 1871). The female sex is the limiting one (Bateman, 1948) and a rare reproductive resource from a male perspective (Trivers, 1972). Thus, in the case of the human species, women prefer long-term mates who are capable of investing in them and their children and offering any kind of resources. Alternatively, they might subconsciously seek for "good" or "sexy-son" genes in a short-term relationship (Buss, 2008; Fisher, 1930; Weatherhead & Robertson, 1979). Female preferences, thus, affect men's behavior, by which men have to show their appropriateness for being a sexual partner, which might be achieved by so-called displays which demonstrate their qualities (Darwin, 1871; Miller, 1999, 2000a).

Regarding male displays, the handicap principle is crucial. In order to display a handicap, one has to be in good enough shape to be able to afford it. Such a trait is, thus, a fake-proof indicator for "good genes" (Zahavi, 1975; Zahavi & Zahavi, 1997). The most prominent example for a sexual ornament following the handicap principle is the peacock's plumage (Miller, 2000a), which is physiologically and metabolically very costly to produce and easily visible to predators. Peafowls are lekking birds. Leks are display areas in which male individuals show their beneficial traits as soon as female individuals come along who watch the displays in order to make their choice, preferably choosing males with the most prominent sexual ornaments serving as handicaps, while males with poor quality remain mateless (Höglund & Alatalo, 1995). Petrie, Halliday, and Sanders (1991) showed that the number of eyes on the peacock's plumage positively affects the mating opportunities of its bearer. By choosing the males with the most brilliant plumage, peahens select for "good genes", as a brilliant plumage signals low parasite affection and thus a good immune system (Møller & Petrie, 2002). Generally, a positive correlation between displays and offspring viability is assumed (Andersson, 1994). Hence, at least one condition which qualifies a trait to be an adaptation caused by natural selection, namely to be economical, that is not too costly

(Williams, 1966), is challenged by the handicap principle, which works with conspicuous waste and luxury. The handicap principle is relevant for human behaviour as well (Miller, 2000a) and had already basically been proposed by Veblen (1899) with his idea of conspicuous consumption.

Males might not only use their ornaments for intersexual selection but for intrasexual selection as well in order to intimidate male rivals in ritualized contents whose winner will get access to female individuals (Fisher, 1930; Miller, 2000a), which seems to be also an universal feature of human behavior (Brown, 1991). Thus, there is a stronger selection on males pertaining to such displays as well as to high assertiveness (Darwin, 1859, 1871; Feingold, 1994; Miller, 2000a).

Pertaining to reproduction, the term "fitness" is essential as it is a key concept in evolutionary biology because it describes an individual's ability to pass his or her genes on to the next generation (Fisher, 1915; Dawkins, 1976; Miller, 2000a; Williams, 1966; Zahavi & Zahavi, 1997). To be precise, it can be considered the appropriateness of an allele combination as part of a genotype to be passed on to the next generation via its corresponding phenotype which is respectively beneficial for attracting mates. Fitness is measurable by the relative reproductive success and is, therefore, at the heart of evolution itself, which can be defined as differential reproduction in the past. A fitness indicator may, therefore, be considered a biological trait which is an "adaption that evolved to advertise an individual's fitness during courtship and mating, typically by growing an ornament or performing a behavior that a lower-fitness individual would find too costly to produce" (Miller, 2000a, p. 439). The very basic hypothesis of this doctoral thesis is that verbal proficiency serves as such an ornament, or in other words that language and the peacock's plumage are biologically analogous, as already Darwin (1871) had assumed.

Most sexual ornaments are, therefore, fitness indicators, which exemplify the main principle of sexual selection, namely to solve evolutionary problems not in the most economic way but by conspicuous waste (Miller, 2000a). Because of its costly production, a fitness indicator is closely linked to the handicap principle theory proposed by Zahavi (1975), which revived the idea of the fitness indicator first presented by Fisher (1915). For instance, the peacock's plumage serves as a fitness indicator just because of being a handicap and, thus, a costly signal of genetic quality. So, each luxurious handicap which is difficult to be prodcued is basically a fitness indicator, because unfit individuals can not afford showing a handicap (Miller, 2000a).

According to one decisive feature of sexual selection, namely variance among individuals, a trait is able to serve the better as a fitness indicator, the more variance it shows among individuals. As evolution necessarily requires genetic transmission of a trait, fitness indicators should, thus, be highly heritable and very complex in terms of genetics (Miller, 2000a). The more genes are involved interacting efficiently to create a specific phenotype, the more suitable this phenotype becomes as a fitness indicator, because such a complex allele combination is comparably vulnerable to harmful mutations. The proportion of the genome responsible for the development of a specific trait is called "mutational target size". A fitness indicator, hence, tends to have a large mutational target size. If the respective trait is intact, it therefore proves the individual's genetic quality. For fitness indicators, there is, therefore, the tendency that the proportion of the individual's genome which constructs the trait increases, which is called "genic capture". A fitness indicator tells therefore about an individual's genetic quality and the absence of harmful mutations (Miller, 2000a; Williams, 1966). This process is driven forward simply by female choice of heritable male traits which signal their condition (Rowe & Houle, 1996).

Importantly, any ornament is useless if its bearer lacks the motivation to display it. The most prominent proximate mechanism on an endocrinological level underlying motivation for such displays, assertiveness, and sexual desire seems to be the effect of androgens, mainly testosterone (Dabbs, 2000; Regan, 1999). Generally, the organizational effects of prenatal testosterone are considered to be important for explaining sex differences. More importantly in this context, androgens have activational effects postnatally. For instance, injecting genetically female individuals with androgens causes masculinized behavior (Collaer & Hines, 1995; Kimura, 2000). Apart from the human species, female birds, for instance, can be brought to singing by injecting testosterone (Aitchison, 2000; Hauser, 1997), while in most if not all bird species, only male birds sing due to hormonal influence in order to attract female birds for mating and to chase off male rivals (Hauser, 1997). What male songbirds do is showing their fitness by displaying auditory ornaments that is by singing a vast number of complicated melodies as loud and powerful as possible (Steels, 2002). Importantly, female birds base their mate choice on the size of the males' song-repertoires. Thus, male song-repertoire size is predictive of mate number and reproductive success (Hasselquist, Bensch, & von Schantz, 1996). The basic hypothesis of this doctoral thesis could be circumscribed by asking if song birds and human language are analogous.

Generally, activational effects of sex hormones, to be precise steroid hormones, can be linked to reproduction. Courtship cues increase testosterone in males. Especially assertiveness

seems to be positively affected by such an increase enabling an individual to successfully fight for its status (Dabbs, 2000; Archer, 1988, 2006). The fact that testosterone starts to decrease at around 30 years of age (Dabbs, 2000; Meletis & Wood, 2009) matches the assumption about testosterone being a factor in mating behavior, because at this age, parental effort starts becoming more important than mating effort for men (Alexander, 1987). This evolutionary perspective will now be applied to language which will be done by a literature review on the evolution of language.

2.2 The evolution of language

The question why language exists is one of the most discussed ones throughout the history of science (Christiansen & Kirby, 2003; Miller, 2000a, 2002). Therefore, it is impossible to give a complete literature review of all research positions which have ever existed. The focus will, therefore, be on the latest and most important approaches and besides this on own ideas and assumptions which will lead to the hypotheses of the empirical research.

Natural selection and sexual selection are biological processes which change allele frequency of genes. It has to be clear that language is not simply a cultural artifact. Otherwise, any evolutionary approach towards language would be senseless. Language is often still treated as a mere cultural invention or as the by-product of the large human brain or of other adaptations (e.g., Bickerton, 1991, 2003; Chomsky, 1988, 1991, 2002; Deacon, 1997, 2003; Gould, 1987, 2002). This perspective has been challenged by the adaptationist view (e.g., Aitchison, 2008; Bjorklund & Pellegrini, 2002; Geary, 2002; Miller, 2002; Pinker, 1994, 2003; Pinker & Bloom, 1990).

There are many biological proximate mechanisms underlying language, such as neurobiological ones (Ahlsén, 2006), molecular genetical ones (Jenkins, 2000; Lai et al., 2000), or those relevant in terms of quantitative genetics (Stromswold, 2001, 2005). These aspects which make it unreasonable to view language entirely as a non-biological trait are concerned with the first of Tinbergen's (1963) questions, namely the one asking for proximate mechanisms in terms of genetic or neurological causation. Also the nativist approach on language acquisition gives indirect insight into the biology of language (Chomsky, 1959; Pinker, 1994; see MacNeilage & Davis, 2005, for a short overview), which is concerned with Tinbergen's (1963) second question, namely the one about ontogenetic development. For lack of space, neither neurobiological aspects of language, nor the nativist approach on language acquisition will be elaborated, because asking why language and its corresponding proximate

mechanisms evolved is more important than this. Hence, it is important to turn to ultimate causes and, thus, to Tinbergen's (1963) third and fourth question, namely the one asking for the adaptive value of language in terms of its function and the one concerning its phylogeny. This ultimate perspective will be in the scope of the following review.

2.2.1 The natural selection of language – A critical overview

Even though this doctoral thesis focuses on the sexual selection of language, it is important to examine the natural selection of language first for two reasons. First, language could probably only have gotten in the scope of sexual selection, after it had evolved by means of natural selection (Buss, 2008; Dunbar, 1996; Miller, 2000a). Second, by summarizing approaches on the natural selection of language, the weaknesses of these approaches regarding a complete explanation of language and all of its features will become clear, as many striking features of language do not make much sense from the perspective of natural selection, such as its luxuriousness (Miller, 2000a).

Many works in the past years and decades have coped with the evolution of language as a result of natural selection. Several scientific disciplines have been involved, such as psychology (e.g., Corballis, 2010; Herrmann, 2005; MacNeilage & Davis, 2005; Pinker, 1994, 1997, 2003; Tomasello, 2008), linguistics (e.g., Aitchison, 2000, 2001; Bichakjian, 2002; Jenkins, 2000; Lieberman, 1984, 2002, 2006, 2007; Wildgen, 2004), anthropology (e.g., Dunbar, 1996; Foley, 1997), and biology (e.g., Hauser, 1997). In order to answer the question why language as a biologically-determined trait exists as a result of natural selection, one might simply look at the functions of language: vehicle for information; social regulative, such as by means of gossip or by defining agreements; to express feelings; to give orders and commands; to manipulate others; even to talk about language itself (Aitchison, 2000; Burling, 2005; Dunbar, 1996; Dunbar, Marriott, & Duncan, 1997; Pinker, 2003; Smith, 2010). Contrary to mimical and gestural communication, it works in darkness. Hands are free for other usage than for gestures (Bayer, 1994; Corballis, 2002; Pinker & Bloom, 1990). Generally speaking, there are only very few human activities which are totally language-free (Pinker, 1994).

Strikingly, language is a vehicle that enables me to convey information to another human being while I still have the information. I can teach another individual how to hunt or where to find food, water, and shelter. On other occasions, this human being can return this favor (Pinker, 1994, 2003; Pinker & Bloom, 1990). Thus, language is a verbally played tit for

tat or simply verbally practiced reciprocal altruism, and thus a social regulative (Aitchison, 2000; Bickerton, 2000a, 2000b; Cappella, 1995; Dunbar, 1996; Pinker, 1994, 1997; Smith, 2010). However, as first emphasized by Burling (1986) and later elaborated by Miller (2000a), if language evolved merely for transmitting information, there would be no need for it to be more elaborate than a pidgin language, because if so, content would be more important than form, but strikingly many ways of language performance are characterized by luxurious form (Miller, 2000a; see 2.2.2.3.1). For merely establishing and maintaining social cohesion by means of verbal grooming, language is way too complex (Bickerton, 1995; Burling, 1986, 2005; Scott-Phillips, 2007). Furthermore, generous information-giving is probably too altruistic to be selected for. What if one individual is keen on telling his fellows about food or possible dangers, but none of his fellows returns the favor? Hence, language merely as a vehicle for information is simply too susceptible to exploitation. If language mainly evolved as a vehicle for information, "we should be a species of extremely good listeners and very reluctant talkers", as Miller (2000a, p. 350) pithily points out. Instead, everyone, and especially men, is keen on making oneself heard.

Apart from transmitting useful information, scientists taking mainly the perspective of natural selection point to group size as a major factor in language evolution. Language would thus be a means for cooperative alliances and for being embedded in the large social groups in which the evolution of the human species took place. There is indirect evidence for this assumption. The relative neocortex size is larger in species, which form coalitions, than in other species (Dunbar & Shultz, 2007), and language is mainly rooted in the neocortex (Caplan, 1998). The neocortex, which is a comparably new organ from an evolutionary perspective and does only exist in mammals, is considered to be important for assessing social aspects and for coping with group life in general. Being part of a social group leads to social competition, which could have created a selection pressure for abilities such as language in order not to be outsmarted (Allman, 1994; Flinn, Geary, & Ward, 2005). The most prominent of these approaches was proposed by Dunbar (1996, 2003). He emphasizes the importance of gossip in large groups. Thus, language might have simply been beneficial for talking about social issues that is about the question who did what to whom, when, where, and why (Pinker, 1994). One can also discuss questions like who is a reliable social partner. It does not surprise that such gossip is an essential part of human conversations and that two-thirds of human talking is about social issues (Allman, 1994; Dunbar, 1993, 1996). Brown (1991) regards gossip as a human universal.

One important factor in this context which Dunbar (1996) has proposed is that the evolution of *Homo sapiens sapiens* presumably took place in social groups which were much larger than groups of other primates. Whereas for most primates, group sizes of approximately 50 members can be found, group sizes up to 150 members are assumed during the phylogeny of the human species. Group size is the result of ecological and general environmental selection pressures created by predators, own predation, the need for temporary nomadism or by the necessity of defending food sources (Dunbar, 1996; Dunbar & Shultz, 2007). This larger size of human groups probably had evolutionary consequences. Other primates, such as chimpanzees, keep their groups together by grooming each other. One individual can only groom one other individual at a time. Keeping the group together does work though, as there are only around 50 individuals around. For humans, grooming was no option, as the grooming of many more than only 50 individuals was not possible in terms of time. The social function of grooming was therefore substituted by the social function of language, for instance by gossip, as Dunbar (1993, 1996) claims. As a matter of fact, one can groom only one individual, but can talk to more than one at a time. According to this theory, language evolved for being verbal grooming in order to keep the social group together. These assumptions are in strong accordance with the fact that human language has a strong phatic function. It is simply used a lot to maintain contact with each other (Jakobson, 1968).

Dunbar's theory is supported by several indirect evidences. For mammals, there is a high correlation between group size and neocortex size in relation to the whole size of the brain (Dunbar, 1992, 1995) with language being rooted in the neocortex (Caplan, 1998; Pinker, 1994). Human groups are not only three times larger than groups of other primates. Also the human neocortex is three times larger than the chimpanzee cortex in relation to the whole size of the respective brains (Dunbar, 1996). Considering this, it can be assumed that the optimal group size for a conversation as a group should be four, namely one speaker plus approximately three listeners (Dunbar, 1993, 1996). Dunbar (1993) refers to the results of several studies which roughly prove his hypothesis. Psycholinguistic experiments show that up to a group size of five individuals, a group communication is possible. Above that number, not only a group communication is no longer possible, but single individuals start focusing on the speaker who is considered most dominant (Fay, Garrod, & Carletta, 2000). Lange (2008) used a questionnaire study in which participants were asked up to which group size they thought a conversation as a group is still possible. The result both for median and mode was again five. This empirically obtained number was, hence, close to the hypothesized number by Dunbar (1993, 1996).

Hence, given the fact that this gossip theory is theoretically plausible and empirically supported, one might assume that there is no need to try to explain language as a result of sexual selection. Scientists who are critical towards the sexual selection of language, such as Fitch (2005), would agree. But, even though, Dunbar's theory has some appeal, is at least roughly supported by empirical data and is frequently cited, when summaries on language evolution are given (e.g., Buss, 2008; MacNeilage & Davis, 2005), there are good reasons to be critical towards assuming that language is only a product of natural selection. Remember the constellation of one speaker and three listeners (instead of one groomer and one groomee) and think of the speaker as an eloquent man and of the listeners as women, does this not remind of male r-strategy? In the large human groups of 150 individuals, other group members are not only possible coalitioners or opponents in terms of survival, they are also, if of different sex, potential reproductive mates. Because of the advantages of language compared to other communicative channels, such as reaching many recipients, in such large groups verbal displays are much more effective than other displays. It has to be conceded that many factors can be identified which probably caused large groups to evolve as a result of natural selection. But once large groups existed, they provided the perfect playground, the perfect lek, for sexual selection to take over. In defense of Dunbar (1996), however, it has to be pointed out that he discusses his theory also in the framework of sexual selection, even though not in extense. Still, when cited, Dunbar's work is reduced to being a theory of the natural selection of language (e.g., MacNeilage & Davis, 2005), but as this review has already indicated so far, natural selection can not explain several striking features of language. Hence, the perspective has to be switched to sexual selection in the following review which focuses on linguistic features which make even less sense from the perspective of natural selection than the above presented ones.

2.2.2 The sexual selection of language

Natural selection solves problems economically, reliably, and efficiently (Williams, 1966). Especially the first but also the second principle is challenged by sexual selection theory, which will be elaborated with respect to language in the following review. Also several language-related sex differences, as predicted by this theory, will be discussed.

2.2.2.1 Verbal handicaps as fitness indicators

Fitness indicators basically follow the handicap principle (Zahavi & Zahavi, 1997) and thus contradict one principle of natural selection, namely to create adaptations which solve problems economically (Miller, 2000a). Also many features of language follow the handicap principle and thus probably work as fitness indicators.

A passive lexicon consisting of 50,000 units and an active one of more than 10,000 units (Aitchison, 2006), for instance, is simply waste from the perspective of natural selection (Miller, 2000a). For most communication, a fraction of this would suffice, as pidgin languages show (Bickerton, 1984) or as was demonstrated by Ogden and Richards and their Basic English whose vocabulary consisted of only 850 words but which sufficed for coping with most areas of life (Ogden, 1937). Therefore, from the perspective of natural selection, human's large lexicon seems an unnecessary waste, which qualifies it for being a fitness indicator following the handicap principle and being relevant in sexual selection. Especially rhymes are obvious handicaps on a lexical level (Miller, 2000a). This perspective is valuable, because approaches focussing on the natural selection of language cannot satisfiably account for human's large lexicon (Miller, 2000a; Rosenberg & Tunney, 2008). Also extremely long sentences, verbal humor and literature, especially poetry, are pure luxury regarding mere survival (Burling, 1986, 2005; Miller, 2000a). However, Briscoe (2008) argues against Miller's (2000) view of vocabulary as being sexually-selected by presenting a non-adaptationist theory based on iterative learning. But still, a large lexicon is waste, irrespective of how exactly it develops in the individual's ontogeny. Most importantly, lexicon size is highly heritable (Bratko, 1996) and, thus, acquiring words by means of environmental factors only occurs within a limited reaction norm. Hence, any radically non-biological approach is endangered to fail.

Pinker (1994, 2003), for instance, emphasizes the excess of human language, such as the ability to create sentences theoretically unlimited in size. However, he fails to consider that this excess is exactly what sexual selection theory applied to language would predict. The etymological relation between "glamour" and "grammar" might, therefore, not be a coincidence, because the semantics of "glamour" properly express the conspicuous waste and luxuriousness which are obvious features of grammar. It is surprising that Pinker (1994) of all people emphasizes the glamorousness of grammar without realizing that this fact is a strong hint for language being also a handicap and hence sexually-selected.

Pinker (2003) also states that components of language interact with several other systems of the human mind, which also gives a hint that not only natural selection is at work but sexual selection as well, as sexually-selected fitness indicators strongly interact with other adaptations in order to tell about an individual's general fitness (Miller, 2000a). All these evidences strongly support Miller's (1999, 2000a, 2002) approach on the evolution of language focusing on sexual selection and considering language serving as a handicap and as a fitness indicator. More evidence for this assumption is found when examining the genetics of language.

2.2.2.2 Behavioral genetics of language

Behavioral genetics comprises molecular genetics and quantitative genetics. While the first area of research is traditionally mostly concerned with single genes and their effect on single traits, the latter one studies the additive effects of genes on traits in combination with environmental factors (Plomin et al., 2001).

Pertaining to the molecular genetics of language, the discovery of the FOXP2 gene (Lai et al., 2000) has stimulated the discussions on language evolution anew (Armstrong & Wilcox, 2007; Christiansen & Kirby, 2003; Lieberman, 2006; Pinker, 1994). In the 1990s, this gene on chromosome 7q31 was discovered, which in his mutated version causes a complex phenotype of language and speech disorders (Corballis, 2003; Lai et al., 2000; Lieberman, 2003; Pinker, 2001; Vargha-Khadem, Gadian, Copp, & Mishkin, 2005). Thus, a mutated FOXP2 gene obviously causes pleiotropy, as several linguistic traits are affected, which is most likely due to the fact that the FOXP2 gene is a so-called transcription factor gene (Enard et al., 2002) and, therefore, controls the expression of other genes during embryogenesis.

However, it has to be emphasized that the FOXP2 gene is still only one of probably hundreds or thousands of genes responsible for language (Enard, personal communication, June 21, 2010; Jenkins, 2000). Language is, thus, a strongly polygenic trait, as it could be assumed from an adaptationist view (Lieberman, 2000; Pinker, 2003) and especially from the perspective of sexual selection (Miller, 2000a). The polygenic nature of language is supported by the fact that in cases of language disorders, language does not completely fail, but is often only partially affected (Pinker, 2003). If up to several thousand genes are involved in language, it means that the mutational target size of language is very high, which qualifies it to be an important mental fitness indicator, because if an individual is capable of totally

mastering language, it indicates a low mutation load and thus "good genes" (Miller, 2000a). Many features of language could have evolved to serve as fake-proof handicaps in order to make valid judgments of mutation load possible, because of the large number of genes involved in language it is very likely that ancestral individuals with high mutation loads suffered from heritable language impairment and, thus, could not properly display the broad palette of linguistic features. Accordingly, disorders such as schizophrenia, which might indicate high mutation load, negatively affect mate choice and go along with deficits regarding several fitness indicators (e.g., musical rhythm and humor) and most importantly with language abnormalities (Shaner, Miller, & Mintz, 2004, 2008). Language with its probably large mutational target size is, thus, also a good indicator for variations among individuals regarding mutation load, while it is variation that counts especially from the perspective of sexual selection.

The FOXP2 gene, on the contrary, does not contribute to normal variance regarding language abilities or disabilities among individuals. Thus, it follows that it has strongly been in the scope of natural selection, as natural selection uses up variation (Enard et al., 2002; Meaburn, Dale, Craig, & Plomin, 2002; Pinker, 1994, 2003; Vargha-Khadem et al., 2005). But it is this variance caused by genetic variance which counts from an evolutionary and especially from the perspective of sexual selection. Hence, molecular genetic research on language, even though contributing to research on language evolution, as it supports assumptions on the biology of language, the quantitative genetics of language are of more importance, as this research can account for two decisive preconditions of evolution, namely variance and genetic transmission (Miller, 2000a; Plomin et al., 2001).

Generally speaking, evolutionary scientists often try to identify universals (Buss, 2008; Brown, 1991). But what is universal from one perspective does not deny genetically determined variation discovered from another perspective. More likely, heritability and thus variation is the starting point of the evolution of a trait, which turns out to be a universal and species-specific (Mayr, 2001; Tooby & Cosmides, 2005). The same applies to language. There has to be a cognitive mechanism for language acquisition which all members of the species possess. Otherwise, the fast acquisition of language would not be possible (Chomsky, 1959; Pinker, 1994). Hence, on first sight, language seems to be a reliably-developing trait, as could be assumed from the perspective of natural selection (Williams, 1966). However, there is obvious variation between individuals, for instance, with respect to grammatical abilities (Bernstein, 1962a, 1962b, 1971, 1972; Labov, 1969), and this variation is partially the result of genetic variation (Pinker & Bloom, 1990; Stromswold, 2001). Thus, verbal abilities are

heritable, and as the following review will elaborate substantially (Jenkins, 2000; McGue & Bouchard Jr., 1989; Niyogi, 2006; Pedersen, Plomin, Nesselroade, & McClearn, 1992; Stromswold, 2001, 2005). Hence, as will be argued, language cannot be totally naturally-selected, as natural selection eliminates variation and, thus, creates only marginally heritable traits (Fisher, 1930; Miller, 2000a).

McGue and Bouchard Jr. (1989) found a heritability of $h^2 = .57$ for verbal abilities by using verbal reasoning tasks in which synonyms had to be detected and words had to be generated starting or ending with a specific letter. Pedersen et al. (1992) could replicate this high heritability for verbal abilities with $h^2 = .58$ testing knowledge of synonyms but also of verbal analogies. Bratko's (1996) estimation for the heritability of word fluency is $h^2 = .52$. Lexicon size seems to be one of the highest heritable linguistic traits with estimations between .61 and .66 (Van den Berg, Posthuma, & Boomsma, 2004; Bratko, 1996), which is one of Miller's (2000a) most striking arguments for the sexual selection of language. But also syntactical abilities are comparably highly heritable (Stromswold, 2001). Phonemic awareness shows also a high heritability of $h^2 = .68$. For language impairments and disorders, the highest language-relevant estimations of heritability can be found. For the liability to stuttering, estimations of heritability range between .66 and .71 (Andrews, Morris-Yates, Howie, & Martin, 1991; Dworzynski, Remington, Rijsdijk, Howell, & Plomin, 2007; Felsenfeld, Kirk, Zhu, Statham, Neale, & Martin, 2000). For spoken language impairments, heritability is comparably high with $h^2 = .68$ (Stromswold, 2005). Examining the genetics of poor verbal abilities is important, because it will not only be hypothesized in the experimental study that high verbal proficiency increases but also that low verbal proficiency decreases mate value. So variance, also caused by genetic variance, is one important foundation of the emprical studies. Hence, the above mentioned linguistic features will especially be paid attention to in Study 1 (Chapter 3).

Fitness indicators phenotypically correlate with each other (Miller, 2000a). With respect to language as fitness indicator, correlations between health on the one hand and intelligence and verbal intelligence on the other hand (Kanazawa, 2006) and between vocabulary size and body symmetry (Prokosch, Yeo, & Miller, 2005) are reported. Body and facial symmetry are considered major physical fitness indicators, because they are probably markers of developmental stability, health, and genetic quality in general (Fink, Neave, Manning, & Grammer, 2006; Jones, Little, Penton-Voak, Tiddeman, Burt, & Perrett, 2001; Møller & Swaddle, 1997). Importantly, phenotypic correlations between fitness indicators might partially be genetic correlations, that is, correlations due to shared genetic influence (Miller,

2000a; for an overview on genetic corrlation, see Falconer & Mackay, 1996, and Plomin et al., 2001). High genetic correlations between general cognitive abilities, which are female mate choice criteria and major mental fitness indicators (Feingold, 1992; Miller, 2000a, 2000b), on the one hand and language skills on the other are evident (Butcher, Kennedy, & Plomin, 2006; Haworth, Dale, & Plomin, 2009; Haworth, Kovas et al., 2009), again supporting the idea of language serving as a fitness indicator.

In sum, high heritabilities of linguistic traits and genetic correlations between them and other fitness indicators give a hint that language cannot be only naturally-selected. It follows that language is also the result of sexual selection. If so, language-related sex differences should be found.

2.2.2.3 Language-related sex differences

The Darwinian theory of sexual selection predicts sex differences in non-monogamous species. The degree of polygyny of a species, such as *Homo sapiens sapiens*, or a population determines the extent of intrasexual competition among members of the sex with the higher reproduction variance and, therefore, physical and behavioural sexual dimorphism between the sexes (Buss, 2008). If language is sexually selected, language-related sexual dimorphisms should be found. If this can be shown, it would again serve as an indication for language being not only naturally-selected. Therefore, a short literature review on several sex differences pertaining to language will be given.

On average, women show slightly better linguistic performances than men, as already Maccoby and Jacklin (1974) had proposed and as Hyde and Linn (1988) found in their meta-analysis of 165 verbal tests. However, only a few tests yielded ds higher than -0.3. The overall sex difference was so small ($d = -0.11$) that the authors concluded that there is no appreciable sex difference pertaining to verbal abilities (Hyde & Linn, 1988, p. 64). Wallentin (2009) comes to the same conclusion in his review on verbal tests. However, sexual selection applied to language would predict that men have significantly higher verbal proficiency than women, which is not the case (Wallentin, 2009).

Still, sex differences in verbal proficiency, even though small and not going in the predicted direction, seem to be affected by fundamental biological factors. Transsexuals, for instance, show a large decline of performance in verbal fluency tests after androgen therapy. It seems to be one of a few robust findings that women outperform men especially in verbal fluency tasks (Kimura, 2000). In general accordance with this, women show highest verbal

proficiency, for instance regarding verbal fluency, in the middle of their menstrual cycle that is at the phase when levels of progesterone and also estradiol, major "female" hormones, are high and conception is most likely (Halpern, 2000; Hampson & Kimura, 1988; Kimura, 2000). However, the data on sex differences regarding verbal abilities mostly seem to contradict sexual selection theory which will be addressed in the general discussion (6.1). In the following, the focus will switch to sex differences in actual verbal behavior, first primarily with respect to the possible contents of language and right after more regarding form of language.

2.2.2.3.1 Male usage of language as a vehicle for information in mate choice

Language merely as a vehicle for giving information is very prone to exploitation, as it can turn out to be too altruistic. However, this holds only true if the speaker's information only contributes to the fitness of the listener. In mate choice, both speaker and listener have fitness interests, and the information given by the speaker is expected to be not totally altruistic (Miller, 2002). As much as information-giving is concerned, this review focuses on the content of language rather than its form, which means that it does not primarily cover language as a fitness indicator itself. Still, this review is valuable, as sex differences will be presented which can be expected from the perspective of sexual selection theory which will support the idea of language as a sexually-selected trait. Moreover, it will become clear that from the perspective of sexual selection theory, form is more important than mere content.

First, communication has to be started. Considering sex-different reproductive conditions (Trivers, 1972), men can be expected to be more prone than women to make the first step in order to start communication with a potential mate (Grammer, 1994). Lange (in press) could prove this in a questionnaire study with statistical significance and almost moderate effect size ($t_{(106)} = 1.99$, $p < .03$, one-tailed, $d = 0.41$).

From sexual selection theory (Darwin, 1871; Trivers, 1972) it can also be expected that men more than women tend to reveal much personal information, such as about their personality, preferences, social and economic status, and abilities such as intelligence (Lange, 2008; Miller, 2000a). It is a robust finding that for men high status and certain skills can be transformed into access to fertile women (Buss, 2003, 2008). Women, on the contrary, should be trying to elicit this male revelation in order to get useful information. According to Grammer et al. (2000), this is the case. In their study, men produced more verbal revelations than women, which is elicited by female behavior, among others, by subtle nonverbal signals,

for instance, by smiling or head nodding. Male speaking time correlated with these female signals of affirmation. Grammer et al. (2000) also reported that men talk the more the more interested they are in a woman. Accordingly, Garcia, Stinson, Ickes, Bissonnette, and Briggs (1991) showed that in a conversation with a woman, men talk the more about themselves, the more attractive she is. Also when it comes to talking about social issues, two-thirds of women's talking is about others, while two-thirds of men's talking is about themselves (Dunbar, 1996). When in a conversation, an all-male group switches to a mixed-sex group, namely when women join the group, men start talking about academic issues and work (Dunbar, 1996) – all of these topics are strongly status-relevant and, therefore, strongly relevant for male reproduction as well (Buss, 2003, 2008; Dunbar, 1996).

A lot of conversation is often needed for a woman to decide whether sexual intercourse should occur, which becomes already obvious, when considering that women are reluctant and hesitant to agree too easily on sex. In a study by Buss and Schmitt (1993), only after five years of knowing an attractive person of the opposite sex, both sexes reported the same likelihood for sexual intercourse. For all shorter time intervals, the reported likelihood for sex was always much smaller for women than for men. This time gap between first date and first sexual intercourse might simply be bridged by conversation, first of all in order to get to know each other. A man could simply use language to convince a woman by advertising his qualities. Generally, language strongly has a persuasive function, which has its own science, namely rhetoric which considers persuasion even as an art (Noeth, 1995; Perloff, 1993). Miller (2000a) calculates that up to one million words are uttered between a man and a woman before having the first child.

But as long as only content and not form of language is concerned, the whole conversation does not necessarily deliver fake-proof information of genetic quality, because language can not only be used to transmit true information but for deceit as well. The evolutionary relevance of lying is supported by the fact that it is a human universal (Brown, 1991). Sex differences regarding deceit and betrayal which can be expected from an evolutionary perspective can be found. Men lie about their willingness for commitment, displaying high interests in long-term relationship while hoping for copulation without obligation. Women, on the contrary, might display higher interest in sexual intercourse than they actually have in order to gain resources from men (Haselton & Buss, 2000; Haselton, Buss, Oubaid, & Angleitner, 2005). Thus, language seems to play a decisive role in what is described by Buss' (1989a) strategic interference theory, namely that the sexes differ regarding their adaptive problems and, therefore, lie to each other in order enhance their

respective fitness. Language provides not only the opportunity to lie about one's intentions, but, even more importantly, about one's own mate value as well (Aitchison, 2000; Buss, 2003, 2008; Miller, 2000a). Those displays cost very little and, thus, do not necessarily refer to good and really existing fitness indicators. These displays are, thus, "cheap talk" (Miller, 2000a, p. 125) in the truest sense of the word, because it is easier, for instance, to verbally claim to be rich than actually being rich. On the contrary, it is impossible to convingly claim to be eloquent by means of uneloquent speech. Accordingly, negatively connotated words such as "bigmouths" or "loudmouths" are commonly used to refer to showoffs in order to inflict high social costs on such cheaters. Likewise, the desirability for true fitness indicators by means of language instead of faked ones is, thus, expressed. So, the argumentation must get away from the cheap signals of language, namely its content, and focus on its luxurious form. Language should be examined as a fitness indicator itself, as a means of honest signaling genetic quality instead of a device used for pretending and faking. Male should again be more prone than women to produce such verbal displays.

2.2.2.3.2 Male proneness to verbal displays

If language serves as a fitness indicator, it would pertaining to its function be close to signal communication of other animals. Its focus would, thus, not only be on providing useful information of the real world, but more likely on fitness-relevant messages about the signaller (Miller, 2002). If so, sexual selection should have favored men who were prone to display their verbal fitness indicators, as mere competence without any performance is difficult if not impossible to be selected for (Locke & Bogin, 2006). On the contrary, women should focus more on the reception of such displays in order to make a proper choice.

Generally, men talk the more the larger the group is (Klann-Delius, 2005). Accordingly, Lange (in press) could show in questionnaire studies that men find it easier than women to talk in front of an audience ($t_{(231)} = 3.12$, $p < .002$, one-tailed, $d = 0.44$). Dunbar (1996), even though focusing on language as a result of natural selection, considers also the possibility of a strong sexual selection of language and interprets conversations, in which men and women are present, as leks that is as display areas which are used by men to advertise themselves, while women watch and judge the displays in order to make their choice. Men obviously behave similar to male members of lekking species, such as peafowls, in which male individuals start fitness displays as soon as a female one comes near (Dunbar et al., 1997; Rosenberg & Tunney, 2008). Women, on the contrary, talk the less, the larger a conversation

group gets (Dunbar, 1996), which can be expected from the perspective of sexual selection, because the larger a group gets, the more it qualifies for being a lek, as the number of men making displays increases, which is a good foundation for women to judge the displays and, thus, make proper mate choices. Judging what is said instead of being judged logically reduces own speaking time, which is what can be found for women in large conversation groups. This decrease of women's speaking time is most striking in groups consisting at least of eight to twelve individuals (Dunbar, 1996) which is almost exactly the number when, according to Fay et al. (2000), group members start to focus on the most dominant person that is the one talking. What can be found here is the difference between female narrowcasting and male broadcasting, as prominently described by Tannen (2001). Many examples from different cultures also show that public talking is universally dominated by men in order to present their respective verbal proficiency (Locke & Bogin, 2006). Group members can be potential mates. From this perspective, reaching many other individuals in large groups by means of language has influenced mate choice. Large groups built the framework in which the male production and the female reception of displays took place. The more women are present to whom a man can impressively talk and the more time he has to do so, the more women he might get access to as sexual mates.

Hence, men should be motivated to make especially those verbal displays which are complex, elaborate, expensive, costly and even wasteful and, thus, sensational and startling. Therefore, these displays should consist of verbal handicaps (see 2.2.2.1), which could comprise linguistic creativity, extensive vocabulary, extra-ordinarily long sentences, rhymes and many more (Miller, 2000a). Lange (in press) proved the assumption that men are higher motivated to show such displays than women in a questionnaire study. Men, more than women, reported to improve their linguistic behavior if interested in someone as a potential mate ($t_{(105)} = 1.77$, $p < .04$, one-tailed, $d = 0.37$).

Moreover, men are more prone than women to use rare and special words in mate choice (Lange, in press; Rosenberg & Tunney, 2008). Rosenberg and Tunney (2008) could show that men use vocabulary and especially low-frequent words for mating display purposes. They do so more as a display for young than for older women, as sexual selection theory would predict. On the contrary, women seem to use fewer low-frequency words in mate choice. Accordingly, in questionnaire studies by Lange (in press), men reported on average a higher tendency than women ($t_{(231)} = 1.77$, $p < .04$, one-tailed, $d = 0.25$) to use impressive and unknown words in conversation with a potential mate. The high heritability of lexicon size (Bratko, 1996) comes to mind.

Verbal creativity and innovation should also be more produced by men than by women. Concerning function words such as prepositions, there is no potential for creative change. On the syntactic level, there is creativity but as a result of grammar being a discrete combinatorial system (Miller, 1998; Pinker, 1994). Hence, innovation in language is mainly a matter of lexical change (Wildgen, 2004). New words such as neologisms can be invented. New expressions can be created by composition[3] and derivation[4]. Metaphorical expansion can enrich the expressivity of language as well (Wildgen, 2004). An application of Zipf's (1935, 1949) law to language and, thus, a statistical analysis of word frequency and form shows that the less frequent a word form is, the longer and the more complex the respective word is (Givón, 1995; Zipf, 1935). Considering that the more complex a word is, the more it potentially qualifies for being a fake-proof indicator of fitness, it does not surprise that Rosenberg and Tunney (2008) found that men prefer low-frequency words in mate choice.

Generally, concepts of creativity are closely linked to verbal abilities. The Torrance Test of Creative Thinking, for instance, is a test for measuring creativity (Torrance, 1974). The verbal Torrance Test measures linguistic originality, but also fluency and flexibility. Therefore, examining creativity in general from an evolutionary perspective seems valuable for studies on linguistic creativity. Haselton and Miller (2006) found that highly fertile women (i.e., ovulating women) prefer highly creative men, even if they are poor, to rich but uncreative men as short-term mates. They interpreted their results as supporting the idea of creativity indicating "good genes". In strong accordance with this, men seem to be more motivated to produce creative linguistic displays and actually produce more such displays, when the cues for a mating context are given, regarding short-term as well as regarding long-term relationships. Women's creative output, on the contrary, is only increased by cues of a committed long-term relationship (Griskevicius, Cialdini, & Kenrick, 2006).

A common misunderstanding of evolution, namely that adaptations allow no behavioral freedom, can be found in the discussion on language evolution as well (Piattelli-Palmarini, 1989). The question arising from this misunderstanding could be how creativity can be an adaptive trait if creativity is unpredictable and an adaptation a fixed set of behavior. But adaptations do not create fixed behavior but are complex conditional algorithms which create behavioral output according to variable input (Buss, 2008; Cosmides & Tooby, 1987; Gottlieb, 2000). So, arbitrariness of linguistic structure and the potential for linguistic

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[3] For instance, "verbal" and "proficiency" can be combined to "verbal proficiency".
[4] For instance, by adding "-ary", "evolution" (a noun) can be transformed to "evolutionary" (an adjective).

creativity linked with it are in accordance with the adaptationist view (Pinker & Bloom, 1990).

As testosterone is considered one major proximate mechanism behind male motivation for making displays (Regan, 1999), it can be assumed that this applies to male proneness for verbal displays as well. Dabbs, Alford, and Fielden (1998) showed that trial lawyers who have to speak in court and do so in order to successfully manipulate others have higher levels of testosterone than other lawyers. One question might arise again, namely why women seem to be verbally more proficient than men on average, whereas sexual selection theory predicts the opposite (Wallentin, 2009). This problem will be addressed in 6.1.

2.2.2.3.3 Female reception of male verbal displays

Male motivation for verbal displays, as well as the luxuriousness of language, could not have evolved if ancestral women had not preferred verbally proficient men who displayed their eloquence. Especially regarding the highly heritable lexicon size, Fisher's (1930) theory of runaway selection qualifies for being a proper explanation in this context, because as soon as language got captured by sexual selection, a runaway process could have started (Wildgen, 2004), in which women preferred eloquent men with large lexicons who displayed their verbal proficiency to verbally unproficient men, *ceteris paribus*, resulting on the one hand in eloquent sons with large lexicons and on the other hand in daughters sharing their mother's preference for this type of man. This scenario is one way to explain the extensive luxuriousness of language.

There is some evidence showing that women treasure such displays and make them a factor of their mate choice. Generally, appreciation of articulateness is a human universal. Most importantly, especially men universally gain higher status by articulateness (Brown, 1991) with male status being a major female mate choice criterion (Buss, 2003). Locke and Bogin (2006) list several examples from different cultures which show that verbal proficiency and high status are closely linked with each other. Men of high status, such as tribal chiefs, are often elaborate talkers and furthermore polygynous. So, it can be concluded that eloquence and elaborate communicative skills universally raise a man's status and thus reproductive success (Brown, 1991; Burling, 1986, 2005; Miller, 2002; Pinker, 1994; Pinker & Bloom, 1990; Wildgen, 2004). Verbal intelligence significantly correlates with formal schooling ($r = .53$) and earning ($r = .19$) (Kanazawa, 2008). Both education and financial resources are major female mate choice criteria (Buss, 1989b, 2003, 2008). These aspects are

only indirect evidence, or in other words, these data suggest a more indirect positive female reception of verbal proficiency.

Pertaining to clearer evidence and a direct female selection of male verbal proficiency, questionnaire studies by Lange (in press) delivered an insightful result. Participants were presented the following scenario: "Imagine, you meet a person of the opposite sex whom you would consider the perfect mate so that you would give the highest rating if you had to rate his or her overall attractiveness. Now imagine that in your first conversation the other person has problems articulating, is always seeking for the right words, and makes many language-related mistakes such as confusing words so that you would consider him or her verbally unproficient. What would your rating of his or her overall attractiveness be now?" From an evolutionary perspective and considering language as a fitness indicator, it has to be expected that the attractiveness of an imagined woman would still be rated relatively high by men, whereas an imagined man rated by women would lose a lot of his attractiveness because of being verbally unproficient. Exactly this was the result with high statistical significance and almost moderate effect size ($t_{(231)} = 3.03$, $p < .002$, one-tailed, $d = 0.43$). In this study, ten of 13 correlations between the number of past mates and items covering male proneness to verbal displays and verbal competition were positive (controlling for age), even though most of them were comparatively small and not statistically significant. Only two items yielded Pearson correlation coefficients higher than .30: (1) "If I meet a person whom I consider a potential mate because of his/her attractiveness, I would be upset if I did not find the right words in the decisive moment". (2) "In the presence of a potential mate, I try to talk stylistically well and to appear rhetorically talented" (Lange, in press).

Despite some evidence for a positive female reception of male verbal proficiency, overall findings seem to be inconsistent. In questionnaire studies by Lange (in press), several questionnaire items which covered this female reception and were, thus, predicted to result in higher female means, mostly resulted in higher male means, one of them with statistical significance. Hence, the experimental design presented in Chapter 3 is especially valuable, as it puts emphasis on female reception of male verbal proficiency.

2.2.2.3.4 Higher male than female variance

If some males are over-proportionally successful in mating and intrasexual competition and if there is a relative numerical equality of the sexes, which is the case for the human species (Fisher, 1930; Trivers, 1985), there must be males who remain without any chance of

reproduction. On the contrary, for females the risk of going away empty-handed is on the one hand smaller, the chance of higher reproductive success by extra-mating on the other hand not given because of the limitations of female reproductive conditions (Trivers, 1972). The fact that some males do not mate at all, whereas others have access to several females, results not only in a higher intrasexual selection in the male sex, but in a higher male reproduction variance as well, as already Darwin (1859, 1871), Huxley (1938) and Bateman (1948) have pointed out. After all, it is higher male reproductive variance which defines a mating system as polygyny. Thus, there are not only sex differences in mean values but in variance as well (Feingold, 1992, 1995) mostly with the male sex showing higher variance than the female sex for several traits, especially for those which are potential mate choice criteria, at least if some sort of biological mechanism is involved. As there is higher male than female variance in reproductive success, each trait which is potentially relevant for reproduction should show higher variance in males than in females as well. An alternative explanation for sex differences in variance is the following. Whereas females are necessarily K-strategist regarding reproduction, males can be K- as well as r-strategists. So, males show a higher variability in mating strategies and thus a higher variability regarding traits which are relevant for mate choice (Archer & Mehdikhani, 2003). Both explanations do not exclude each other and can both be considered valid explanations for higher male than female phenotypic variance.

Such higher male than female variance is evident in several species (Archer & Mehdikhani, 2003), which is important for an evolutionary perspective which generally takes a comparative view. For the human species, it can, for instance, be found for intelligence (Feingold, 1992; Irwing & Lynn, 2005). Generally, there is higher variance in the male than in the female sex in all or at least almost all other cognitive traits such as quantitative, mathematical, and visuo-spatial abilities (Cole, 1997; Halpern, Benbow, Geary, Gur, Hyde, & Gernsbacher, 2007; Hedges & Nowell, 1995; Heim, 1970; Maccoby & Jacklin, 1974; Strand, Deary, & Smith, 2006; Stumpf & Stanley, 1998). Accordingly, there is a higher male than female variance in success at school (Lehre, Lehre, Laake, & Danbolt, 2009; Nowell & Hedges, 1998).

Apart from biological explanations for higher male than female variance, environmental factors are considered to provide an alternative explanation (see Strand et al., 2006). This is not convincing for several reasons. For intelligence, there is higher variance in male than in female individuals already at the age of 10 years (Deary, Thorpe, Wilson, Starr, & Whalley, 2003; Dykiert, Gale, & Deary, 2009). Arden and Plomin (2006) found higher male variance

even before pre-school age, which gives a hint that this sex difference cannot be caused by educational factors, because the sooner a trait appears, the less time environmental factors had to shape it. Furthermore, even for somatic traits higher male than female variance is evident (Bell, Adair, & Popkin, 2002; Lehre et al., 2009), indicating a biological foundation of sex differences in variances, because for psychological or cognitive traits an environmental explanation seems at least possible but not entirely for somatic traits without further ado (Lehre et al., 2009).

Also concerning verbal proficiency, it can be expected that males are over-represented at both ends of the distribution. With respect to high verbal proficiency, this seems to be evident, as almost all areas in which verbal abilities can be considered a decisive feature for gaining status are male-dominated. Most writers are male (Miller, 1999). Other occupations in which advanced verbal abilities are highly beneficial such as professor, lecturer, lawyer, politician, leader, and journalist are also dominated by men (Burling, 1986, 2005; Halpern, 2000). Gardner's (1983, 1993) theory of multiple intelligences seems to fit in. He assumes, among others, a specific verbal intelligence which should, for instance, be especially important for writers, poets, lawyers, and teachers.

For poor verbal proficiency, that is the other end of the distribution, the evidence is even stronger. Language impairments, disorders, and pathologies, such as stuttering and dyslexia, are more prevalent in the male than in the female sex already in young ages, which makes it difficult to explain these disorders by environmental factors alone (Ardila, Rosselli, Bateman, & Guzmán, 2000). Dyslexia is five to ten times more likely in men than in women (Halpern, 2000). For stuttering, male-to-female sex ratios of up to 4:1 or even 5:1 are reported (Andrews, 1964; Bloodstein, 1995; Felsenfeld et al., 2000). These findings on more men than women being affected by language problems such as stuttering seem to be a robust one, as comparable results have already been reported more than 30 years ago (Eme, 1979; Fairweather, 1976; Ingram, 1975) and even almost 90 years ago by Jespersen (1922), who also took an evolutionary perspective on language. The same sex difference can be found for developmental language disorders, for which the prevalence is two to three times higher in the male than in the female sex (Canning & Lyon, 1989; Thomson & Polnay, 2002). No social factors seem identifiable which could constantly cause a higher prevalence for men than for women regarding dyslexia, for example. Instead, the biological foundation of language disorders in general is evident (Alarcón et al., 2008; Hayiou-Thomas, 2008; Jenkins, 2000; Stromswold, 2001, 2005) and even proved for single disorders such as stuttering (Dworzynski et al., 2007). Taking into account that language disorders and impairments are highly heritable

already early in life (Dale et al., 1998), one has to assume sex-specific genetic factors responsible for language and language deficits (Galsworthy, Dionne, Dale, & Plomin, 2000).

Locke and Bogin (2006) summarize the results of several studies which show that language deficits strongly affect courtship and any form of intimate relationship in a negative way. Zhang, Saltuklaroglu, Hough, and Kalinowski (2009) asked mostly female non-stutterers to take the perspective of people who stutter. These non-stuttering participants believed that stuttering had mild to moderate negative impact on social life and life in general, but relatively severe consequences on romantic relationships and marriage, among others.

Apart from finding examples for men being over-represented at both ends of the distribution compared to women, the assumption of higher male than female variance is strongly supported by statistical analyses. Strand et al. (2006) could show with an analysis of standardized tests from the UK that there is higher male than female variance in verbal classification, sentence completion, and verbal analogies. Hedges and Nowell (1995) found in an analysis of mental test scores that in vocabulary, reading, and writing, there is also higher male than female variance. For oral reading abilities, the same is reported (Reynolds, Hewitt, Erickson, & Silberg, 1996). Lange (2008) analyzed data from several language-related scholastic aptitude tests and comparable programs (Educational Testing Service, n.d.) and could show that in almost all tests, men showed numerically higher variance than women. These findings can be directly translated into hypothesizing that low verbal proficiency will be more detrimental to male than to female mate value, whereas males will benefit more than females from high verbal proficiency in mate choice. This hypothesis will be tested in Study 1 (Chapter 3). An extension of this study will then be conducted in Chapter 4.

2.2.2.3.5 Language in male intrasexual competition

Verbal fitness indicators in general can be used in intersexual selection but also in intrasexual selection to chase off same-sex rivals (Wildgen, 2004). Generally, men's communication is strongly oriented towards competition, dominance, self-assertion, and hierarchy, especially in male-male groups, in order to gain and maintain status (Eckert & McConnell-Ginet, 2003; Guiller & Durndell, 2007; Klann-Delius, 2005; Wildgen, 2004). Moreover, men show higher verbal aggression than women (Archer, 2009) with verbal aggression being positively correlated with body symmetry (Møller & Swaddle, 1997) which proves its evolutionary relevance.

In same-sex communication, men make more commands, claim more speaking time, and interrupt more often than in other contexts (Athenstaedt, Haas, & Schwab, 2004; Klann-Delius, 2005; Makri-Tsilipakou, 1994; Schmid Mast, 2001), which appears to be an appropriate measure to prevent other men from conducting fitness-relevant displays. Lange (in press) showed in a questionnaire study that men in a confrontation with another man try more than women in a confrontation with another woman to win this confrontation by means of language ($t_{(105)} = 2.09$, $p < .02$, one-tailed, $d = 0.43$).

From an evolutionary perspective, all cultural displays are partially shaped by male intrasexual competition (Miller, 1999), which holds also true for ritualized verbal competition such as rapping, which is also dominated by men (Locke & Bogin, 2006; Scalise Sugiyama, 1996). The main goal of rapping is language production as fast and fluent as possible while consisting of many verbal handicaps, such as rhymes, special rhythms, rhythm schemes, and pitch aspects. These special features of rap, such as rhymes and rhythms and their interaction, are subsumed under the term "flow". These features have to be properly delivered, which shows the importance of a good public display (Edwards, 2009; Foley, 1997). Rapping often occurs in the form of duels (so-called "battles") between two young men who fight out their rivalry. In this sense, it is simply a "competitive verbal game" (Foley, 1997, p. 342). In form of such battles, rapping takes place in front of an audience, which shows that such behaviour is probably not only in the focus of intrasexual but intersexual selection as well, at least if women are part of the audience (see Chapter 5). Rapping in freestyle instead of using formerly prepared segments increases the chances for winning. This advantage of language creativity can be expected from an evolutionary perspective. In a rapping game called "signifying", creative handling of words is required, as the goal is to give old words new meanings. Hence, rapping is difficult to be produced and costly. Assertive aggression is especially prominent in a game called "playing the dozens" in which the young male rivals insult and provoke each other (Eckert & McConnell-Ginet, 2003; Foley, 1997). The discipline "dissing" has similar rules and goals. Not everyone is able to participate successfully in these rituals, which thus tell about the qualities of each individual (Steinig, 2007). It is striking that rappers are very aware of the quality of their verbal displays, as most of their rap lyrics are about their own outstanding styles and rhymes. Styles and rhymes of rivals are at the same time devalued. Furthermore, mate choice and sexuality are often aspects of rap lyrics as well, which underlines its evolutionary relevance. Moreover, rappers seem to be aware of the fact that rap is used for positively influencing female mate choice (Lange, 2008; Miller, 2000a). A similar phenomenon is slam poetry which is mostly referred to as competitive poetry

performed in front of an audience and sometimes even compared to "a sports arena" (Kelly Smith & Kraynak, 2009, p. 5). Strikingly, Kelly Smith, and Kraynak (2009, p. 12), probably without being aware of it, describe slam poetry, as if they had taken an evolutionary perspective, when they state that in "the poet-audience relationship, the crowd is the standoffish mate waiting to be wooed by the poet. The poet dances his words in a mating ritual". Again, this phenomenon seems to be intrasexually as well as intersexually selected.

German medieval Minnesingers behaved similar to rapping men, which gives a hint that such verbal displays are not mere "cultural" phenomena but part of human nature (Sager, 1988, 1995). Minnesongs also consisted of many verbal handicaps, such as rhymes, alliterations, metre, and innovative figures of speech (e.g., metaphors) and were explicitly meant to display rhetoric abilities. Most importantly, Minnesingers used their art in direct confrontation with each other. In 12th and 13th century, among Minnesingers there was massive rivalry and many feuds. They had it out with each other by means of public poetic battles in which they tried to outclass each other by demonstrating their verbal virtuosity. The most prominent example for this is the Minnesingers' contest at the German Wartburg in 1206, the so-called singers' war. These competitive elements of Minnesongs were not the exception but most likely the rule (Lange, 2008). Especially important for a discussion on the role of language in male intrasexual competition is that around puberty, when mate choice becomes especially important, boys start to compete with each other in verbal rituals by showing their verbal proficiency (Locke & Bogin, 2006), which indicates that verbal displays are the result of a maturational timetable and thus influenced by biological factors. Testosterone can not only be considered responsible for the fact that men are higher motivated than women to make displays but also for the fact that men are prone to participate in duels with male rivals, also regarding language (Dabbs et al., 1998; Locke & Bogin, 2006). In sum, reviewing the role of language in same-sex interaction supports the basic hypothesis of this doctoral thesis, namely that language is sexually-selected, and provides an important foundation for the comparative study on the sexual selection of verbal displays by means of writing literature (see Chapter 5). In order to elaborate this foundation, the above presented considerations will be applied to the writing of literature in the following review on evolutionary literary and media psychology.

2.2.2.4 Evolutionary literary and media psychology

In this section, the above presented aspects will be applied to art and, thus, shortly summarized. Importantly, the medium language is a crucial element in almost all areas of art (Zaidel, 2010). It is used, for instance, in all forms of literature. And not only language can be considered a human universal (Pinker, 1994) but literature as well, because it has basically been the same for millennia (Nettle, 2005a). This holds true with respect to different forms of literature, such as poetry, narratives, story-telling, and drama (Brown, 1991; Carroll, 2005; Turner, 1999), but also to figures of speech, such as rhetorical speech forms, rhymes, and metaphors, which are all frequently used in several forms of literature and furthermore qualify for being handicaps (Brown, 1991; Locke & Bogin, 2006; Miller, 2000a; Turner, 1999). Rhymes as strong handicaps are decisive for poetic literature. They fix the audience's attention, probably because listeners follow the structure of the rhymes anticipating rhyming words (Bauman, 1975; Jakobson, 1968; Noeth, 1995). The handicap results mainly from a limitation of word choice. If words have to rhyme, only a very limited number of words are a possibility for being used in a rhyming poem at the end of a line (Aitchison, 2006). Thus, a large lexicon is needed to be able to write poetry. Again, the high heritability of lexicon size comes to mind (Bratko, 1996). Moreover, men show higher variance than women regarding lexicon size (Hedges & Nowell, 1995). Analyses of the works of German classical writer Johann Wolfgang Goethe showed that his active vocabulary must have comprised more than 90,000 units (Steinig, 2007), which is far beyond the average active vocabulary size (Aitchison, 2006). These abilities enabled famous writers like him to produce their pieces of literature. On the contrary, male individuals with only 1,000 units of active vocabulary or so would have to struggle to participate in any elaborate communication. So, a writer needs writing talent posited in his big energy consuming and vulnerable brain (Miller, 2000a). Any creative writing is also always playful, for instance, by excessive usage of words, and playfulness in general is a good fitness indicator, as it is simply an indicator of youth and health (Miller, 2000a). Story-telling signals high general intelligence (Miller, 2000a, 2000b).

Moreover, literary displays are time-consuming and do not contribute to mere survival. A writer must have the energy, motivation, and endurance to finish his work. He needs enough time to write, especially if he is producing many works, which means that he must be financially secured. Effort invested in writing literature by means of time spent in the production process actually does influence consumers' judgement. Kruger, Wirtz, Van Boven, and Altermatt (2004) showed that the same poem was perceived to be of higher quality, when

the subjects thought that it was produced within 18 hours than within four hours. However, time invested is not the only criterion (Kruger et al., 2004), because, furthermore, a writer has to acquire certain writing skills based on his basic writing and verbal talent, which is again time-consuming. Wishbow's (1988) study on poets revealed that about one decade of preparation and accumulation of skills is needed before such a major cultural contribution can be done. Therefore, not everyone is able to participate in these activities which help separating the wheat from the chaff.

Generally, fitness-relevant qualities have to be judged. Variance among individuals eases judgement. But strict comparability does so as well. Throughout the history of literature, there have been rules on writing proper literature, such as specific treatises on the art of poetry. The dramatic theory of antique philosopher Aristotle is only one example for many, partially strict sets of rules on writing literature. Even though not all writers obeyed such rules, there has obviously always been the tendency to standardize what literature should be like. Learning these rules is again a handicap. But more importantly, such rules on how a display should look like make it easier for the judging person to distinguish between displayers of different fitness (Miller, 2000a). Generally, any form of ritualization, which is a common feature of cultural production, creates comparability (Miller, 1999), as the review on rapping showed (see 2.2.2.3.5). The overall data seem to suggest a selectionistic advantage of literary art, especially those of high linguistic and literary quality. Considering this, it does not surprise that men are more prone to such cultural displays (Miller, 1998, 1999) and that women, especially ovulating ones, favour creative men (Haselton & Miller, 2006). Thus, the discussion leaves examining only the regular linguistic phenotype, but focusses more on extended phenotypes (Dawkins, 1999). Genes do not only code for usual phenotypes such as hair color but can code for complicated cultural traits which spread more widely than other phenotypes and might reach the brains of others, for instance, by producing verbal art.

However, sexual selection theory is not the only possible explanation for the existence of art. Strikingly, the discussion on the origin of art and, thus, literature reminds of the discussion on the origin of language. For Dissanayake (2000), art is an adaptation which originated from its benefit concerning social cohesion that is by means of natural selection. This perspective is problematic, as producing art necessarily leads to competition among artists and, thus, not to social cohesion (Dunbar, 1996). Competition is more likely a hint that sexual selection is at work (Miller, 1999).

Pinker (1997, 2002) considers art not as an adaptation but as an evolutionary by-product of the mind's architecture. From this perspective, the human mind is the result of natural

selection, but art is not. If Dissanayake and Pinker were completely right, one would expect very small differences between individuals regarding the capacity for cultural production and especially no sex differences. As a matter of fact these differences exist and seem to be large (Miller, 1999, 2000a). For language as an universal ability for acquiring a specific language, natural selection is a plausible explanation (Pinker, 1994). The same applies to language as a social regulative (Dunbar, 1996). Clear and unambiguous verbal instructions might have been beneficial for managing the large human groups in which human brains evolved. But for verbal art, natural selection is not appropriate, as any form of art is too costly and therefore not beneficial for mere survival (Miller, 1999, 2000a). Verbal art is playful, ambiguous, complicated, difficult to understand and even more difficult to produce. That is why literature is perfectly suited for being considered as sexually-selected. Approaches such as the ones by Dissanayake (2000) and Pinker (1997) are not obsolete, but they neglect one decisive feature of evolution, namely differential reproduction by means of sexual selection. Hence, Miller (2000a) plausibly argues that art is an adaptation, but not as the result of natural selection but of sexual selection. Pinker (2002), referring to Miller's work, admitted that art could be both the result of natural as well as sexual selection. Actually, both Miller and Pinker could be right. It seems, for instance, plausible that art was at first a by-product of the naturally-selected human cognitive architecture. But very shortly after, it might have gotten in the scope of sexual selection. So, these approaches remind of the debate whether language is a by-product of human intelligence, an adaptation by means of natural selection or an adaptation created by sexual selection.

Despite this debate, advances in studying the adaptive value of literature exist. Most works in evolutionary literary and media psychology deal with the striking fact that the contents of literature and media in general are shaped by fitness interests and thus also by sexual selection, as gets clear when examining their topics: cooperation and betrayal, aggression, murder, infanticide, fight for resources, love, sex, female physical attractiveness, jealousy, and intrasexual competition (Buss, 2003; Carroll, 2005; Cooke, 1999; Cox, 1999; Dunbar, 1996; Gottschall, 2005; Gottschall, Martin, Quish, & Rea, 2004; Nettle, 2005a, 2005b; Pinker, 1997; Scalise Sugiyama, 2003; Schwender, 2006; Wilson, 2005). Interestingly, even the optimal group size for a conversation, as assumed by Dunbar (1996), namely one speaker and three listeners, can be found in literature. In Shakespeare's plays, there are usually four characters present in a conversation (Stiller, Nettle, & Dunbar, 2003), just as one would have to expect from Dunbar's (1996) considerations about the natural selection of language when assuming that any media content is in principal *mimesis* of real life.

Still, these aspects, even though important for examining media from an evolutionary perspective, might not suffice to explain the existence of books or art in general. The discussion has to be switched from mere content to the relation between producer and recipient, which is useful, because media might cope with evolutionarily relevant problems, but do not necessarily have to in order to enhance the media producer's fitness (Miller, 1999). Taking the perspective of sexual selection, one has to focus on the male story-teller who might display mental abilities and, therefore, use story-telling for his own fitness interests (Miller, 2000a; Scalise Sugiyama, 1996). For examining the relation between art producer and recipient, a short excursus into communication and media psychology is useful, where different forms of media can be distinguished (Frindte, 2001). Primary media are human media, for instance, when individuals talk with each other or when one individual is holding a speech in front of an audience. Primary media work without special equipment. All phenomena which have been examined so far can be subsumed under this category. Secondary media are print media, such as books. Tertiary media are electronic media, such as the telephone. Finally, quaternary media are digital media, such as the internet (Frindte, 2001). The advantage of secondary to primary media is that larger audiences can be reached by secondary than by primary media. Mentioning larger audiences, one might again think about large human groups and male r-strategy. Thus, it becomes obvious that books as secondary media which allow an individual to reach larger audiences than by using primary media alone are relevant for the sexual selection of language.

Therefore, applying the theory of sexual selection to literature, it has to be hypothesized that men, as members of the sex with the higher reproduction variance, are more prone than women to produce literature in order to succeed in intersexual and intrasexual selection, while women preferably consume literature. This sex difference was found in a questionnaire study by Lange (in press). First, participants were presented the following statement which had to be rated: "I have once considered writing a book". Men showed a higher mean value ($t_{(107)} = 1.96$, $p < .03$, one-tailed, $d = 0.40$), as hypothesized. Furthermore, participants rated the following statement: "I like to read novels and other forms of literature such as plays". For this item, women showed the higher mean value, again as hypothesized. Furthermore, this sex difference was large ($t_{(106)} = -4.98$, $p < .001$, one-tailed, $d = -1.02$). Therefore, the relation between supply and demand which can be expected from an evolutionary perspective is found. The scheme that men are telling stories and women are judging them is a common one across cultures. Not only is public speaking dominated by men, but also public performances

of verbal art in order to impress women (Locke & Bogin, 2006), as the review of rapping and minnesongs showed (2.2.2.3.5).

Moreover, one would expect to find that the majority of literature is produced not merely by men, but furthermore mainly by men at reproduction-relevant age, because sexual selection is the strongest, when reproduction is the most important life effort (Alexander, 1987). Miller (1999) found that for books, but also for paintings and jazz music, men are dominating the respective art and that there is an age peak between 30 and 40 years of age. He analysed 2,213 books listed in the *Writer's Directory* and could show that 78.6% of the books in it were written by men with an age peak of around 40 years. From the 229 writers who produced these books, only 49 were female, which supports evolutionary assumption on literature, as a non-biological explanation of literature would have to assume that literature is produced (1) equally by men and women and (2) in older ages, as the experience as a writer should be the highest then. In Miller's (1999) analysis, women had their age peak in later ages than men, which might be explained by female story-telling to their children, nieces and nephews, and grandchildren (Miller, 2000a). Kanazawa (2000) could basically replicate Miller's findings for the production of scientific research. Before Miller and Kanazawa, several scientists had already found that several creative activities, such as being a scientist or a composer, peak at 30 to 40 years of age with a slow decrease after that age (Hayes, 1989; Sternberg & Lubart, 1991). This slow decrease is what can be expected if linking motivation for such activities to testosterone which also shows a slow decrease from the age of 30 on (Meletis & Wood, 2009). These findings support the claim that cultural activities, such as the production of literature, are acted on by sexual selection. This ultimate perspective is a necessary addition to the generally dominating approach which explains the production of literature by proximate mechanisms alone (Scalise Sugiyama, 1996), such as motivational aspects, without explaining, why motivations to create literature exist in the first place and why this motivation is higher in men and has obviously always been. One could even assume that literature might be relevant in the sense of the sexy son hypothesis (Buss, 2008; Dunbar, 1996; Miller, 1999, 2000a). Actually, Dunbar (1996, p. 190) labels Miller's approach the "poetic males hypothesis", and considers it as a form of the sexy son hypothesis. This will be addressed in Study 3 in Chapter 5.

In sum, several research results suggest that language and verbal displays serve as fitness indicators. However, some research gaps remain which should be filled by the research in the following chapters. How large these gaps are might get obvious when simply considering how much research from the perspective of sexual selection even exists on

paraverbal features of language (e.g., Collins, 2000; Feinberg, Jones, Little, Burt, & Perrett, 2005; Grossman, 1985; Hughes, Harrison, & Gallup Jr., 2002; Hughes, Patizzo, Gallup Jr., 2008; Pipitone & Gallup, Jr, 2008; Puts, 2005; Puts, Gaulin, & Verdolini, 2006; Saxton, Burriss, Murray, Rowland, & Roberts, 2009; Vukovic et al., 2010; Wells, Dunn, Sergeant, & Davies, 2009) compared to research on the sexual selection of language itself.

3. Study 1 – Verbal proficiency as mate choice criterion

This chapter introduces experimental research on verbal proficiency as a mate choice criterion. To my knowledge, no such study exists. Findings from self-reports using questionnaires (Lange, in press) resulted in inconsistent findings. Hence, an experimental design is required to gain clearer data.

3.1 Research questions and hypotheses

If sexual selection explains several features of human language, high verbal proficiency should increase a person's mate value. Oksenberg, Coleman, and Cannel (1986) showed this effect but without using an experimental design. Instead, they had judges rating the voice and language usage of their probands and found that speaking skills in general but also speech rate substantially correlated with general attractivess (rs > .53). The results of the current experiment should be in accordance with their findings.

More importantly, verbal proficiency should increase male mate value significantly more than female mate value due to assumed past sex-different selection pressures (Trivers, 1972). These were the two main hypotheses. It was also expected that men would be rated lower on average than women irrespective of verbal proficiency, because women are more demanding in mate choice than men on average (Buss, 2003, 2008).

Regarding sex differences, more specific hypotheses were formulated. Men should consider a woman's verbal proficiency more if they are about to choose her as a long-term mate than as a short-term mate, because if men limit themselves to monogamy, they should be almost as choosy as women (Buss, 2003, 2008). With respect to short-term mating, one could go as far as to claim that if a woman is young and physically attractive, her verbal proficiency, even if very low, should not affect her mate value very much or even at all.

Women distinguish between long-term and short-term mates as well (Buss, 2003, 2008). However, it is difficult to formulate a hypothesis for female mate choice with respect to differences between short-term and long-term mating. On the one hand, if considering verbal proficiency as relevant in the sense of the sexy-son hypothesis or as an indicator of "good genes" (Dunbar, 1996; Miller, 2000a), it could be hypothesized that women will rate high verbal proficiency in males on average higher for short-term than for long-term mating. On the other hand, one could hypothesize that women will give equal ratings for both relationship types or will give even higher ratings pertaining to long-term mating because

male verbal proficiency is not only universally linked to status (Brown, 1991) but also to education and income, which are important female mate choice criteria especially regarding long-term mating (Buss, 1989b, 2003, 2008). General IQ, which is assessed by word knowledge among other features, and verbal intelligence are strong predictors of education and income (Kanazawa, 2008; Rowe & Vesterdal, 1998). Years of school correlate highly with verbal intelligence, even higher than with nonverbal intelligence (Ceci & Williams, 1997) with education being also predictive of income. Furthermore, these correlations are in part genetically mediated (Rowe & Vesterdal, 1998). So, as there were equally good reasons for any of these two hypotheses, no single hypothesis was favored over the other one in this respect. The answer was planned to be simply given by the data.

3.2 Methods

As research method, a laboratory experiment was chosen in which videos with three different levels of verbal proficiency were used as stimuli. Investigation method was a post-experimental questionnaire.

3.2.1 Experimental design and planned statistical analyses

The first main hypothesis was that high verbal proficiency as independent variable (IV) increases, whereas low verbal proficiency decreases mate value (main effect of verbal proficiency). The dependent variable (DV) was, thus, attractiveness rating.

Generally, to test the main effect of verbal proficiency, three groups of the IV and, thus, three experimental conditions existed that is three levels of verbal proficiency in form of three video clips. These were meant to be presented to the participants. Besides verbal proficiency, sex was also considered a factor, which was due to the second set of hypotheses which was that men benefit more form high verbal proficiency with respect to their mate value than women, but also that low verbal proficiency has a larger detrimental effect on male than on female mate value (interaction effect between verbal proficiency and sex). However, even though attractiveness ratings by women were expected to be more variable than male ratings of female performance, female ratings were also expected to result overall in lower ratings than male ratings (main effect of sex) because of higher choosiness on average in the female sex (Buss, 2003; Trivers, 1972). Table 1 shows the experimental design, which resulted from

these hypotheses. (Note: In the following, if sex is mentioned, it refers to the sex of the rated person, unless stated differently.)

Table 1. Experimental design.

	Verbal proficiency		
	Low	Medium	High
Sex of the rated person			
Male			
Female			

Because each participant was involved in only one condition of the three-condition design, the design was a between-subject design. A three-tiered between-groups analysis of variance (ANOVA) was planned to be carried out in order to test the hypotheses. Doing so, the mean values of the three groups were meant to be compared with each other. To be precise, it should be tested if the variance among all groups was significantly larger than the variance within each group (Haslam & McGarty, 2003; McQueen & Knussen, 2006). As the sex effect was also supposed to be tested, the ANOVA was a two-factorial one resulting in a 2 (male, female) x 3 (three levels of verbal proficiency) design.

Using partial eta-squared (η_p^2) as an effect size measure, it was planned to determine how much of the variance of the DV could be attributed to different verbal proficiency as the factor (i.e., the IV), with the effects of all other factors being partialled out. According to Cohen (1988), η_p^2-values of .01 are small, those of .06 are moderate and those of .14 or above are large.

3.2.2 Participants

Participants were students (most of them minoring in psychology) at the University of Kassel. Female participants were only included if their age ranged between 18 and 29 years of age (*M* = 22.6, *SD* = 2.1, median and mode = 23). This restriction was imposed, because the actor in the video clips claimed to be 27 years of age. The consideration was as follows. As women favor men of their age or older (Buss, 1989b), it seemed necessary to make sure that female participants were not too much older than the man in the video. Otherwise, older female

participants could have felt unable to give proper ratings (see Gangestad, Simpson, Cousins, Garver-Apgar, & Christensen, 2004, for a similar procedure to cope with participants' age). However, it was decided to make the female age cut-off not at a lower age (e.g., 27 or younger) for two reasons. The higher the limitation with respect to participants' age, (1) the lower the external validity of the obtained data would have been and (2) the harder it would have been to manage to recruit the afforded number of participants.

For male participants no such restrictions were applied to the recruitment procedure, simply because men of all ages prefer young mates. To be precise, they prefer women who show a peak of fertility or a peak of reproductive value, which is roughly in women's 20s (Buss, 2008). As the actress in the video clips said to be 22 years of age and hence was very young, there was no need to exclude any men willing to participate. Even male participants of 18 years of age were admitted, because very young men prefer female mates who are several years older than themselves (Kenrick, Keefe, Gabrielidis, & Cornelius, 1996). Hence, male participants' age ranged from 18 to 54 years of age ($M = 25.2$, $SD = 5.3$, median = 24, mode = 22).

Concerning sample size, a power analysis was conducted. The experiment should be able to detect the assumed effects with statistical significance that is statistical conclusion validity should be sufficient (Simpson & Campbell, 2005). Assuming statistical significance with $p < .05$, then β error should not be higher than 20% (Cohen, 1988). Hence, statistical power should be higher than 80% that is the probability to find the hypothesized main effect of verbal proficiency, if it actually exists, should be at least 80%. GPower 3.1.2 (Faul, 2009; Faul, Erdfelder, Lang, & Buchner, 2007) was used during the conduction of the experiments to calculate the finally needed total sample size in order to detect the main effect of verbal proficiency with a probability of 80%. Settings in GPower 3.1.2 were: F-test; ANOVA, fixed effects, omnibus, one-way; medium effect size ($F = 0.25$); α error probability = .05; power = .80; number of groups = 3. The option "one-way" was chosen, as the design included only one measurement and no repeated measures. A medium effect was expected, because if there are no reasons to do otherwise, medium effects should be assumed instead of extremely large or extremely small ones. Expecting a medium effect of $F = 0.25$, the total sample size should have been $N = 159$ for a power of 80%. For $F = 0.30$, a total sample size of $N = 111$ would have sufficed. The sample size used for the experiment was within these calculations, because each of the three groups included 46 participants (23 males, 23 females), amounting to a total sample size used of $N = 138$ (69 males and 69 females) for the actual experiment. This sample size suffices to find a medium effect of $F = 0.25$ with a statistical power of 74%. For an $F =$

0.30, statistical power would be 88%. For detecting the other assumed effects apart from the main effect of verbal proficiency, such as the interaction effect between verbal proficiency and sex, the total sample size would have needed to be slightly higher ($N > 170$) according to further power calculations. However, the used sample size ($N = 138$) was considered to be sufficient, as it seemed difficult to recruit even more participants than had already been recruited. As it was planned to play each video with tone as well as muted to the participants (see 3.2.3.2), the planned total sample size was doubled ($N = 276$). It is important to note that it was planned that the videos with the male performance would only be rated by women and vice versa, because if doing otherwise, twice as many participants would have been needed, which seemed unrealistic to achieve.

The participants had been offered several forms of rewards: contribution to the course credit of two of Professor Euler's lectures / seminars at the Institute of Psychology at the University of Kassel, namely "Introduction to Psychology" ($n = 92$) and "Evolutionary Psychology" ($n = 69$); contribution to the course credit of my seminars there, namely "Communication and Media Psychology" ($n = 9$) and "Psychology of Language" ($n = 20$); experiment credits which were requirements for students minoring in psychology at the University of Kassel ($n = 78$); participation in a lottery, where four gift certificates could be won ($n = 8$). Acquisition of the participants was done by advertising the experiment directly in the mentioned lectures and seminars and by notices on the bulletin boards of the Institute of Psychology at the University of Kassel, as well as on its main website and my website. Additionally, postings in several internet forums were done to advertise the experiments. For the recruitment of the subjects participating in the experiments using the muted videos (see 3.2.3.2), the procedure was likewise.

3.2.3 Materials

3.2.3.1 Independent variable and the operationalization of verbal proficiency

Several different expressions are used for the idea of verbal proficiency for which "verbal abilities" is often used as a synonym (e.g., Barling, 1979; Wallentin, 2009). Verbal proficiency can also be considered to be synonymous to language competence or communicative competence (Chomsky, 1965; Wallach, personal communication, February 5, 2010) and, thus, as the foundation of actual verbal performance. In sum, verbal proficiency can be considered a complex one consisting of several abilities, such as vocabulary size and

grammatical complexity, but also other abilities which are considered to be aspects of verbal IQ, such as verbal comprehension and verbal fluency, or aspects of linguistic creativity (Barling, 1979; Kaufman, Kozbelt, Bromley, & Miller, 2008; Kemper & Sumner, 2001; Rosenberg & Tunney, 2008; Torrance, 1974; Wechsler, 1958, 1981).

For the operationalization of such a trait which is difficult to define, reliance on face validity seems unavoidable. Hence, the video clips should be appropriate so that the experimental design apparently measures what can be considered prototypical verbal proficiency that is the three different performances in the video clips should represent different levels of verbal proficiency. However, it was tried to assure a high construct validity of verbal proficiency as well, for which several linguistic features were chosen to be mainly underlying this concept to start with, namely (1) lexical diversity, (2) grammatical / morpho-syntactical complexity, (3) aspects of speech fluency and (4) additional linguistic features related to sophisticated language use and linguistic faultiness, because most of these features can be measured objectively (see below) and, in case of grammar and the lexicon, represent major areas of the whole linguistic system.

3.2.3.1.1 Lexical features

There were several more reasons for choosing lexical diversity as a key aspect of verbal proficiency. Sexually-selected traits show higher heritabilities than naturally-selected ones (Miller, 1998, 2000a, 2000c; Miller & Todd, 1998). Hence, linguistic traits with high heritability seemed especially appropriate for the operationalization of verbal proficiency. And lexicon size is highly heritable (Bratko, 1996).

Additionally, several scientists define verbal proficiency especially by means of lexicon size and lexical diversity (e.g., Barling, 1979; Kemper & Sumner, 2001; Luo, Luk, & Bialystok, 2010). Furthermore, vocabulary size highly correlates with intelligence (Kemper & Sumner, 2001; Wechsler, 1958), while IQ is strongly relevant in mate choice (Feingold, 1992) and correlates with general fitness (Miller, 2000a, 2000b). Accordingly, men use vocabulary for display in mate choice (Rosenberg & Tunney, 2008).

Finally, variance in lexicon size in an experimental design is obtained easily, because only three at least partial synonyms of one semantic concept have to be found which represent different levels of lexical elaborateness (see Table 2 for an example). Hence, it seemed logical to distinguish the three levels of verbal proficiency by means of vocabulary size (see Figure 1). Level 1 was very limited with respect to vocabulary, such as by using high-frequent

words, such as "haben", instead of more specific, low-frequent ones. Level 3 was characterized by elaborate word choice, as several low-frequent lexemes were used, such as "exorbitantly" (see Table 2 and Appendix 1), which is moreover a foreign word in German. Such vocabulary differences result in different type-token ratios (TTR), which is an objective measure for the number of different lexical items and, thus, lexical diversity. This ratio is calculated by dividing the number of different word forms by the number of all words (Kemper & Sumner, 2001; Templin, 1957). Thus, TTR is a good and objective measure of lexical diversity of the texts used in the experiments. Alternatively, it could be checked for the mean word length (WL) of each level because of the assumption that the higher verbal proficiency is, the longer the words are, for instance, by means of composition (e.g., "Bücher übers Kochen" vs. "Kochbücher", see Table 2, Appendix 1, and 2.2.2.3.2). Both measures (TTR and WL), however, highly correlated with each other ($r = .99$; $p < .001$).

Table 2. Operationalization of verbal proficiency with respect to lexical features.

	Level 1	Level 2	Level 3
Example for lexical diversity	Limited vocabulary: e.g., *total viel* (≈ *that very much*)	Normal vocabulary: e.g., *übertrieben viel* (≈ *extremely much*)	Elaborate vocabulary: e.g., *exorbitant viel* (≈ *exorbitantly much*)
Lexical diversity as measured by type-token ratios (TTR)	Low TTR: .49	Medium TTR: .60	High TTR: .76
Word length (WL)	e.g., *Bücher vom Kochen*	e.g., *Bücher übers Kochen*	e.g., *Kochbücher*
	4.17 letters / word	5.00 letters / word	5.78 letters / word

Table 2 shows the operationalization of verbal proficiency regarding lexical features with reference to the actual texts which were used for producing the video clips (see Appendix 1).

3.2.3.1.2 Grammatical features

Concerning grammar, the following considerations were relevant. Syntax and grammatical structures are those features of language which distinguish *Homo sapiens sapiens* and other species the most with respect to communication (Hauser, Chomsky, & Fitch, 2002). Syntactical abilities are also comparably highly heritable (Stromswold, 2001). Additionally, grammatical complexity seemed to be important, as grammar is the highest area of the linguistic system basically including all other areas (Kemper & Sumner, 2001). Ehrlich and Millet (1979), for instance, assessed verbal proficiency using tests on mastering syntactical structures. Apart from complexity, mere sentence length seemed appropriate for operationalizing verbal proficiency (Kemper & Sumner, 2001; Nippold, 1993), because not only vocabulary size highly correlates with IQ but also number of clauses per utterance (Kemper, Kynette, Rash, Sprott, & O'Brien, 1989). Accordingly, in research on language acquisition, mean length of utterance (MLU) is considered one diagnostic measure for language proficiency, especially regarding syntax. The mean length of an utterance is either determined by the number of words or the number of morphemes in an utterance, whereas a word in most cases is a morpheme but not necessarily vice versa (Aitchison, 2008; Field, 2004). It seemed logical that also in adults long utterances are rather a feature of high verbal proficiency than short ones. In line with this idea, MLU is not only assessed in children, but in adults as well (Nippold, Ward-Lonergan, & Fanning, 2005). Long utterances, for instance, should be more error-prone than short ones, making them better handicaps in the Zahavian sense (Zahavi, 1975). Hence, for the three levels of verbal proficiency, the lengths of the sentences were varied with the shortest sentences on level 1 and the longest on level 3. To cover this feature, emphasis was simply put on different MLU values, which were calculated by dividing the number of morphemes by the number of utterances for each of the three levels. Different opinions are possible about the question which linguistic entities to count as a morpheme and as an utterance. Hence, another scientist and I counted the numbers of morphemes and utterances of each of the three levels independently from each other. For utterances, both countings resulted in exactly the same numbers. But with respect to counting the morphemes, there was a notable difference. Whereas the other scientist tried maximum

segmentation of words into morphemes, I segmented the words more conservatively into morphemes. Hence for the first counting, the number of morphemes was higher than for the second one. However, the results of both countings differed not tremendously from each other, as still good inter-rater reliability was given (Cronbach's $\alpha = 0.87$). Hence, for calculating the actual MLU values, the means of both countings were used. The MLU values were 12.24 for level 1, 13.80 for level 2 and 27.00 for level 3, which means that for level 1 there were about 12 morphemes per utterance on average, and so forth. In sum, contradicting Miller (2000a, p. 369), it seemed possible to measure grammatical complexity given that morphemes in an utterance can be free lexical morphemes (e.g., language) as well as bound grammatical ones (e.g., -s in languages) while the latter ones necessarily increase grammatical complexity. Figure 1 gives a graphical summary of the differences between the three levels of verbal proficiency with respect to the lexical and grammatical features. As can be seen, the three levels ostensibly differ regarding the three objective markers of verbal proficiency.

Figure 1. Differences between the three levels of verbal proficiency with respect to lexical and grammatical features.
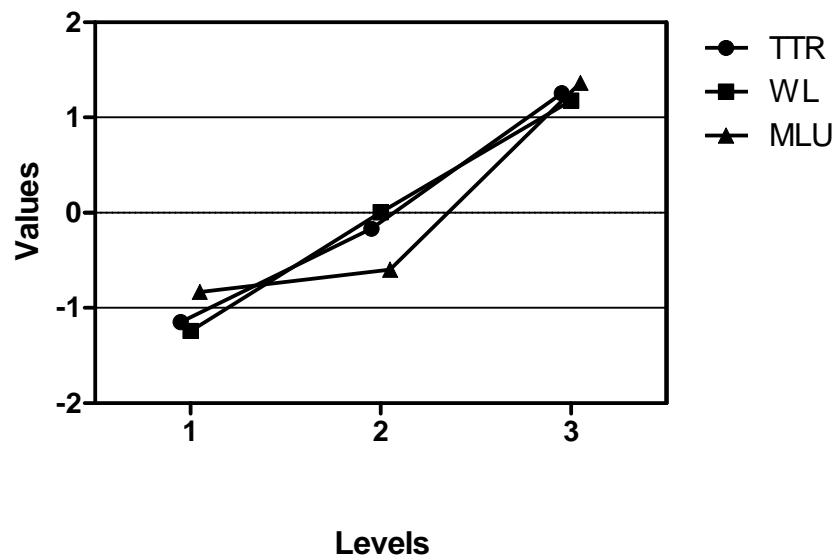
Note: z-transformed values are given for type-token ratio (TTR), mean word length (WL), and mean length of utterance (MLU). Data units are nudged to prevent overlap.

3.2.3.1.3 Language fluency

Apart from grammar and the lexicon, aspects of language fluency were considered, for which high heritability estimations can be found as well (Bratko, 1996). These aspects could be considered to include the ability for fluent word production but also syntactic flexibility and

complexity (Bratko, 1996; Kimura, 2000; Klann-Delius, 2005). In the definition of verbal proficiency, fluency is considered one decisive aspect by several scientists (e.g., Kemper & Sumner, 2001; Luo, Luk, & Bialystok, 2010).

Fluency is impaired in people who stutter. And the liability for stuttering is also highly heritable with $h^2 = .71$ (Andrews et al., 1991). Furthermore, stuttering seems to have a strongly detrimental effect on mate value (Zhang et al., 2009). Hence, it seemed useful to consider fluency in the operationalization of verbal proficiency as well. Moreover, verbal fluency is the only feature of human language which shows considerably higher heritability for males than for females (Hall, 1997). Most importantly, fluent and fast speech is error-prone, thus hard to feign and therefore supposed to be a good handicap. Accordingly, fast speech is associated with intelligence (Kaufman et al., 2008; Miller, Maruyana, Beaber, & Valone, 1976) and high social status (Oksenberg et al., 1986), while many pauses in speech are negatively perceived (Lalljee, 1971). Another advantage of considering fluency additionally to lexical and grammatical aspects existed. Whereas grammar and the lexicon belong to language competence even though influencing performance, fluency in actual speech is more likely part of language performance, and it is the actual performance which is in the scope of selection after all.

Thus, absence of disfluencies was also considered a feature of verbal proficiency. Hence, level 1 consisted of many markers of disfluency, level 2 of fewer ones, while level 3 was supposed to be completely fluent. Interjects (e.g., "uh") or unfinished words and sentences were considered to be features of disfluency. Thus, one possibility to quantify disfluency was simply to count all such markers of disfluency, such as "uh" (German: "äh"), which was done first. However, a more elaborate procedure was conducted additionally. The PC program CSSS-2, a scoring tool for the fourth edition of the stuttering severity instrument (SSI-4, Riley, 2009), was used to determine the disfluency of the speech performances of each video. Generally, CSSS-2 is used to determine the number of syllables and the number of stutterings for the respective voice sample in order to calculate the percentage of stuttered syllables (%SS). Although the three levels of verbal proficiency were not meant to merely cover stuttered versus non-stuttered speech, this procedure seemed useful, because CSSS-2 is simply a helpful tool to count disfluencies and to calculate the percentage of disfluent syllables, which was done for each of the three levels using the final videos (see below). Male and female videos were investigated separately. Hence, for each of the three levels, two countings were conducted. The mean scores of them were then used to calculate %SS. Correlating the number of disfluencies (e.g., "uh") with the values obtained by CSSS-2 (%SS)

showed that both measures were almost equal ($r = .998$; $p < .001$), which does not surprise, as both measures are basically alike. Because the CSSS-2 measure is generally the more elaborate one, only the values for %SS will be reported.

Additionally, speech rate was calculated using CSSS-2, for which simply the number of syllables per minute (SPM) was calculated for each of the three levels, which was done under the assumption that high speech rate is also associated with attractiveness (Oksenberg et al., 1986).

Table 3. Operationalization of verbal proficiency with respect to fluency.

	Level 1	Level 2	Level 3
Example for disfluency	Disfluency: *Ich habe grade mein … äh … Studium erfolgr … äh … mit Erfolg fertig gemacht (≈ I have just finished my … uh … studies succ … um … with success.)*	Medium fluency: *Ich habe gerade mein Studium erfolgreich beendet. … Äh… (≈ I have just finished my studies successfully. … Um…)*	High fluency: *… habe gerade mein Studium erfolgreich abgeschlossen … (≈ I have just finished my studies successfully.)*
Percentages of stuttered syllables (%SS)	High %SS: 11.1	Medium %SS: 4.9	Low %SS: < 0.5
Speech rate measured by syllables per minute (SPM)	Low SPM: 2.51	Medium SPM: 3.45	High SPM: 4.25

Table 3 gives the numbers which were obtained by the above described procedures and illustrates the differences between fluent and disfluent speech by means of one concrete example from the actual texts (see Appendix 1). The example presented in Table 3 ("I have just finished…") shows that on level 1, speech is charecterized by a so-called telegram style, while the other levels are more fluent. Figure 2 gives a graphical summary of the differences between the three levels of verbal proficiency with respect to fluency and speech rate. As can be seen again, the three levels obviously differ regarding the used markers of verbal proficiency.

Figure 2. Differences between the three levels of verbal proficiency with respect to fluency.
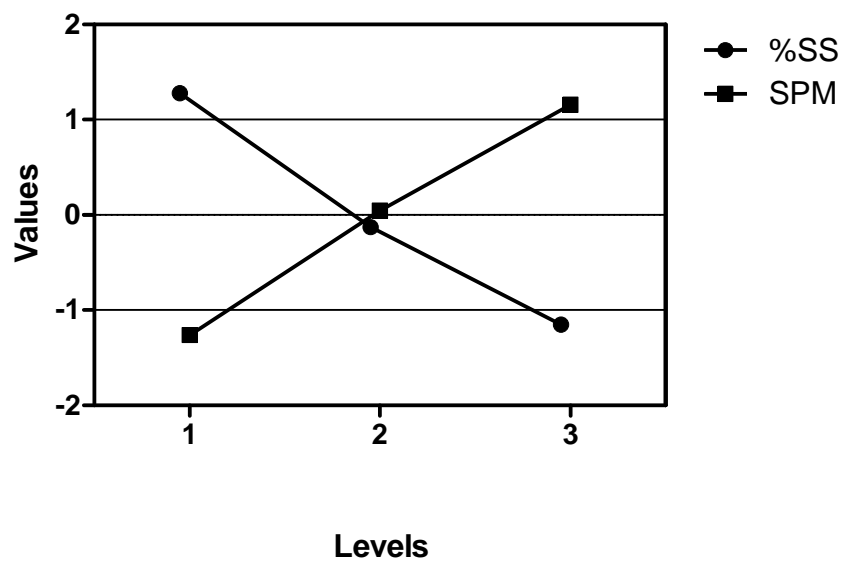
Note: z-transformed values are given for percentage of stuttered syllables (%SS) and speech rate measured by syllables per minute (SPM). Data units are nudged to prevent overlap.

3.2.3.1.4 Linguistic faultiness

Generally, error-freeness should be a feature of verbal proficiency on all linguistic levels (phonetic / phonological, lexical and morphological / syntactical). Therefore, for level 1 several partially severe errors were integrated, while level 3 remained error-free (see Table 4).

Table 4. Operationalization of verbal proficiency by means of presence or absence of phonetic / phonological and morphological / syntactical errors.

Linguistic level	Level 1	Level 2	Level 3
Phonetic / phonological	Cacoepy: *am Amfang* (≈ *in the bebinning*); the cacoepy is here the result of a total progressive assimilation	No cacoepy	Enunciation: *Am Anfang* (≈ *in the beginning*)
Morphological / syntactical	Wrong congruency: *Ich bin wahnsinnig gerne unter Leute;* nominative *Leute* is used, but the accusative *Leuten* would be correct; no English equivalent	Correct congruency	Correct congruency

3.2.3.1.5 Different codes

Sociolinguistic theories on different forms of verbal communication are a valuable addition to the operationalization of verbal proficiency. Bernstein (1962a, 1962b, 1971, 1972) distinguished between elaborated and restricted codes of verbal communication. He described the restricted code using the following features: short, simple and often incomplete sentences, and restricted lexicon. In order to confirm understanding or to emphasize the content of an utterance, amplifications at the end of a sentence are used, such as "right?" or "you know?" These are phrases which negatively affect lexical richness (McCarthy, 2005; Singh, 2001). On the contrary, elaborated code is characterized by grammatical correctness, frequent use of passive sentences, and large lexicon size. Bernstein's distinction between different codes matches very well the above mentioned features of verbal proficiency or unproficiency, respectively. Bernstein took a social-constructivist perspective. However, his theory can be

used in an evolutionary framework, because what counts is that Bernstein described what seems to be perceived as bad or good language performance. Table 5 shows the operationalization of verbal proficiency regarding these code-related linguistic features with reference to the actual texts which were used for producing the video clips (see Appendix 1).

Table 5. Operationalization of verbal proficiency with respect to differences between restricted and elaborate code.

Linguistic feature	Level 1	Level 2	Level 3
Syntactical: Restricted vs. elaborate code	Only active sentences: *Mein Chef hat mich bisher meistens gut gefunden (≈ So far, my boss has mostly thought I was good.)*	Only active sentences	Passive sentence: *Bisher wurde ich von meinem Chef überwiegend positiv bewertet (≈ So far, I have been judged prevailingly positive by my boss.)*
Style: Restricted vs. elaborate code	Amplification: *…, ne?! (≈ …, right?! or …, you know?!)*	No amplification	No amplification

3.2.3.1.6 Production and pre-rating of the video clips

In sum, it was tried to implement each linguistic feature which, according to several linguistic, psycholinguistic and psychological works and evolutionary assumptions, seemed appropriate to distinguish between different levels of verbal proficiency. Thus, content validity could be assumed to be high. All of these considerations were the foundation for the texts which were used for the videos (see Appendix 1). They had identical content but systematically differed with respect to verbal proficiency. Thus, it was tried to make sure that all procedures were alike for all experimental conditions except for the critical manipulation

of the IV in order to test if this manipulation would have the predicted causal effect on attractiveness ratings. Regarding content, the texts should appear to be a self-presentation suitable for a mate choice context. Information was given by the actor and the actress on their age, education, career and prospects, income, several hobbies, and attitudes. Hence, the content basically consisted of mate choice-relevant elements, as mentioned in 2.2.2.3.1.

The three versions of the text were performed in front of a camera. Because of the hypothesized effects of the variable sex, the three versions of the text were performed by an actor and an actress each and filmed on video. The result were six video clips with running times ranging between 55 and 89 seconds, depending on different speech rates (see 3.2.3.1.3). In order to prevent distraction from their performances, the shooting was done in front of a white wall in my office. Thus, uniform colour background was guaranteed. Furthermore, consistent lighting was provided.

These recordings were done using a Panasonic SD Camcorder (model SDR-S100). Distance between actor/actress and camera was approximately two meters. Zooming was used to make sure that both actor and actress were filmed upwards from hip or thighs to head. It was made sure that picture quality was proper (codec: mpegv; resolution: 720x576; frame rate: 25) and especially that audio was of high quality (codec: mpega; channels: stereo; sampling rate: 48000 Hz; bit rate: 224 kb/s). The six video clips can be retrieved under: http://univideo.uni-kassel.de/user/bplange (password: verbal).

After the recording sessions and after editing the video clips, a pre-rating of the videos was done in a pilot study in order to make sure that verbal proficiency was properly operationalized that is that the three levels were actually perceivable as being different with respect to verbal proficiency. Participants (15 men, 49 women), mainly colleagues at the universities of Kassel and Frankfurt / Main as well as students from my seminars at the University of Frankfurt / Main, namely "Psycho- and Biolinguistics" (Department of Linguistics and Cultural Sciences) and "Evolutionary Psychology and Evolutionary Medicine" (Department of Medicine), were presented one of the six video clips, according to their sex. Male participants watched one of the videos with the female performance, female participants one of the videos with the male performance. They did not know that three levels existed, that is three videos for each sex. Then they were asked to rate the verbal proficiency of the respective performance using a 9-point rating scale from 1 (*low*) to 9 (*high*). They were given anchors as a help for their judgement (see the German instruction and the scale for this pre-rating in Appendixes 2 and 3).

Of major importance was to make sure that the three levels resulted in ordinal data that is an order with level 1 having the lowest and level 3 the highest score. This ranking was found. Total ratings ($N = 64$) were as follows. Level 1: $M = 2.52$ ($SD = 0.98$), level 2: $M = 4.33$ ($SD = 1.39$), level 3: $M = 6.64$ ($SD = 0.95$) with sufficient inter-rater reliability (Cronbach's $\alpha = .74$, $p < .001$). Mean values and the results of a *t*-test for independent samples suggested that the difference between level 1 and level 2 ($t_{(40)} = 4.87$, $p < .001$, two-tailed, $d = 1.50$) was smaller than the one between level 2 and level 3 ($t_{(41)} = 6.63$, $p < .001$, two-tailed, $d = 1.94$). Figure 3 shows all ratings.

Figure 3. Results of the pre-rating of the videos on a 9-point rating scale from 1 (*low*) to 9 (*high*) using mean values, by sex of the rated person.
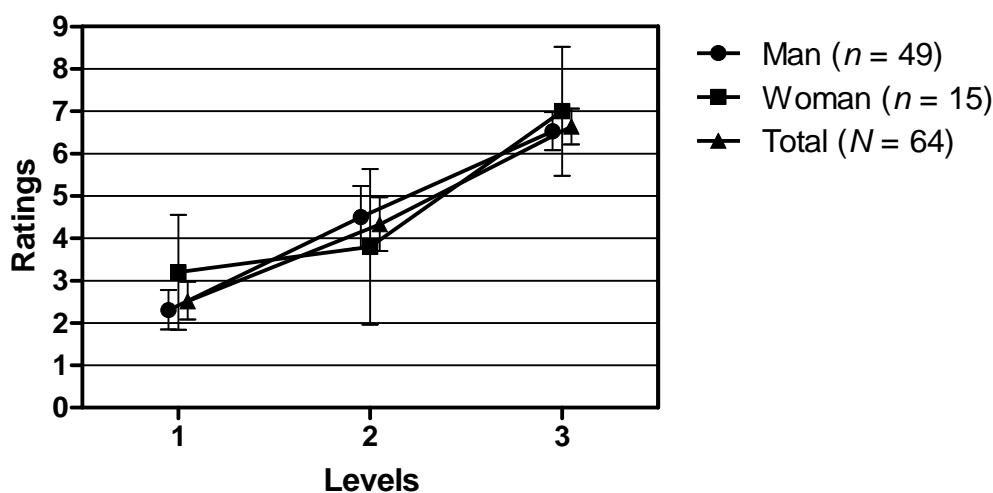
Note: Given are mean values and error bars showing 95.0% CI of mean. Data units are nudged to prevent overlap.

Furthermore, Pearson correlation coefficients (two-tailed) were computed between these ratings and the values of the above mentioned objective markers of verbal proficiency (type-token ratio, mean length of utterance, stuttered syllables and speech rate measured by syllables per minute). Table 6 shows the results.

Table 6. Pearson correlation coefficients (two-tailed) between the pre-ratings of verbal proficiency and the values for the objective markers of verbal proficiency.

TTR	WL	MLU	%SS	SPM
$r = .84$ ***	$r = .84$ ***	$r = .79$ ***	$r = -.83$ ***	$r = .83$ ***

Note: The markers of verbal proficiency are: type-token ratio (TTR), mean word length (WL), mean length of utterance (MLU), stuttered syllables (%SS) and speech rate measured by syllables per minute (SPM)
*** $p < .001$; for all correlation coefficients, $df = 62$

In sum, it could be concluded that verbal proficiency was properly operationalized. (1) The three levels differ with respect to five objectively measurable markers of verbal proficiency. (2) The pre-rating shows that the three levels are considered different with respect to verbal proficiency by the raters with good within-group consistency. (3) These ratings highly correlate with high statistical significance with the five objective markers of verbal proficiency referred to under (1).

3.2.3.2 Possible confounding variables

Several possible confounding variables (e.g., different room temperatures or differences in reading the instructions to the participants) were tried to keep constant. Still, one potentially severe problem needed to be taken care of, namely subconsciously different nonverbal performances of the actor and the actress according to the level of verbal proficiency they were performing, apart from actual language differences. In other words, it seemed possible that the actor/actress performed level 1 subconsciously in such a manner to appear especially unattractive or dislikable by nonverbal means (e.g., mimics, gestures or body movements) just because of somehow knowing that he/she was performing level 1 and that level 1 was hypothesized to result in low ratings. As such nonverbal communication plays an essential role in mate choice (for an overview, see Hugill, Fink, & Neave, 2010), it needed to be made sure that there was no such confounding of variables. Hence, the video clips were not only planned to be played with tone to 138 male and female participants who built the experimental group but also in a muted version to the same number of participants who were, thus, the control group (see 3.2.2; see Appendix 6 for the used instruction). Thus, it was intended to measure what the experiment was not meant to measure, namely attractiveness of nonverbal behavior. By this procedure, the experiment's validity should be increased that is it should be made sure that the experiment measures what it is supposed to measure, namely attractiveness according to different levels of verbal proficiency. For the rating of the muted versions, the questionnaire used for rating the regular versions of the videos in the main experiment was used (see Appendix 4 and 3.2.3.3 and 3.2.4 for further details). Figure 4 shows the total attractiveness ratings (mean values of the ratings for short-term and long-term attractiveness) on a 9-point ratings scale from 1 (*low*) to 9 (*high*) of the muted versions of the videos.

Figure 4. Total attractiveness ratings for the muted versions of the videos on a 9-point rating scale from 1 (*low*) to 9 (*high*) using mean values, by sex of the rated person.
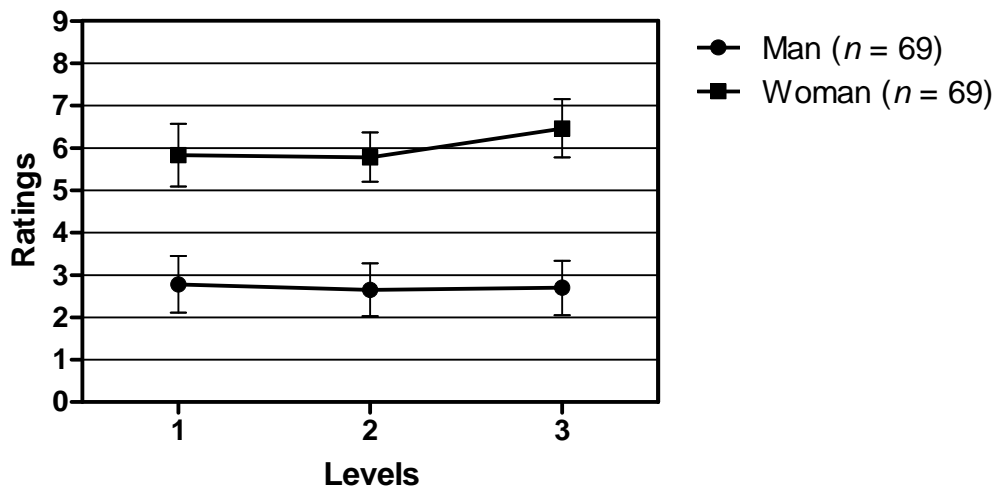
Note: Given are mean values and error bars showing 95.0% CI of mean.

Data from a 2 (sex) x 3 (level) ANOVA showed that for the three levels (muted), there was no significant effect ($F_{(2, 132)} < 1$) that is all videos were alike apart from differences pertaining to verbal proficiency. Also no significant interaction effects between sex and the levels (muted) were found ($F_{(2, 132)} < 1$). Also with respect to short-term and long-term attractiveness, there were no significant differences between the levels, neither for male nor for female ratings (all Fs < 1.9). Hence, the videos seemed sufficient.

What can be found is a large and highly significant main effect of the variable sex ($F_{(1, 132)} = 161.80$, $p < .001$, $\eta_p^2 = .551$), which is caused, as Figure 4 shows and as predicted, by the fact that the actress ($M = 6.02$, $SD = 1.57$) was rated much more attractive than the actor ($M = 2.71$, $SD = 1.48$) on average. A *t*-test for independent samples yielded a large effect for this difference ($t_{(136)} = 12.77$, $p < .001$, one-tailed, $d = 2.17$). It does not have to be concluded that the actor is extremely unattractive per se, because women as K-strategists are simply so critical in mate choice (Buss, 2003, 2008; Trivers, 1972) that after watching only a short video clip, high ratings can not be expected anyhow. Hence, these differences were not considered a severe problem, not the least as the ratings of the muted versions could still be compared to the regular versions of the video clips.

3.2.3.3 Dependent variable and the questionnaires

Attractiveness was the DV which was assessed by a postexperimental questionnaire with a 9-point rating scale from 1 (*low*) to 9 (*high*) (see Appendix 4 for this questionnaire and Appendix 5 for the second questionnaire). For each of the two sexes, a specific questionnaire was constructed. Both versions differed only regarding sex-specific formulations.

Analysis of variance is only a permissible statistic if the DV can be classified to be at least interval scale type. One could overcritically claim that the 9-point rating scale which was used in the questionnaires is only an ordinal scale. However, as it could also be considered quasi-metrical, I treated it as an interval scale. Otherwise, such an experiment would not have been possible.

The first questionnaire (see Appendix 4) was for rating the actual performance, for the regular versions as well as for the muted versions of the videos (see 3.2.3.2). The participants were asked to rate the person in the video imagining him or her as a short-term mate and as a long-term mate for them. Examples given for a short-term mate were: affair, liaison, one-night stand, noncommittal sexual contact. A long-term mate was described as someone to have a committal steady relationship with (see Appendix 4). The distinction between short-term and long-term relationship was made in order to test whether the two sexes differentiate between short-term and long-term regarding verbal proficiency (see 3.1). The mean of the two ratings was again considered the total attractiveness of the rated person (see 3.2.3.2). The question could be, especially with respect to the obtained data if total attractiveness actually consists equally of short-term and long-term attractiveness. This issue will be critically addressed in the results section (3.3).

The second questionnaire (see Appendix 5), retrieved several socio-demographic data. Apart from age, it was asked if the respective participant was actually in a relationship, and if so if he/she would consider it a short-term or a long-term relationship. For those participants who were single, the option was given to tell whether they would prefer to be in a short-term or a long-term relationship. Furthermore, they were asked to tell the total number of their sexual mates in order to check for effects of this variable. Finally, it was asked for their sexual orientation. As evolution can be defined as (a change of allele frequency due to) differential reproduction in the past it seemed logical to consider only the data of heterosexual participants. Moreover because male participants generally watched the female performance, homosexual male participants seemed inappropriate for rating female attractiveness and were, hence, excluded ex post.

Furthermore, the second questionnaire included 13 items. In these items, mate choice relevant aspects which had been mentioned in the video clips were rated, namely concerning education, intelligence, attractiveness, career and prospects, income, several hobbies, and attitudes (see Appendix 5). An evolutionary perspective would predict several sex differences regarding these items. Furthermore, it was meant to check for correlations between the values of these items and the ratings of the video clip. But mainly, these items of the second questionnaire were meant for distraction, as the following item was of major interest: "It is important for me to have a mate who is verbally proficient" (see Appendix 5). Thus, it could be tested if the rating especially of this item was in accordance with the ratings of the video clips. Furthermore, it could, thus, be checked for correlations between this language item and the other 12 items.

3.2.4 Procedure

The main experiment took place from January 2009 till February 2010. Participants were greeted and thanked for their participations. Then they were randomly assigned to one of the three experimental conditions, according to their sex. The experiment was always conducted with only one participant at a time. In Appendix 7, the German instruction for the whole procedure which was read to each participant can be found. The experiments took place at my and another office at the Institute of Psychology of the University of Kassel, which provided a laboratory setting. The whole procedure took about 15 minutes.

In the experiment, the participants watched one of the videos without knowing what the experiment was about. Neither did they know that several versions of the video existed and that the performer was an actor/actress. The respective video was played to them by means of my office PC and a standard speaker system or my laptop and its integrated sound system. After watching the respective video, the participants had to fill out the two questionnaires according to the planned procedure which can be reconstructed by means of Appendix 7. For the experiment using the muted videos, basically the same procedure was used. Only the instruction read to the participants slightly differed compared to the experiment using the regular videos (see Appendix 6).

3.2.5 Statistical analyses

Main statistical analyses were planned to be conducted by means of a two-factorial ANOVA using the data which were obtained using the videos in their regular form (i.e., non-muted). Before running an ANOVA to obtain the main results, it was checked whether the DV fulfilled the requirements of an ANOVA, namely normal distribution and homoscedasticity that is homogeneity of variances (Dancey & Reidy, 2004; Haslam & McGarty, 2003; Howle, 2010) in order to decide if additional statistical analyses would have to be conducted. Homoscedasticity was tested using the Levene test. The result was that homoscedasticity was given for the total sample ($F_{(2, 135)} = 0.90$, $p = .91$). Normal distribution was checked for using the Kolmogorov-Smirnov test. The finding was that normal distribution was not given for the total sample (Kolmogorov-Smirnov-$Z = 1.72$, $p < .007$, $N = 138$), for the data were distributed right-skewed. Hence, each factor level ($n = 46$) was checked for normal distribution separately. Each level was normally distributed (Kolmogorov-Smirnov-Zs < 1.4, ps $> .06$). Therefore, it was concluded that there was only a minor violation of the ANOVA requirements, which was not considered a severe problem, because ANOVAs are especially robust in respect of deviations from normal distribution (Dancey & Reidy, 2004; Howle, 2010). However, two measures were taken to react appropriately to this partial violation of the ANOVA requirements: (1) A logarithmic transformation was conducted on the data to create normal distribution (Howle, 2010). An ANOVA was planned to be undertaken on these log-transformed data. (2) Additionally, the Kruskal-Wallis test was conducted. The Kruskal-Wallis analysis of variance is the non-parametric equivalent to an ANOVA and can, hence, be used as an alternative if the ANOVA requirements are not fulfilled, because the Kruskal-Wallis test does not require normal distribution and homoscedasticity (McQueen & Knussen, 2006).

All statistical analyses, namely ANOVAs, Pearson correlations, Tukey tests, Levene tests, Kolmogorov-Smirnov tests, Kruskal-Wallis tests as well as t-tests and the logarithmic transformations of the data were conducted using SPSS, versions 15.0 and 17.0. An alpha level of .05 was used for all statistical tests.

3.3 Results

3.3.1 Main effect of verbal proficiency

First, after running the two-factorial ANOVA on the data, the main effect of verbal proficiency was investigated. It was found that there was a statistically significant effect of the IV verbal proficiency on the DV total attractiveness ($F_{(2, 132)} = 12.75$, $p < .001$, $\eta_p^2 = .162$). The main effect was due to differences between medium and high verbal proficiency ($p = .002$), not to differences between low and medium verbal proficiency (ns), as tested by the Tukey test as a post-hoc procedure. Accordingly, in the pre-rating, the difference between low and medium verbal proficiency was smaller than between medium and high verbal proficiency (see 3.2.3.1).

Apart from total attractiveness, an examination of different relationship types was undertaken, which yielded a larger effect of verbal proficiency on long-term ($F_{(2, 132)} = 15.85$, $p < .001$, $\eta_p^2 = .194$) than on short-term attractiveness ($F_{(2, 132)} = 3.29$, $p < .05$, $\eta_p^2 = .047$). These results indicate that the effect of verbal proficiency on total attractiveness is largely due to the effect of verbal proficiency on long-term attractiveness, which is supported by the high correlation between long-term ratings and the total attractiveness score ($r = .85$, $p < .001$).

Additionally to the ANOVA using the original data, an ANOVA using the logarithmically transformed data and the Kruskal-Wallis test using the original data were undertaken due to slight violations of the ANOVA requirements (see 3.2.5). The results differed only slightly from each other and will, therefore, only be reported in Appendix 8.

3.3.2 Main effect of sex

The two-factorial ANOVA showed a highly significant main effect of the variable sex with respect to total attractiveness ($F_{(1, 132)} = 80.67$, $p < .001$, $\eta_p^2 = .379$). The effect was larger regarding short-term ($F_{(1, 132)} = 110.42$, $p < .001$, $\eta_p^2 = .455$) than long-term mate value ($F_{(1, 132)} = 19.71$, $p < .001$, $\eta_p^2 = .130$), which was due to the fact that the man was rated extremely unattractive, whereas the woman was rated very attractive (see Figure 5). This sex difference was most prominent regarding short-term mate value (see Figure 6).

Figure 5. Total attractiveness ratings on a 9-point rating scale from 1 (*low*) to 9 (*high*) using mean values, by sex of the rated person.
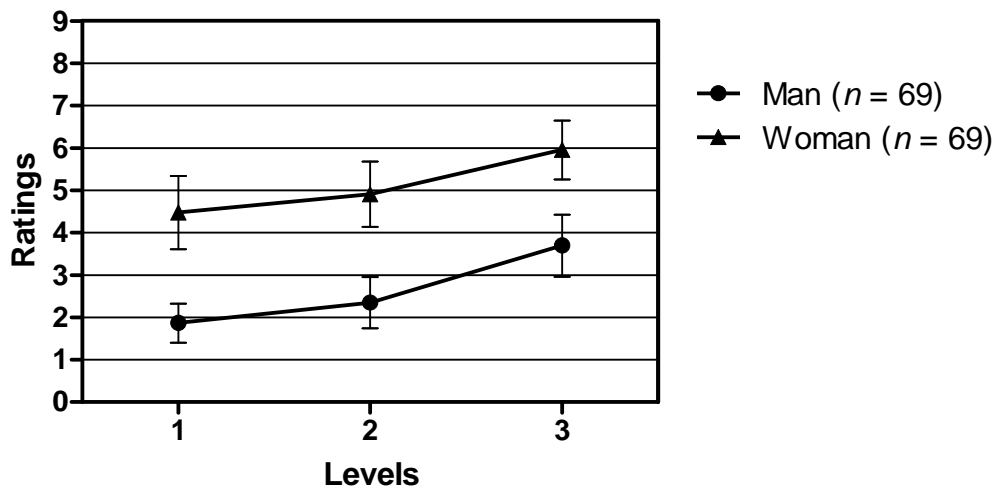
Note: Given are mean values and error bars showing 95.0% CI of mean.

Figure 6. Attractiveness ratings on a 9-point rating scale from 1 (*low*) to 9 (*high*) using mean values, by sex of the rated person: differences between short-term and long-term mating.
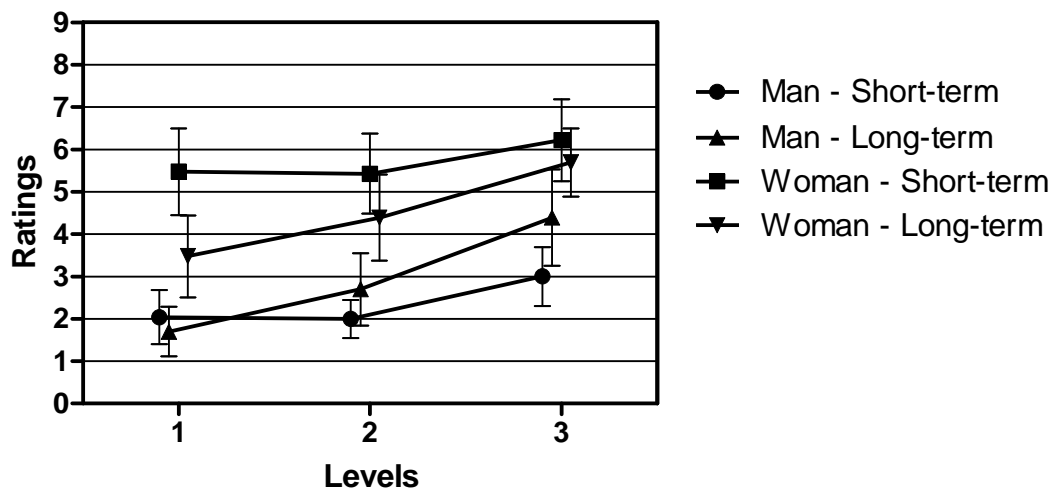
Note: Given are mean values and error bars showing 95.0% CI of mean. Data units are nudged to prevent overlap.

Especially striking is the difference between long-term and short-term female mate value on level 1 ($t_{(22)} = 4.21$, $p < .001$, two-tailed, $d = 1.24$), which means that for an affair a verbally unproficient woman is acceptable but not so for a long-term relationship, as predicted. On the contrary, male mate value on level 1 is extremely low, irrespective of relationship type. On level 3, the benefit for male mate value is higher for long-term than for short-term mating ($t_{(22)} = 2.48$, $p < 0.3$, two-tailed, $d = 0.73$).

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Additionally to the ANOVA undertaken on the original data, the same analysis was conducted using the logarithmically transformed data. This analysis resulted in equal estimations of statistical significance and similar effect sizes (short-term: $F_{(1, 132)} = 98.72$, $\eta_p^2 = .428$; long-term: $F_{(1, 132)} = 23.61$, $\eta_p^2 = .152$, all ps < .001; total: $F_{(1, 132)} = 74.60$, $\eta_p^2 = .361$; cf. Table 7). The Kruskal-Wallis test was not conducted additionally, because two-factorial analyses can not be undertaken using this test, but require the Scheirer-Ray-Hare test, which seemed unnecessary effort, as all obtained effects of the variable sex had similar values and equal significance levels. Hence, the ANOVA undertaken on the original data seemed sufficient.

3.3.3 Interaction effect between verbal proficiency and sex

Most importantly, the interaction between verbal proficiency and sex was not statistically significant, neither for short-term nor for long-term nor for total attractiveness (Fs$_{(2, 132)}$ < 1), which means that the data do not confirm the hypothesis that men benefit more from verbal proficiency than women (cf. Figure 5). See Table 7 for an overview of all data.

Table 7. Overview of all data obtained by the two-factorial ANOVA.

Relationship type	Main effect: Verbal proficiency	Main effect: Sex	Interaction: Verbal proficiency x Sex
Short-term	$F_{(2, 132)} = 3.29$ * $\eta_p^2 = .047$	$F_{(1, 132)} = 110.42$ *** $\eta_p^2 = .455$	$F < 1$
Long-term	$F_{(2, 132)} = 15.85$ *** $\eta_p^2 = .194$	$F_{(1, 132)} = 19.71$ *** $\eta_p^2 = .130$	$F < 1$
Total[1]	$F_{(2, 132)} = 12.75$ *** $\eta_p^2 = .162$	$F_{(1, 132)} = 80.67$ *** $\eta_p^2 = .379$	$F < 1$

* $p < .05$, *** $p < .001$
1 Mean of short-term and long-term ratings

More specific hypotheses were formulated with respect to the effect of verbal proficiency, depending on the sex of the stimuli on attractiveness. These hypotheses were that verbal proficiency should increase male mate value significantly more than female mate value and that men should consider a woman's verbal proficiency more if they are about to choose her as a long-term than as a short-term mate. In order to test these hypotheses, each sex was investigated separately using an one-factorial ANOVA (with verbal proficiency as IV), which was done despite the missing interaction effect between verbal proficiency and sex (all Fs < 1) simply because some of the hypotheses were formulated in such a specific way that ANOVAs were meant to be conducted seperately for each sex (see 3.1). However, the results of these analyses have to be interpreted with caution. These analyses are reported for total, short- and long-term attractiveness separately.

For total attractiveness, the results for male performance were: $F_{(2, 66)} = 10.34$, $p < .001$, $\eta_p^2 = .238$. For female performance, the ANOVA yielded the following values for total attractiveness: $F_{(2, 66)} = 4.08$, $p < .05$, $\eta_p^2 = .110$. For short-term mate value, the result was that for male performance there was a significant effect of moderate size ($F_{(2, 66)} = 3.82$, $p < .05$, $\eta_p^2 = .104$), whereas for female performance no statistical significance and only a small effect were found ($F_{(2, 66)} = 0.87$, ns, $\eta_p^2 = .026$). Also pertaining to long-term mating, the effect of verbal proficiency is larger on male ($F_{(2, 66)} = 10.10$, $p < .001$, $\eta_p^2 = .234$) than on female mate value ($F_{(2, 66)} = 6.12$, $p < .01$, $\eta_p^2 = .156$). Thus, even though the interactions between verbal proficiency and sex in the main analyses were not significant, the trends reflected in these data support the hypotheses, as verbal proficiency always explains more variance of male than of female attractiveness.

Next, simply for explanatory reasons, the ratings of the regular videos were compared to the ones of the muted versions. If considering the ratings of the muted versions as the basic attractiveness, it seemed of interest to check, which detrimental effects low and which beneficial effects high verbal proficiency had on the mate value of both sexes. Figure 7 shows the ratings for total attractiveness of the regular videos in comparison to the ratings obtained from the muted versions, separated by sex (cf. Figures 4 and 5).

Figure 7. Comparisons between muted and regular versions of the videos on a 9-point rating scale from 1 (*low*) to 9 (*high*) using mean values, by sex of the rated person.
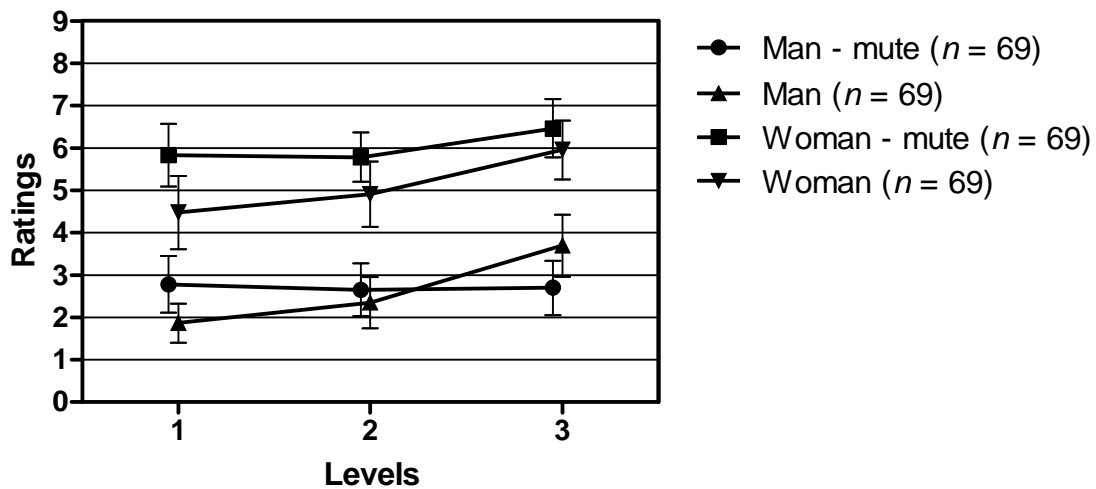
Note: Given are mean values and error bars showing 95.0% CI of mean. Data units are nudged to prevent overlap.

Especially striking is that on level 1, when comparing the ratings of the muted male performance with the rating of the regular one, the rated man forfeits even more of his already low attractiveness if additionally verbally unproficient ($t_{(44)} = 2.33$, $p < .03$, two-tailed, $d = 0.69$). For level 2, ratings of the regular and the muted version were almost alike. For level 3, high verbal proficiency substantially increased a man's mate value ($t_{(44)} = 2.12$, $p = .04$, two-tailed, $d = 0.62$). On the contrary, female mate value was fewer affected by verbal proficiency. Moreover, Figure 7 even suggests that an attractive woman is more attractive if not speaking than if speaking. In support of this, a *t*-test for independent samples conducted to compare the muted female performance with the regular one yielded a statistically significant difference ($t_{(132)} = 3.07$, $p < .004$, two-tailed, $d = 0.52$).

By the second questionnaire (see Appendix 5), participants where asked to give information about their own relationships, their past number of mates and their age (see 3.2.3.3). After running the above decribed ANOVA with these variables added as IVs, it was found that there were no significant effects of these variables with respect to attractiveness ratings in relation to different levels of verbal proficiency. Furthermore, there were no significant interaction effects between any of these variables. However, one noteworthy result was that in the total sample ($N = 276$), male participants showed significant larger variance than females ($F_{(135, 136)} = 2.30$, $p < .001$) for number of mates, as predicted by sexual selection theory (Bateman, 1948; Darwin, 1859, 1871; Fisher, 1930; Huxley, 1938).

3.3.4 Additional correlational analyses

The objective markers of verbal proficiency (see 3.2.3.1) were furthermore correlated with the attractiveness ratings obtained by the experiments (see Tables 8 and 9).

Table 8. Pearson correlation coefficients (one-tailed) between the attractiveness ratings and the values of lexical and grammatical markers of verbal proficiency.

Relationship type	TTR	WL	MLU
	Man / Woman	Man / Woman	Man / Woman
Short-term	$r = .29$ * / .14	$r = .27$ * / .13	$r = .32$ ** / .16
Long-term	$r = .48$ *** / .40 ***	$r = .48$ *** / .39 ***	$r = .47$ *** / .38 **
Total[1]	$r = .48$ *** / .33 **	$r = .47$ *** / .32 **	$r = .48$ *** / .33 **

Note: The markers of verbal proficiency are: type-token ratio (TTR), mean word length (WL), and mean length of utterance (MLU)
* $p < .05$; ** $p < .01$; *** $p < .001$
For all correlation coefficients, $df = 67$
1 Mean score of short-term and long-term ratings

Table 9. Pearson correlation coefficients (one-tailed) between the attractiveness ratings and the values of fluency-related markers of verbal proficiency.

Relationship type	%SS	SPM
	Man / Woman	Man / Woman
Short-term	$r = -$ .26 */ $-$ .13	$r = .26$ * / .13
Long-term	$r = -$ .47 *** / $-$ .39 ***	$r = .48$ *** / .39 ***
Total[1]	$r = -$ .46 *** / $-$ .31 **	$r = .46$ *** / .32 **

Note: The markers of verbal proficiency are: percentage of stuttered syllables (%SS) and speech rate measured by syllables per minute (SPM)
* $p < .05$; ** $p < .01$; *** $p < .001$
For all correlation coefficients, $df = 67$
1 Mean score of short-term and long-term ratings

If transforming r to the coefficient of determination r^2, it yields that the five linguistic features explain between 6 and 23 per cent of male attractiveness variances and between 1 and 20 percent of female attractiveness variances each. More importantly, for all 15 correlation coefficients in Tables 8 and 9, men show higher values than women, even though none of these differences were statistically significant (all ps $\geq$ .15, all zs $\leq$ 1.03). Also all correlations for long-term mate value were numerically higher than for short-term mate value. Hence, the numbers at least indicate again that men benefit more from verbal proficiency than women and generally that verbal proficiency affects long-term more than short-term mate value.

The second questionnaire (see Appendix 5) assessed sex differences regarding several mate choice criteria. The results obtained from the total sample ($N = 276$) can be found in Appendix 9. Of most interest was the item asking the participants to rate how important they consider the verbal proficiency of a potential mate. Higher female than male means were expected, which was not the case (Ms = 5.63 vs. 5.77, $t_{(274)} = 0.57$, one-tailed, ns), contradicting the tendencies found in the experiments (see 3.4). However, it seemed of interest to check for correlations between these self-reported preference for a verbally proficient mate and the given attractiveness ratings obtained by the experiments ($N = 138$). Table 10 shows these data. (Note that the values refer not to the rated but to the rating sex.)

Table 10. Pearson correlation coefficients (one-tailed) between self-reported preference for a mate being verbally proficient and given attractiveness ratings.

Relationship type	Level 1	Level 2	Level 3
	Man / Woman	Man / Woman	Man / Woman
Short-term	r = .21 / r = – .02	r = – .30 / r = – .20	r = – .21 / r = .12
Long-term	r = .06 / r = .12	r = – .16 / r = – .17	r = .02 / r = .50 **
Total[1]	r = .16 / r = .06	r = – .29 / r = – .19	r = – .14 / r = .44 *

* p < .05; ** p < .01
For all correlation coefficients, df = 21
1 Mean score of short-term and long-term ratings

Only two significant correlations were found, both for women, as could be expected. In accordance with the other results (see Tables 7, 8, and 9), the correlations were found for long-term and total attractiveness but not short-term attractiveness. Pearson correlation

coefficients between self-reported preference for a mate being verbally proficient and the other obtained mate choice criteria can be found in Appendix 10.

3.4 Discussion

The hypothesized main effect of verbal proficiency was supported by the empirical evidence. Taking into account that ratings of the muted videos resulted in no significant difference between the three different levels, it can be argued that the experimental manipulations in the main experiment were successful and that the obtained results are valid. Furthermore, pre-tests and objective measures showed that the three levels actually represent three levels of verbal proficiency. However, no significant interaction effect between the variables verbal proficiency and sex was obtained. Exploratory post-hoc analyses at least suggest that the data point in the predicted direction, but this has to be handled with caution because of the missing statistical significance for the interaction effect.

Regarding self-reported preference for a verbally proficient mate, no such sex difference could be obtained, neither in former questionnaire studies (Lange, in press), nor in the questionnaire part of the current study (see Appendixes 5 and 9). As the validity of the experiment can be considered higher than of a questionnaire study, one can conclude from the current experimental study, at least with caution, that verbal proficiency is rather a female than a male mate choice criterion, but that a questionnaire assessing self-reported mate choice preferences is insufficient to detect this sex difference.

Furthermore, support for the hypothesis that men are more demanding regarding a woman's verbal proficiency when it comes to long-term mating than when they are looking for an affair, was also provided by the conducted experiments. One open question, namely whether verbal proficiency has larger effects on short-term or long-term male mate value, could be answered, too. Even though the features of human language qualify for being markers of genetic quality, which is especially relevant for short-term mating (Miller, 2000a), the results show that verbal proficiency has larger effects with respect to long-term than to short-term mating. Strikingly, the actress seems to be rated more attractive in the muted versions than in the regular ones, which could be due to the fact that there is no auditive input in the muted versions which would distract the participants from the judgement of the perceived physical attractiveness. In sum, the results suggest that verbal proficiency is currently under sexual selection, as it has probably been throughout the phylogeny of *Homo sapiens sapiens*.

Generally, the video clips simulated a first meeting of two individuals being potential sexual mates for each other. To be precise, a first impression of the opposite person regarding his or her verbal proficiency was simulated. Therefore, one might conclude that verbal proficiency is a mate choice criterion only at the beginning of a romantic relationship. Although, there is no specific reason to assume this, it has to be kept in mind that there is limited conclusiveness of the experiment. One question linked to this is to what extent conclusions about real-life mate choice are possible on the basis of the result of the experiment (Simpson & Campbell, 2005). On the one hand, the high internal validity of an experiment is an advantage compared to other methods, because such a design allows conclusions on the causal relation between variations of the IV and the DV. On the other hand, awareness of the problem of the generally comparably low external validity of experiments is appropriate. Real-life mate choice is true interaction in the sense of mutual communication instead of one-way communication which is the case when merely watching a video clip. Moreover, in real mate choice, speaking time is much higher than in any of the video clips. Because women are on average more demanding in mate choice than man and simply need time to decide if they want to get involved with a man (Buss, 2003; Buss & Schmitt, 1993), a short verbal display might not be sufficient. To counter these possible objections, one might simply claim that in real-life communication, between two turn-takings each communication partner is holding also only a short monologue, which is judged by the other person, who in turn is holding a monologue sooner or later. Hence, if judging verbal proficiency is in the focus, a short performance which includes all major linguistic areas should suffice. Although, the external, ecological validity of experiments are still basically problematic, a video experiment is at least very close to real world situations, and there are other successful studies on attractiveness using videos (e.g., Saxton et al., 2009). Furthermore, a video experiment on verbal proficiency as a mate choice criterion could be the starting point of media psychological research, because communication via mass media, such as television, is also one-way communication which is transmitted via a video screen and, hence, similar to the setting in the experiment. A TV show host or a news anchorman should be of highest attractiveness. The question could be to what extent his or her verbal proficiency contributes to his or her perceived attractiveness and popularity. This question could be addressed in further research.

Another limitation of external validity could be seen in the participant selection. If only university students participate in an experiment, the question could be, in how far the results are valid for all social groups. Although, this question is basically justified, it must be clear

that other studies use university students as participants as well, as this group is most available. However, future experimental research on verbal proficiency as mate choice criterion could be conducted using different participants. It is imaginable that such future studies will yield different results.

One could criticize that one question is not answered by the experiment, namely which linguistic ability (e.g., lexical or grammatical) is the most important one. This question could not be answered due to the fact that it was tried to construct the videos in such a way that the three levels differed equally regarding lexical, grammatical, and other linguistic aspects (cf. Figures 1 and 2). The high heritability of lexicon size and its costliness and obvious waste could, for instance, lead to the assumption that lexical aspects are most important (Miller, 2000a). However, to counter such a critique, answering the question, which linguistic feature is most important with satisfying ecological validity seems difficult. An experimental design which focuses on lexicon size would have to use several verbal displays with varying lexicon sizes as stimuli, anything being equally high. But assuming that there is a person of high grammatical abilities but low lexicon size, for instance, is unlikely for two reasons. First, grammar is a discrete combinatorial system (Pinker, 1994). Therefore, grammatical complexity depends at least partially on lexicon size. The more words are accessible, the more grammatical constructions are possible (Dale, Dionne, Eley, & Plomin, 2000; Pinker, 1994). Kemper and Sumner (2001) showed that sentence length and lexical diversity are associated with each other. Already in childhood, vocabulary and sentence complexity highly correlate with each other ($r = .66$) (Dale et al., 2000). Separating lexicon size and grammatical abilities seems, therefore, difficult. Second, there are high genetic correlations between grammatical and lexical aspects that is a substantial overlap of the variances of both traits due to genetic influence (Dale et al., 2000; Dionne, Dale, Boivin, & Plomin, 2003; Hayiou-Thomas, 2008). Although these findings come from studies with participants in young infancy and, hence, might not tell about such genetic correlations in adults, still, it seems unlikely that these genetic correlations are present in childhood but totally absent in adulthood (Dionne et al., 2003). So, also from a genetic point of view, several linguistic abilities are difficult to be separated from each other. However, it does not seem impossible to conduct experiments in order to examine if different linguistic abilities differently contribute to a person's mate value. But this must be left to future research.

Finally, one major question is if there are other theories which could explain the empirical results equally good or even better than an evolutionary approach. For evolutionary theory to be a proper explanation for language-related sex differences and the role of language

in mate choice, empirical results should confirm what the theory predicts, for instance, that verbal proficiency is more important to male than to female mate value. The data at least suggested that this is the case. Furthermore, it should be made clear that other theories cannot explain the results as good or even better. A social-constructivist or behaviourist perspective, for instance, would claim that the obtained results originate from sex-different expectations and nurture styles (Eckert & McConnell-Ginet, 2003). Hence, men would have been told during their childhood and adolescence to put most emphasis on a woman's attractiveness and to neglect cognitive abilities (e.g., verbal proficiency), especially when it comes to short-term relationships, while women would have been told to look at a man's status, intelligence, and comparable traits. This assumption could be true but even if so, it could simply be assumed that culture emphasizes what nature is already providing. To my knowledge, no empirical data exist, which would force to conclude that the specific sex differences which were found in the experiments are mere cultural effects. On the contrary, evidence was summarized in Chapter 2 showing that not only language but also language-related sex differences are substantially caused by biological factors. Generally, in the evidence-based discussion on language-related sex differences, a biological perspective is increasingly favoured (Klann-Delius, 2005).

4. Study 2 –
Verbal proficiency as a menstrual cycle-dependent mate choice criterion

The research in this chapter is based on the experiments described in Chapter 3 but examines one aspect additionally, namely verbal proficiency as a menstrual cycle-dependent mate choice criterion. The experiments were conducted from May to July 2010. As an initial data analysis after 37 participants showed no significant results and due to difficulties in recruiting more than 37 female participants fulfilling the specific requirements of this study (see 4.2), this research was cancelled. Therefore, it will be described only very briefly.

4.1 Research questions and hypotheses

The hypothesis was that verbal proficiency is a good genes indicator, as probably are symmetry, masculinity, social presence, competitiveness (Gangestad et al., 2004), intellectual abilities in general, and creativity (Miller, 2000a; Haselton & Miller, 2006). Women's mate choice criteria vary across their ovulatory cycle. In the middle of their cycle, when conception is most likely, women especially prefer men of high quality that is men possessing traits which serve as good genes indicators, as genes are probably the only resource they can get during this cycle phase in short-term mating (Pillsworth & Haselton, 2006). Puts (2005) could show that even the paraverbal feature male voice pitch is preferred especially by women in short-term mating context and in the fertile phase of their cycle. The hypothesis in the current study is, therefore, that verbal proficiency, that is the verbal rather than the non-verbal features of language, serve also as such an indicator and are more preferred by ovulating that is fertile women than by non-fertile women. If this could be shown, it would furthermore make mere cultural explanations for the female preference for verbally proficient men, as described in Chapter 3, to appear very unlikely, as no cultural factor can be thought of to cause women to show shifts of mating preferences during their menstrual cycles (Haselton & Miller, 2006).

However, as the data presented in Chapter 3 show, verbal proficiency is more important regarding long-term than short-term mating. Selecting for good genes, on the contrary, is rather a matter of short-term mating, because even though women should prefer to select for good genes in their long-term mates as well, they decide for a trade-off and prefer the ability for paternal care to good genes in long-term mating (Haselton & Miller, 2006). Still, verbal

proficiency also increases a man's mate value regarding short-term mating (see 3.3). Hence, this study described in this chapter seemed justified.

4.2 Methods

4.2.1 Participants

Participants were 37 women between 19 and 29 years of age ($M = 23.4$, $SD = 2.8$, median = 23.0, mode = 22) and mainly students at the University of Kassel minoring in psychology and students of medicine at the University of Frankfurt / Main. Recruitment of participants was basically similar to the study described in Chapter 3 (see 3.2.2). However, exceptions have to be mentioned. In beforehand, women who were willing to participate but were using hormonal contraception such as the pill or any form of contraceptive patch or implant were excluded. Also all women who were pregnant or breast-feeding were excluded, because all these factors influence normal menstrual cycle (see below). To make sure not to have the problem of extensive beforehand exclusion, recruitment was also done online in forums or discussion groups where single women from Kassel and Frankfurt / Main could be found. The idea behind this was that single women predominantly do not use hormonal contraception. Still, around 80% of all found women who were basically willing to participate were using hormonal contraception and had to be excluded which is almost exactly the percentage of German persons between 20 and 29 years of age who practice contraception (Bundeszentrale für gesundheitliche Aufklärung, 2007). Therefore, to quicken this difficult recruitment, an additional reward was offered to the participants, namely 5 € paid in cash ($n = 18$). The other participants ($n = 18$) were again offered experiment credits which are requirements for students at the University of Kassel minoring in Psychology and course credit for my seminar "Evolutionary Psychology and Evolutionary Medicine" at the Department of Medicine at the University of Frankfurt ($n = 1$).

4.2.2 Materials and procedure

Generally, the materials and the procedure were highly similar to the ones used in the former study (see 3.2.3 and 3.2.4). Hence, to test the hypothesis of cycle-dependent mate choice preferences pertaining to language, the same videos were planned to be used as for Study 1. In all videos, the actor claims to hold a university degree and to have a good income. Both are

features which suffice for high paternal investment (Buss, 2003, 2008). Remember that in video 1, his verbal proficiency was very low, whereas it was high in video 3. If only video 3 was used and fertile women would have rated the performance in this video as more attractive than non-fertile women, it would not have been definitely clear if this finding proves fertile women's preference for verbally proficient men or for good paternal investors. Hence, level 1 (low verbal proficiency, high paternal investment) and level 3 (high verbal proficiency, high paternal investment) were chosen to be presented to the female participants. Thus, the originally three videos were used to simply create two groups which differ only with respect to one factor, namely verbal proficiency.

Hence, with respect to the actual used materials, the above mentioned hypotheses can be specified. First, fertile women should rate level 1 lower than non-fertile women, because fertile more than non-fertile women subconsciously try to avoid sexual intercourse with a verbally unproficient man and, thus, avoid receiving "bad genes". For non-fertile women, there would be no such strict need to avoid intercourse or partnership, as the man in the video at least appears to be a good father because of his good income. This quality is simply more important in the non-fertile phase. Second, fertile women rate video 3 higher than non-fertile women. In this video, the man also appears to be a good father, which is generally a favorable feature, especially for non-fertile women. But fertile women, if the hypothesis is correct, should ascribe more importance to indicators of good genes, such as verbal proficiency, at least if verbal proficiency serves as such an indicator. The assumed effects of low or high verbal proficiency on fertile women should be most prominent regarding short term mating, as genes is almost everything a woman can gain from a brief affair, whereas for a long-term relationship the above mentioned trade-off can be expected (Haselton & Miller, 2006).

All materials were the ones described in Chapter 3. The only difference was that the questionnaire was extended by a few variables (see Appendix 11). For instance, a poem by German writer and poet Bertolt Brecht was added which should be rated. The prediction was that fertile women would give higher ratings than non-fertile women. Furthermore, a scenario item was included which was already used in a former questionnaire study (Lange, in press). This item (see 2.2.2.3.3) covered the question of how much attractiveness an attractive person loses if verbally unproficient. The prediction was that fertile women would give lower ratings than non-fertile women. More variables were added which were concerned with female fertility changes across the menstrual cycle. It was asked if the participants were using hormonal contraception, such as the pill or any form of contraceptive patch or implant, if they were pregnant or if they were breast-feeding in order to make sure that all inappropriate

participants could be excluded afterwards. The two remaining variables were concerned with fertility estimation. It was asked how many days ago the last menstruation started and in how many days the next menstruation was expected to start. These variables, which were placed at the end of the questionnaire in order to make sure that they would not affect the procedure, were chosen due to the following considerations.

There is a vast number of methods used for determining different phases of female menstrual cycle. Still, many of them are considered insufficient (for an overview, see Pillsworth, Haselton, & Buss, 2004). The most accurate way of estimating a woman's fertile period within her menstrual cycle would be a measurement of hormone levels. The level of the luteinizing hormone (LH), for instance, rapidly increases very shortly before ovulation with a short and high peak at ovulation. Hence, measuring LH would be an appropriate method. One could also measure estradiol, which is a hormone slowly increasing in the first half of the cycle and peaking shortly before ovulation. It is this small time window before ovulation in which sexual intercourse most likely leads to conception. These measurements could be done using urine tests (e.g., Dennerstein, Gotts, Brown, & Morse, 1994) or blood assays (Van Goozen, Wiegant, Endert, & Helmond, 1997). However, this would have meant to include laboratory tests of urine or blood samples, which are costly and linked with inconveniences for the participants and, thus, would have reduced the number of participants (Pillsworth et al. 2004). Another method to estimate ovulation is the measurement of basal body temperature (Stanislaw & Rice, 1988). Again, this would have meant too much effort for the investigator as well as for the participants. Hence, it seemed necessary to simply rely on women's self-reports. Therefore, in the questionnaire, female participants were asked to give information on how many days ago their last menstrual cycle started (first day of menstrual bleeding) and in how many days they expected their next menstruation. Thus, the whole menstrual cycle of each participant could be covered, because by convention the menstrual cycle starts with first menstrual bleeding and ends the day before next bleeding (Lenton et al., 1984). This procedure was, for instance, used by Haselton and Miller (2006), Pillsworth et al. (2004) and Thornhill and Gangestad (1999). Even though it is not as accurate as physiological measures of hormone levels, it is beneficial for a large sample size, which helps reducing the effects of measurement error.

Although it was asked for the start of the last menstrual cycle and the start of the next one, it was planned to use only the latter information, which meant to use the so-called reverse-cycle-day method. Using this method, ovulation can be estimated by assuming that ovulation is 15 days prior to next menstrual onset (Gangestad et al., 2004; Haselton & Miller,

2006; Thornhill & Gangestad, 1999). Information about the start of the last menstruation was only planned to be used if the participant would not tell about the onset of the next menstruation, because this method does not take individual cycle lengths into account. Women with longer cycles ovulate later than women with shorter cycles (Baker & Bellis, 1995). This problem, which necessarily causes restricted accuracy of fertility estimation, can be avoided by the reverse-cycle-day method (Haselton & Miller, 2006; Thornhill & Gangestad, 1999).

The procedure was similar to the experiment described in Chapter 3, except for the exclusion of video level 2 (see Appendix 7 for the used instruction). Another difference was that the participants were only female and that I was handing them a calendar, while they were filling out the questionnaire, in order to help them to give accurate information on their menstrual cycle.

Using data from Jöchle (1973, p. 538) about different pregnancy rates across the menstrual cycle depending on the day of the cycle, the probability of pregnancy was ascribed to each participant according to the information given by them in the questionnaire about the phase of the menstrual cycle of the day of the experiment. Hence, metrical data were retrieved. Moreover, a slightly different analysis method was chosen, namely to simply categorize the participants either as fertile or non-fertile instead of giving the exact probability of conception. Such a nominal categorization, using a dichotomized variable, is described by Baker and Bellis (1995, p. 161) and Haselton and Miller (2006, p. 57). However, they use slightly different criteria for categorization. Baker and Bellis (1995) consider the last 13 days of the cycle as least fertile, followed by four non-fertile days (menses) and eleven days categorized as most fertile. Haselton and Miller (2006), using data from Jöchle (1973), categorize each day of the cycle with a conception risk of at least 10.5% as fertile and all other days as non-fertile. Comparing the categorization procedure by Baker and Bellis (1995) with the one by Haselton and Miller (2006) with reference to the actual data of this study, it can be said that in 34 of 37 cases, both procedures led to the same fertile / non-fertile categorization (Cronbach's $\alpha = 0.91$). Besides, according to the categorization procedure by Baker and Bellis (1995), 18 of 37 women were considered fertile, according the categorization procedure by Haselton and Miller (2006) 17 of 37.

4.3 Results

No significant results could be obtained, irrespective of relationship type (short-term, long-term, and total attractiveness) and fertility determination procedure (Jöchle vs. Baker and Bellis vs. Haselton and Miller). For the dichotomized categorizations (Baker and Bellis and Haselton and Miller), *t*-tests for independent samples were conducted in order to compare fertile to non-fertile women with respect to the attractiveness ratings they had given (all *p*s > .58). For the metrical categorization following Jöchle, bivariate correlation coefficients (Pearson) were computed between attractiveness ratings and conception probability (all *p*s > .45). Regarding all other items, also no noteworthy result could be obtained.

4.4 Discussion

As no significant result could be obtained, the question is why. First of all, the hypothesis that verbal proficiency as an indicator of good genes is preferred by women in mate choice, when conception is most likely, could be wrong. The data from Study 1 show that verbal proficiency is more important in long-term than in short-term mating, and menstrual cycle-dependent mate choice preferences are more important in short-term mating. This could be the reason why the hypothesis was not supported. However, there are, from a theoretical standpoint, still good reasons to assume such cycle-dependent mate choice mechanisms with respect to language (Miller, 2000a; Miller & Haselton, 2006). If these mechanisms exist, they could be so subtle that they are hard to detect. More specifically, the used materials could be insufficient to detect them. Generally speaking, the actor was rated relatively unattractive in the experiment described in Chapter 3, which could be the reason why no significant results could be obtained in the current study. He could simply be considered so inacceptable as a mate by fertile women that low or high verbal proficiency could not make any difference. Hence, this study could be repeated using different materials, namely by choosing an actor who, according to results of an attractiveness pre-rating, is so attractive that the height of fall is higher to start with. Furthermore, only two different videos could be used. (1) The actor claims to possess the qualities for proper paternal care but does so with low verbal proficiency. (2) The actor does not claim to have any paternal qualities but does so with high verbal proficiency. Such a procedure would be closer to the one used by Haselton and Miller (2006), who could actually find differences between fertile and non-fertile women with

respect to the preference for male creativity, which is a trait that could, very basically, be considered similar to verbal proficiency.

5. Study 3 – Comparative research: Sexual selection for literary displays

Apart from experimental methods, also comparative research is useful in evolutionary psychology, for instance, by comparing different species or human cultures with each other or men with women or individuals in general with each other, which matches the necessary claim to combine several methods and data sources in order to test evolutionary hypotheses. For instance, human products can be used as data sources (Buss, 2008; Simpson & Campbell, 2005). Hence, the sexual selection for literary production will be examined in the current study. The already existing evolutionary approach in the literary and media sciences which aims to find evolutionary relevant elements in literary texts and other media (Carroll, 2005; Pinker, 1997), needs an additional approach which is more empirical and accounts for evolutionary relevant variables such as age, sex, and status (Carroll, 1999) and which examins who is producing literature and under which circumstances. This addition will be provided by the current study.

The current study and the experimental one described in Chapter 3 differ from each other in one decisive way. The experimental study gave a hint that verbal proficiency and its display are an adaption created by sexual selection, as they contribute to one's attractiveness, especially to male attractiveness. Female consideration of male verbal proficiency could, thus, be considered adaptive, too. It can be concluded that these adaptations are executed in mate choice. However, examining assumed adaptations and their execution does not tell anything about actual fitness outcome (Tooby & Cosmides, 1992). On the contrary, the study in the current chapter does not only examine if writing literature increases one's attractiveness but also if it increases the number of mates and children. Thus, not only assumed mate choice mechanisms can be indirectly proved, but the behavioral ecology of verbal displays can be examined, which is an advantage of the current study compared to the former one. Another advantage is that the current study examines extensive verbal displays (e.g., books), while the other study worked with verbal displays only by means of short video clips (see 3.2.3.1.6). Hence, the current study is a valuable addition to the experimental research, especially regarding the comparatively low external validity of experimental research. Miller (1999) provided evidence on the sexual selection of literature. However, a detailed and extensive research is still missing which should be provided in this chapter.

5.1 Research questions and hypotheses

The research question could be expressed as follows. If a peacock has the more mates, the more eyes it has on its tail (Petrie et al., 1991) and especially if a male bird has the more mates, the larger its song repertoire is (Hasselquist et al., 1996), do writers or poets have the more mates and children, the more literary works of high quality they produce? Are verbal displays analogous to the peacock's plumage and to bird songs with respect to its Darwinian fitness consequences? Miller's (1999) display hypothesis, if consequently thought out, should predict this. Generally, comparing several species with each other might deliver insights into complex phenomena (Buss, 2008) such as language, the more so as several similarities between language on the one hand and bird songs or other handicaps such as the peacocks plumage on the other hand could be presented in Chapter 2. Already Darwin (1871) had pointed out these similarities. Even if one considers the questions above as an inappropriate and a misleading analogy, still, the theory of sexual selection would predict that producing literature enhances mating opportunities, especially male ones, because of consisting of several handicaps and, thus, serving as a fitness indicator.

First, it can be expected to replicate Miller's (1999) results, namely that most literary works are produced by men between 30 and 40 years of age. While Miller examines all works in the canon he has chosen, in the current study, additional emphasis is put on the first work of each writer, because of the following assumption. Cultural displays should be produced, when testosterone and, therefore, motivation for making displays and for assertive aggression *is still high* and when the abilities and experience (based on a general talent) for the respective cultural production *is already high enough*. It can be assumed that both factors (still high motivation and already high abilities) cross each other at an age of around 30 years, (1) because testosterone as a major proximate mechanism for assertive aggression starts to decrease in men at around 30 years of age (Dabbs, 2000; Meletis & Wood, 2009) and (2) because up to ten years of preparation are needed before making a mentionable cultural contribution, such as writing literature, is possible (Wishbow, 1988). Both factors are linked with each other, as motivation is required to endure the large time span needed for preparation (Hayes, 1989). Hence, the first work should be most representative of the mental state described by (1) and (2).

Furthermore, more hypotheses were formulated which Miller did not explicitly consider. His display hypothesis (Miller, 1999, 2000a) leads to assume, among others, a correlation between literary and markers of reproduction-relevant success that is between

number of literary works of high quality on the one hand and number of girlfriends, affairs, (female) admirers, and children on the other hand, at least so for male writers. The highest correlations can be expected for affairs, as many of them are necessarily the result of an r-strategy. For this reason, one should expect weak correlations between entries in the canon and marriages, because even though a marriage is a mating success, it might, as a form of socially imposed monogamy, also be an obstacle for a man to gain access to many different women. By checking for these correlations, an oppositional theory about the origin of literature can be tested as well, namely the Freudian theory of sublimation, which is incompatible with the evolutionary perspective, yet still present, for instance, in the literary sciences and the humanities in general. Broadly speaking, this theory considers the production of literature as a substitution for sexuality, because, according to this theory, erotic energy (the so-called libido) is transformed into socially accepted achievements on a higher level, such as art (e.g., Freud, 1988). It is obvious that, in contrast to the Freudian psychoanalysis, an evolutionary perspective considers the production of art not as a substitution for sexuality, but as a way to sexuality and, furthermore, to reproduction as the ultimate cause. A valid explanation for the production of literature as a result of sublimation would predict negative correlations between literary production and sexual activity, which is empirically testable and should be provided in this chapter. Generally, sexual function and sexual motivation should not be confounded, as a certain behavior might have evolved for being beneficial to reproduction irrespective of the question whether the individuals intended to attract mates with it (Miller, 2000a).

The next hypothesis was that lyric poetry, which could be considered to follow the handicap principle (Miller, 2000a), is more difficult to fake than non-lyric literature and, thus, a better indicator of human reproductive quality. This hypothesis results when applying the handicap principle to literature (Zahavi, 1975; Zahavi & Zahavi, 1997). Obviously, lyric poetry is a stronger handicap than other forms of literature (Miller, 2000a). Because by clinging to the self-imposed handicap of writing lyric poetry, the lyricist has to follow a certain metre or has to make sure that several words rhyme. Especially the usage of rhymes limits the number of possible words, which is a profound way to demonstrate a high lexicon size by still finding words which express a certain idea and rhyme with each other on top of that. This hypothesis is especially congruent with the high heritability of vocabulary size (Bratko, 1996; Miller, 2000a). Hence, it should be tested if writers who entered the canon partly with lyric poetry had more mating successes than non-lyricists. Again, this should be most prominent for affairs.

The final hypothesis was concerned with the Trivers-Willard hypothesis (Trivers & Willard, 1973) and thus, to be precise, with the sex ratio of the offspring, the so-called secondary sex ratio. According to the Trivers-Willard hypothesis, which can be linked to sex differences in reproductive conditions as described in Chapter 2, parents preferentially invest in the sex which probably will give more grandchildren. That is why grandchildren can be considered a higher reproductive success than children, as children who remain childless are an evolutionary failure. As a result of the higher reproductive potential in the male sex, a son is capable of fathering more grandchildren than a daughter, at least if equipped with the necessary status. Thus, parents of high status should invest more in sons, whereas parents of low status should invest more in daughters, because a young and beautiful girl will certainly have children, even if of low status. So, the Trivers-Willard hypothesis is also linked to sex differences in reproduction variance. However, this hypothesis is not always supported, as findings are inconsistent (Keller, Nesse, & Hofferth, 2001).

However, this hypothesis was put to empirical test with respect to the examined writers. It was assumed that literary success increases a writer's status, such as the socio-economic status, not the least as high verbal proficiency, which is essential for writing literature, universally increases a person's status, especially a man's status (Brown, 1991; Burling, 1986; Miller, 2002; Pinker, 1994). If writing literature increases status, a writer should thereby be capable of enabling a son of being sexually successful and having more children than a daughter could have. Therefore, the hypothesis was tested that writers have a significantly higher male-to-female secondary sex ratio than average people, for whom a ratio of approximately 106 sons to 100 daughters can be assumed (Trivers, 1985, p. 289). Even though, other ratios can be found in the literature, such as 105:100 (Mealy, 2000; Trivers, 1985), 106:100 seems to be the most typical one and was, thus, assumed to be valid for a general population.

5.2 Methods

First, it needed to be determined which writers and which works to examine in this study. Literary quality is difficult to be measured objectively. It is, therefore, unavoidable to accept a certain subjectivity when deciding which writers and which of their works should be examined. It seemed appropriate to choose the writers and literary works which are mentioned in two famous literature canons. The first list consisted of recommendations in the literary canon of Marcel Reich-Ranicki, Germany's most famous and highly respected literary critic.

In 2001, Reich-Ranicki gave these recommendations in the German magazine *Der Spiegel* (Hage, 2001; Hage & Saltzwedel, 2001; for an overview of the entire list of works, see wikipedia, n.d.), where he named writers and those of their works which are, according to him, worth reading and characterized by high literary quality. Even though Reich-Ranicki gave recommendation even for German medieval literature, however, I examined only 18th, 19th, and 20th century writers, as the relevant information about former centuries seemed too difficult to obtain. Thus, the finally used list consisted of 161 entries by 69 writers. The second canon was the Western canon compiled by US American famous literary critic Harold Bloom (1994). As Bloom's list of works is very extensive, a selection was done. Only US American writers and their works from 20th century were considered, as it seemed again likely to gain most information on the writers' mating successes for this century compared to other centuries. The result was an American list of 374 entries by 161 writers after all. The decision to examine two canons separately instead of only one canon was based on the following considerations. Athough it is very unlikely that any literary critic consciously or subconsciously compiles a canon in order to achieve that sexually successful writers have more entries than sexually unsuccessful writers, it could still be criticized that if choosing only one canon, just this canon is in any way biased towards the hypotheses. Choosing another canon additionally, especially when providing the same results, would enhance the reliability of the results and invalidate such a critique.

Regarding Reich-Ranicki's list, a few writers entered the canon only once, whereas others had half a dozen entries. Classical writer and poet Friedrich Schiller had the most entries with eight. For Bloom's list, the variance of entries was comparable, as the number of entries ranged from one to nine. It seemed obvious to use the number of entries to operationalize literary quality and success. Some writers did not enter the canon with a specific work but unspecified with poems or short stories in general. Those unspecific entries in plural were counted as two entries. Some works were produced over a long time span. For determining the writers' age in which such works should be considered to be produced, the age was chosen in which the respective writer started producing the respective work, because it is this age, when on the one hand motivation for the literary production is obviously present and on the other hand the needed skills are already high enough.

For each male writer, extensive research was conducted, besides sex and age at death, about the following aspects. At which age has each work been written? How many marriages, engagements (without marriages), affairs, romances, girlfriends, sexually relevant admirers, and children are certain for each writer? When did each of these reproduction-relevant

successes occur? In order to obtain this information, extensive internet research was conducted first. As each writer has his own wikipedia site, this was the starting point to obtain the most basic information. Furthermore, the search engine of google was used, where the author's name was combined with the following key words: marriage, engagement, affair, romance, girlfriend, admirer, child, children, son, daughter. For each writer, the first ten search results were examined. Furthermore, one preferably up-to-date biography for each writer was consulted. Finally, at least two experts for each writer (literary scientists, biographers, historians) were contacted and asked to name all known reproduction-relevant successes and to help clarifying cases of doubt.

No comparison between literary writers and non-writers was conducted, as it seemed impossible, for instance, to gain reliable information about affairs of 18th century common people. Therefore, all analyses were done within each canon, which was supposed to suffice, as there was a great enough variance concerning entries in the canon among the writers to answer the question if there are positive correlations between literary and mating success.

5.3 Results

5.3.1 Sex differences in writing literature

92.8% of all German writers were male. 93.2% of all German entries were achieved by men. Examining only the 20th century part of the German list, the female share was higher but still small. 11.1% of the 20th century writers were female and 10.7% of all entries from 20th century were produced by women. Mean age of male writers ($n = 64$) in the total German list for the first work in the canon was 30.94 years ($SD = 9.11$, median = 28.00, lowest modus = 24), for all works in the canon it was 35.93 ($SD = 12.84$, median = 33.00, lowest modus = 24). The female ($n = 5$) age peak was higher than the male one (cf. Miller, 1999, p. 85). It was 35.40 ($SD = 7.77$, median = 33.00, lowest modus = 27) for the first work and 37.29 ($SD = 7.13$, median = 33.00; lowest modus = 27) for all works in the canon. See Figure 8 for the distributions of both sexes regarding German canon entries.

Figure 8. Number of entries in the German literary canon (18th to 20th century), by age and sex of the writer.
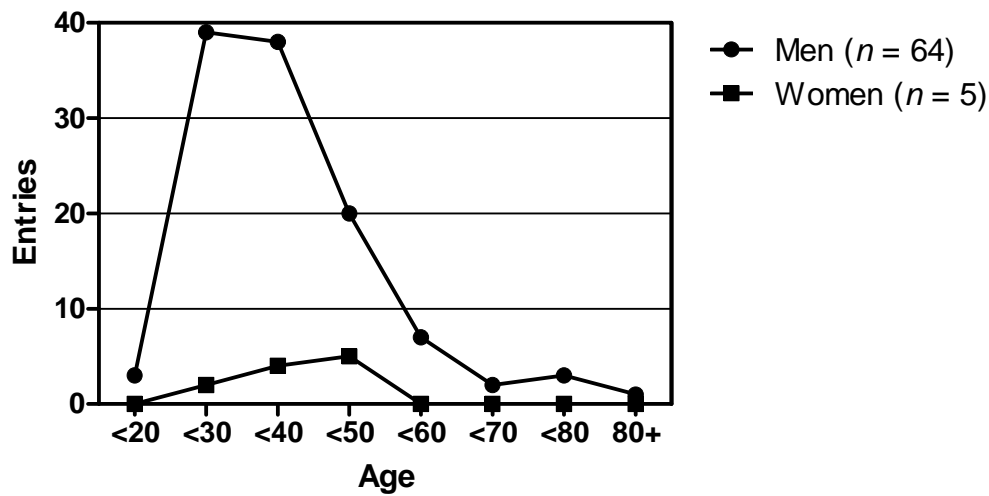
In the American list, 16.8% of all writers were female with 15.8% of all entries being achieved by women after all. Hence, for the American list, the female contribution was slightly higher than for the German list. Mean age of male writers ($n = 134$) for the first work in the American canon was 35.54 years ($SD = 10.86$, median = 34.00, modus = 26). For all male works in the American canon, the male age mean was 40.63 ($SD = 12.60$, median = 39.00, lowest modus = 26) and, thus, slightly higher than for the German list. For female writers ($n = 27$), it was 37.59 ($SD = 10.89$, median = 35.00, lowest modus = 27) for the first work and 41.47 ($SD = 12.39$, median = 37.00, lowest modus = 27) for all works in the canon. See Figure 9 for the distributions of both sexes regarding American canon entries.

Figure 9. Number of entries in the US American literary canon (20th century), by age and sex of the writer.
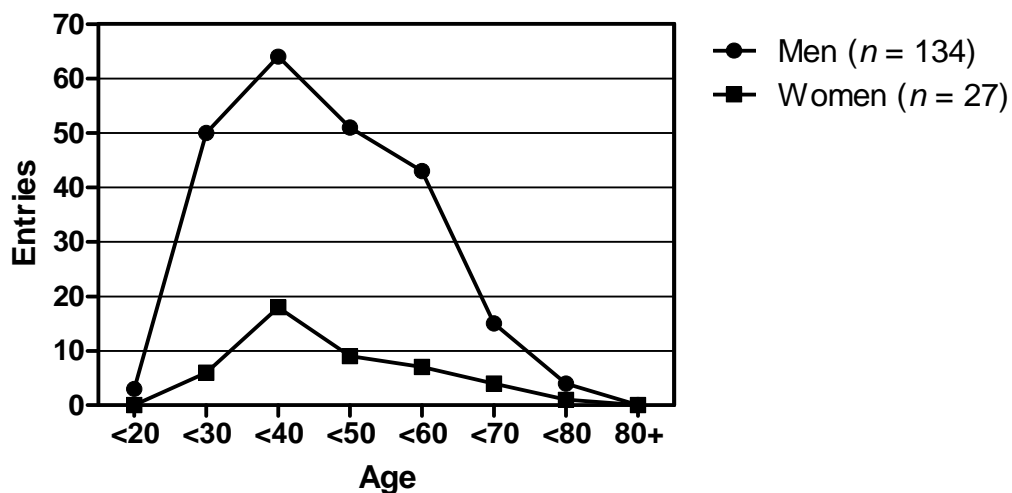
As can be seen from both figures, the data basically confirm the hypothesis of a higher male than female share in the production of literature.

5.3.2 The relation between markers of literary and mating success

Most importantly, it was checked for correlations between markers of literary and those of mating and reproductive success, which was done only with respect to male writers, because the number of female writers was too low. Furthermore, the theory predicts especially a male advantage in mate choice resulting from such cultural displays. The data can be retrieved from Table 11. Note five aspects: (1) Reported p-values were obtained by one-tailed analyses, because the hypotheses clearly predicted the direction of the correlations. (2) The variable age could mediate the relation between number of entries and number of mates, because the higher the age, the more mating and reproductive successes as well as entries are possible to be achieved. Hence, age was chosen as control variable in the statistical analyses. (3) Total score of all mating successes was calculated, but additionally also the total score without marriages, because it was hypothesized that marriages are obstacles for many mating successes (see 5.1). (4) For some writers, not for all categories of mating successes, findings could be achieved, and for a few writers, no mating successes could be found at all. These cells remained, thus, empty in SPSS. As this reduces actual sample size for some analyses (see degrees of freedom in small parentheses in Table 11), it affects statistical significance as well. Hence, for some correlations, although high, statistical significance was not given. For instance, research was conducted on writers' female admirers, but only for a few writers information on this aspect could be retrieved. So, the correlations between this mating success and canon entries will not be reported, as sample size was too small (ns < 10). For the same reason, correlations between canon entries and engagements (without marriages) will not be reported either. (5) In order to make a comparison possible between the American and the German list, the data from 20th part of the German list are given separately, as the American list only covers 20th century.

Table 11. Pearson correlation coefficients (one-tailed) between number of male canon entries and the number of mating successes, controlling for age.

Mating success	German list, 18th to 20th century ($N = 64$)	German list, only 20th century ($n = 36$)	US American list, 20th century ($N = 134$)
Marriages	$r_{p(43)} = -.24$	$r_{p(25)} = -.09$	$r_{p(101)} = .05$
Affairs, girlfriends, romances	$r_{p(35)} = .57$ ***	$r_{p(19)} = .73$ ***	$r_{p(37)} = .47$ **
Children	$r_{p(34)} = .28$ *	$r_{p(18)} = .23$	$r_{p(79)} = -.20$ *
Number of mates[1]	$r_{p(52)} = .38$ **	$r_{p(31)} = .64$ ***	$r_{p(102)} = .55$ ***
Total score[2]	$r_{p(57)} = .42$ **	$r_{p(32)} = .55$ ***	$r_{p(102)} = .41$ ***
Total score[2] (w/o marriages)	$r_{p(48)} = .46$ ***	$r_{p(25)} = .66$ ***	$r_{p(88)} = .41$ ***

* $p \leq .05$; ** $p < .01$; *** $p < .001$
df as given by SPSS in small parentheses
1 Total score of marriages, affairs, girlfriends, and romances
2 Total score of all mating successes

As for the actual fitness outcome of writing literature that is number of children, only for the German list, there is statistical significance ($r_{p(34)} = .28$, $p = .05$, one-tailed). Although, for the 18th century, there is a high correlation between canon entries and number of children ($r_{p(2)} = .74$, $p = .13$, one-tailed), due to a low sample size for 18th century, there is no statistical significance. For 19th century, there is a negative but not significant correlation between entries and number of children. For the American list, there is also such a negative correlation, which moreover reaches significance (see Table 11).

5.3.3 Differences in mating success between lyricists and non-lyric writers

As for the hypothesized differences between non-lyric writers and writers who entered the respective canon also with lyric poetry, only one significant different could be found. In the German list, male lyricists had a higher total score of affairs, girlfriends, and romances ($M =$

4.14; $SD = 3.48$) than male writers of other genres ($M = 2.13$, $SD = 1.60$). This difference was statistically significant with a large effect size ($F_{(1, 36)} = 5.99$, $p < .02$, $\eta_p^2 = .143$). No more significant differences between lyricists and non-lyric writers could be found.

It could be argued that this difference between lyricists and non-lyric writers is mediated by other variables, such as age. However, it was found that lyricists, who had more mating successes on average than non-lyric writers, lived even shorter than non-lyric writers (Ms = 58.4 vs. 61.8 years, SDs = 18.2 vs. 15.7) and had thus less time to achieve many affairs. However, this age difference was not statistically significant. What is important here is that the differences between the two groups of writers regarding mating success can not be explained by age differences. Hence, additionally controlling for life age in the ANOVA did only increase effect size estimation at the third decimal place ($\eta_p^2 = .143$ vs. $\eta_p^2 = .144$). Admittedly, lyricists had more entries in the canon on average than non-lyric writers (Ms = 2.6 vs. 2.2; SDs = 1.50 vs. 1.46), and the number of entries correlates positively with mating successes, especially with affairs. But again, the effect of canon entries regarding the differences between the two groups of writers was not significant.

5.3.4 The Trivers-Willard hypothesis

Secondary sex ratios of the writers' offspring were compared to the most typical one of 106 sons to 100 daughters (Trivers, 1985, p. 289). Again, lyricists and writers of other genres were examined separately. See Table 12 for the results. Irrespective of literary genres, there is support for the hypothesis that the Trivers-Willards hypothesis applies to literature and its writers.

Table 12. Secondary sex ratios of the male writers' offspring and statistical values with respect to differences between writers' ratios and the common ratio of 106:100.

	German list, 18th to 20th century ($N = 64$)	German list, only 20th century ($n = 36$)	US American list, 20th century ($N = 134$)
Lyricists	84:100	100:100	136:100
	$\chi^2_{(1)} = 1.311$	$\chi^2_{(1)} = 0.086$	$\chi^2_{(1)} = 1.691$
Non-lyric writers	168:100	239:100	98:100
	$\chi^2_{(1)} = 6.023$ *	$\chi^2_{(1)} = 20.007$ ***	$\chi^2_{(1)} = 0.155$
All writers	138:100	190:100	112:100
	$\chi^2_{(1)} = 1.900$	$\chi^2_{(1)} = 9.896$ **	$\chi^2_{(1)} = 0.079$

* $p < .05$; ** $p < .01$; *** $p < .001$

5.4 Discussion

Almost all writers in the canons were men, as hypothesized. Also with respect to age, the hypotheses were supported by the data, as most works by men were written at an age when mating effort is most important that is when intrasexual competition is still strong and intersexual selection of massive interest (Miller, 1999). Hence, most literary works are not written, when experience as a writer is the highest, namely at old age, but when individuals are opposed to highest selection pressure by sexual selection. Focussing on proximate mechanism, it can be concluded that it is the age when testosterone is definitely still high and when the literary experience based on a general writing talent is already high enough, as predicted. Therefore, these results strongly support an evolutionary perspective.

Comparing Figures 8 and 9, one can conclude that both appear to be similar, especially regarding their right-skewness and the obvious sex differences. However, one could describe Figure 8 as leptokurtic and Figure 9 as platykurtic. Whereas for the German list, there is a sharp age peak in the 30s, strongly supporting the above presented hypothesis of literary production being a product of intrasexual selection, however, the production of American literature with respect to the writers' age seems to be broader distributed. Another slight

difference is that in the German list, contrary to the American list, female age peak is nummerically higher than the male one, as it was the case in Miller's (1999) data. Future research with other canons should clarify these slightly inconsistent findings. In sum, however, Miller's results can be considered to be replicated.

More importantly, for both canons similarly, numerous considerable correlations between markers of literary success and quality on the one hand and mating and reproductive successes on the other hand could be found. As expected, this was the least the case for marriages. As expected, the highest correlations were found for number of affairs, girlfriends and romances, as affairs are mating successes which mainly foster the quantitative reproduction strategy. This result is not only an important verification of an evolutionary perspective, but also a preliminary falsification of the psychoanalytic theory of sublimation with respect to the origin of art.

As for actual fitness outcome, only one positive correlation between literature production and number of children could be found with statistical significance, namely for the total German list (18th to 20th century). For 18th century, the correlation is high, but due to low sample size not statistically significant. Further research with a larger canon of works from this century could, therefore, be worthwhile. Examining only the 20th century part of the German list, no such positive correlation can be found. Examining the American list yielded even a small but significant *negative* correlation between entries and number of children. So, even though writers in both canons and all centuries did have access to the more mates, the more works they produced, this did not constantly pay out with respect to number of children. One possibility to explain the mostly missing positive correlations between literary success and number of children especially in the 20th century, despite the existing correlation between literary success and number of mates, is the availability of effective contraceptives in the 20th century. In accordance with this interpretation, Pérusse (1993) found a correlation between male status and mating success but no such a correlation between male status and number of children. He explained his findings with reference to contraception and enforced monogamy. His study is especially noteworthy, as it took place in 20th century Canada, which is an industrial society and, thus, very similar to 20th century Germany and USA, where the canons origins lie, with respect to several socio-demographic aspects. Also Kanazawa (2008) mentioned a negative correlation between verbal intelligence and number of children. Do these several findings disprove evolutionary assumption on the sexual selection of literature and language in general? There are two reasons for answering this question with no. (1) Instead of considering human beings as reproduction maximizers, they might also be seen as

adaptation executers (Pinker, 1997, pp. 207–208; Tooby & Cosmides, 1992). Hence, they behaviorally show the mechanisms which in our evolutionary past promoted reproduction, although nowadays there might be contrary effects. This explanation is supported by the above presented data showing that writers and poets were obviously talented in attracting mates depending on their writing success. Hence, high literary success is translated into high mating success, but can not constantly be translated into high reproductive success due to specific environmental factors of modern societies. (2) Moreover, not mere quantity of children matters, but their quality as well (Kanazawa, 2008). In this respect, verbal proficiency might still have been evolutionary favored. Hence, further studies could examine not only how many children writers had but also how many grandchildren.

As for the hypothesized difference between lyricists and non-lyric writers, the evidence is not very strong, which might have been due to too many confounding variables. For instance, persons who decide throughout their writing career to also write poetry might fundamentally differ from persons who never decide to write poetry to start with.

The Trivers-Willard hypothesis is partially supported by some data from the German list. But in sum, the findings were inconsistent. Future studies should clarify this inconsistency.

Several objections can be done with respect to the current study. It could be claimed that the differences between the writers with respect to mating success do not reflect reality. Instead it could be that the more famous a writer is, the more likely it is for him to have many entries in a literary canon (or vice versa). And the more famous a writer is, the better studied his personal life is. And the better studied a writer's personal life is, the more mating successes can be found when conducting biographical research. To counter this possible objection, it should be emphasized that for all writers the same procedure and amount of biographical research was conducted (see 5.2). Especially, if taking the German list as an example, it gets clear that the 64 male writers in it represent the prime quality of German literature of the past three centuries and are, thus, probably equally well-studied. My experience during the biographical research was that for no writer gaining the wanted information was particularly problematic compared to other writers. Moreover, if the objection was correct, it would mean with respect to the actual data that, for instance, lyricists or writers with many sons are better studied than other writers, which seems unlikely. In sum, the data are too specific to be merely the result of inaccurate methods.

Another objection could be that in the human environment of evolutionary adaptedness, literature in our sense did not exist. Still, mechanisms underlying modern literary production,

such as verbal proficiency and motivation for public verbal displays, probably did exist and were selected for. Ad-lib poetry or other verbal displays spontaneously presented to the women of one's social group should have had the same positive effect on mating success throughout the stone ages under non-literate conditions as writing literature has today.

However, one could still claim that the sexual dimorphism regarding the production of literature has no biological foundation but is a cultural phenomenon caused by patriarchy. Dabbs (2000, p. 47) does so when stating that it is true that "there are more male than female names in literature, but the number of famous men may say more about limited opportunities for women than the literary superiority of men. […] Literary men might be surprised to learn that men have less verbal ability than women". Even if patriarchy was a proper explanation, the reasons for patriarchy would still have to be explained (Miller, 1999). But there are good reasons to assume that women are not precluded from writing books, but that men are simply higher motivated to write books (Lange, in press). Moreover, Dabbs referrs to an advantage of women over men *on average* in the sense of mean values, while sex differences in variance are probably more important here. An extremely verbally proficient man can benefit from his verbal superiority, irrespective of the fact that all men taken together perform worse on linguistic test than all women taken together (see 2.2.2.3.4).

Finally, one objection could be done with reference to the specific topic of this doctoral thesis. It could be claimed that verbal proficiency is not the decisive factor which causes the relation between literary and mating success. Instead, it could be the imaginativeness necessary for writing literature, for instance, which is selected for. It could also be claimed that writing literature enhances one's status with the latter one being selected for. To rule out these objections, it can be simply countered that writing literature does not work without elaborate verbal proficiency. If writing literature increases mating and reproductive success, verbal proficiency is necessarily selected for as well. Furthermore, the data from the German list seem to suggest the possibility of lyricists being especially successful in short-term mating, because lyric poetry consists of many verbal handicaps (Miller, 2000a). Furthermore, writing drama or fiction is more suitable for raising one's status, while writing poetry is especially considered as an activity where no money is in. Still, lyric writers were no less preferred than non-lyric writers, which makes it unlikely that only status gained from writing literature is selected for.

In sum, it can be concluded from the data that even though social factors might change over the centuries, there seems to be a consistent pattern of mate choice-relevant benefits from literary production (Hayes, 1989). Despite social factors, no social-constructivist model exists

which could entirely explain the obtained results. Social factors, either by means of parenting, peer groups or culture in general, are not imaginable which existed throughout three centuries and constantly led women to have the shown preferences (everything else being equal). Strong and various empirical evidences could be presented which show that the production of literature is evolutionarily favored. Especially for men, it should, therefore, be beneficial to their fitness to show verbal displays, for example by creating literature. Therefore, one has to strongly contradict Carroll (2004), Eibl (2004) and others who, even though being general supporters of an evolutionary perspective in the arts, are critical towards the sexual selection of literature. "L'art pour l'art" seems to be an appropriate position only if neglecting the ultimate cause of human life, namely reproduction.

6. General discussion and conclusion

Language is one of the most if not the most complex and multifaceted human trait. Hence, it is impossible to explain all of its features from an evolutionary perspective in a single doctoral thesis. However, many insights in the evolution of language and verbal displays could be provided. To my knowledge, the presented studies are the first ones of their kind and will hopefully foster future evolutionary research on language and language-related human behavior, such as writing literature.

To sum up the main results, sexual selection seems to have favored verbally proficient human beings. Therefore, not least because verbal proficiency is an extremely complex trait, it can be considered a fitness indicator. This conclusion does not imply that there cannot be other fitness indicators or that verbal proficiency is overwhelmingly important compared to other traits only because language is so salient in every-day life. Other fitness indicators exist, be they behavioral, cognitive or somatic/physical. After all, what counts is the overall fitness, which can be expressed by different fitness indicators, which sum up to an overall mate value (Miller, 2000a). Strategies for successful mating are always conditional strategies, depending on the existing circumstances, which might include personal traits such as verbal proficiency (Alexander, 1990). So, there is not only a large variance in each trait, but there are also very different reproductive strategies which are after all the result of the individual's variability (Miller, 2000a).

The theory of sexual selection was the main theoretical background for this doctoral thesis. However, it needs to be emphasized that sexual selection might not explain all features of human language, as natural selection or behaviorist approaches do not so, either. There are many features which cannot be explained by natural selection, namely those which are characterized by obvious waste of mental resources, function as a handicap and are beneficial for mate choice (Miller, 2000a). So, as much as Pinker (1994) and Pinker and Bloom (1990) are critical towards any approach which considers language not as an adaptation created by natural selection, one might as well be critical towards any approach which focuses only on natural selection, considering the obvious waste of many features of language (Miller, 2000a). It could be shown that natural selection can explain why and how language first evolved but cannot explain all its features. However, approaches focusing on natural and those emphasizing the role sexual selection do not exclude each other, because each trait which is beneficial for survival should generally be favored by sexual selection as well, as the trait will be inherited by the offspring, which promotes their chance to procreate themselves. Language

is useful when it comes to mere survival, and this advantage is basically an attractive feature in mate choice (Wildgen, 2004). Apart from that, taking all evidences together, there is strong support for the assumption that language is sexually-selected. However, critique is possible.

Fitch (2005) dedicates some thoughts to the sexual selection of language, but has also to be considered one critic towards this approach, because he claims that language emerges very early in life, while sexually selected traits emerge at puberty. Thus, he denies sexual selection theory to have a considerable potential of explaining human language. To counter this critique, it can be claimed that, although verbal abilities of a three-year-old are remarkable (Pinker, 1994), they do not suffice for proper mate choice, and they do not have to, because little children do not engage in mating effort (Alexander, 1987). Most importantly, an advanced language which suffices the requirements for mate choice (and not some sort of language itself) must be fully developed only at puberty (and not before). Evolution must have favored different forms of traits at the times in ontogeny, when they are most beneficial (Bjorklund & Pellegrini, 2002). If language is used in mate choice, there should have been the highest selective value for advanced language skills, when mate choice becomes relevant that is around puberty. In support of this assumption, primary language acquisition is only possible until puberty (Locke & Bogin, 2006; Miller, 1998, 2000a; Scott-Phillips, 2007; Snowdon, 2004), which is accordingly the time when voice change occurs in men, which is considered a secondary sex characteristic. Hence, one could categorize early acquired features of language as economic and, thus, naturally-selected (Bichakjian, 2002), while later acquired features are more and more complex and costly and, thus, the result of sexual selection. Around puberty, also the abilities for long and coherent discourse and narratives emerges for the first time, which are factors that strongly qualify for being sexually-selected, as was elaborated throughout this doctoral thesis. Especially, the production of narratives and story-telling show strong sex differences, as men produce the majority of literature (Miller, 1999). Hence, Fitch's position is probably too critical.

Moreover, not only cognitive abilities for verbal displays are relevant, but also the motivation to produce such creative displays (Hayes, 1989; Sternberg & Lubart, 1991). So, verbal abilities itself do not suffice if there is no motivation to show them (Sternberg & Lubart, 1991). On the contrary, mere motivation for verbal displays without possessing high verbal proficiency does not suffice either, but is predestined to result in malapropisms and other linguistic mistakes (Lange, 2008). One major problem is linked to the role of androgens with respect to verbal displays. On the one hand, testosterone seems to be a positive factor for male assertiveness and motivation for displays. Moreover, creativity, such as musical

creativity, correlates with low 2D:4D ratios that is with a low ratio between the length of the index finger and the length of the ring finger (Sluming & Manning, 2000). A low 2D:4D ratio, that is a "masculinized" ratio, indicates high prenatal testosterone and low prenatal estrogen and is probably associated with high sperm counts on a physiological level and high assertiveness on a behavioral level (Manning, 2002). Hence, creative displays depend at least partially on the effects of androgens. On the other hand, prenatal as well as circulating testosterone seems to be nonbeneficial for verbal proficiency (Kimura, 2000). Men with low 2D:4D ratios, for instance, score worse on some verbal fluency tests than men with high ratios (Manning, 2002). Hence, there is an ambivalent role of testosterone with respect to verbal displays. One might go as far as to concur with Dabbs (2000, p. 47) who postulates "a trade-off between verbal ability and masculinity". So, one might conclude that there is a contradiction between two major aspects of verbal displays, namely competence, which is negatively affected by testosterone, and motivation for performance, which is positively affected by testosterone. Both competence and performance do not work without each other. There is no proper performance without a correspondingly proper competence (Chomsky, 1965). Hence, further empirical research is needed to elucidate the ambivalent role of testosterone in producing verbal displays. One hypothesis could be the following. As Johnston, Hagel, Franklin, Fink, and Grammer (2001) concluded in their study, testosterone has detrimental effects on health. Thus, high levels of testosterone are markers of good health, because unhealthy men cannot afford high levels of testosterone. Similar to this, it could be that verbal displays are especially fitness-relevant, because testosterone needed to motivate such displays decreases verbal proficiency. Hence, an individual's verbal proficiency must be very high, again in order to afford high levels of testosterone which are needed to display this ability. Apart from this issue, more questions remain with respect to the sexual selection of language.

6.1 Why are men verbally not more proficient than women on average?

If assuming that men benefit more from high verbal proficiency in mate choice than women, the question arises, why do women have slightly higher abilities than men on average in almost all verbal tasks (Kimura, 2000; Wallentin, 2009)? Hyde and Linn (1988) found a small female advantage over men in their meta-analysis, which makes at least clear that men do not outperform women in verbal proficiency, but which should be the case according to sexual selection theory. Generally, this non-existing sex difference could lead to the conclusion that

language is not sexually selected at all if assuming that sexual selection creates phenotypic sex differences. This critique was raised by Buss (2008) and Fitch (2005). Fitch (2005, p. 219) goes as far as to claim that the idea of language being sexually-selected is a "dubious assumption". As neither Buss (2008) nor Fitch (2005) provides profound evidence, their perspective is probably too skeptical towards Miller's (2000a) approach. To counter their critique, one has to recall that there are numerous language-related sex differences, which could be linked to evolutionary processes.

One more specific approach to counter their critique could be to claim that in case of language there is a strong fitness matching between the sexes, which drove the evolution of language by means of sexual selection towards phenotypic equality of the sexes. This process could work even under strict or near-monogamy (Hooper & Miller, 2008). On first sight, there seems to be evidence for this assumption. There is high assortative mating in verbal skills and especially with respect to lexicon size (Mascie-Taylor, 1988; Miller, 2000a). For vocabulary, the correlation is around $r = .41$. For verbal IQ, it is even higher with $r = .46$ (Mascie-Taylor, 1988). Generally, assortative mating can create and maintain a positive genetic correlation between the sexes, resulting in low or even non-existing sexual dimorphism (Lande, 1987; Miller, 1998). These findings are in accordance with Miller's (2000a) claim of a mutual mate choice.

Another possibility to explain this non-existing sex difference in verbal proficiency is sexual recombination. Generally, a trait can be selected for in men because of being especially beneficial for them but not as much for women, but gets transmitted to the female sex by sexual recombination (Lande, 1987; Price & Langen, 1992; Rice & Chippindale, 2001), which even works if the genes coding for the respective trait have detrimental effects for one of the sexes (Cox & Calsbeek, 2009). Hence, sexual recombination could at least partially explain why men do not excel women on average regarding verbal proficiency that is why there is an almost total overlap. This interpretation is supported by the fact that traits which are not sexually dimorphic show high genetic correlations between the sexes, that is, that these traits are coded by the same genes in both sexes. However, traits serving as fitness indicators in polygynous species should be sexually dimorphic with rather small genetic correlations between the sexes, as high genetic correlations between the sexes are a constraint for the evolution of large sexual dimorphisms (Lande, 1987; Poissant et al., 2010). Although, sexual dimorphisms can still evolve, even when genetic correlations between the sexes are high, namely when the sexes differ regarding variance (see 2.2.2.3.4), the problem remains that there is no sex difference in verbal proficiency with respect to mean values. But does this

contradict theories on the sexual selection of language? There are three major reasons for answering this question with no.

(1) Female linguistic advantage was observed in standardized tests in quiet test rooms or laboratories with no one interfering (Locke & Bogin, 2006). Sexual selection would not favor such verbal proficiency, at least not directly. Insted, sexual selection acts on phenotypes which are publicly displayed and, thus, recognized by others. Only if performed, verbal proficiency can fulfill its functions which it evolved to serve for (Hauser et al., 2002; Lieberman, 2000) that is to operate as a fitness indicator. Mere linguistic competence is useless if not displayed. The review on verbal fitness indicators used by men against male rivals (see 2.2.2.3.5) showed that these displays must work in front of an audience. And they must suffice for spontaneously responding to others. Also in this respect, there is a major difference between standardized verbal tests and reality (Locke & Bogin, 2006). The presented data show that verbal displays by men affect mate choice and, thus, potentially reproduction. Verbally proficient men are probably evolutionarily favored independent of the question if there is a female advantage on average or not. Sex differences in verbal performance are more important than those in mere competence (Locke & Bogin, 2006; Rosenberg & Tunney, 2008).

(2) Sexual selection itself might be able to explain why men do not outperform women with respect to mean values. Discrimination of potential mates depends first on the senses and the corresponding perceptual abilities (Miller, 2000a). Physical attractiveness is recognized by one's eyes, an appropriate immune system, for instance, by one's nose, and verbal proficiency by one's ears. However, the senses are only the first gate to be passed. The real judgment of the respective traits depends more on cognitive mechanisms and abilities of the receiver. If verbal proficiency is sexually selected, which would lead to the assumption that men benefit more than women from high verbal proficiency in mate choice, women need to be able to judge a man's verbal proficiency – by being linguistically well-equipped themselves. Generally, there must be male capacities for producing a display and female capacities for judging them. As one needs a sense of humor in order to judge someone's humorous display (Flamson & Barrett, 2008), verbal abilities are needed to judge verbal displays (Miller, 2000a). Hence, the capacities of both individuals – the one judging and the one being judged – are necessarily quite similar, at least so for cognitive traits. Vocabulary is a good example. A high number of words can only be beneficial to a male sender's reproductive success if the female receiver has a comparatively large lexicon in order to understand the male sender and judge whether his usage of words is appropriate. This explanation is compatible and

supported by the above mentioned fact that there is high assortative mating in verbal tests, especially regarding lexicon size (Mascie-Taylor, 1988; Miller, 2000a). These considerations would lead one to expect to find a proper distinction between verbal production and reception. Thurstone (1938) could statistically distinguish between verbal fluency and verbal comprehension, which supports the idea that apart from abstract linguistic competence, there are linguistic entities, which can be linked to proper verbal display production and reception. Women show highest verbal proficiency (e.g., verbal fluency) in the middle of their menstrual cycle, and this is the phase of the cycle when conception is most likely (Halpern, 2000; Hampson & Kimura, 1988; Kimura, 2000) and when female sexual desire peaks (Stanislaw & Rice, 1988). If women are verbally as proficient as men on average, because this was beneficial for female mate choice, women should have the highest verbal proficiency, when conception is most likely that is when proper judging is most important, which seems to be the case. Furthermore, the female advantage in verbal proficiency seems to increase from puberty on (Hyde & Linn, 1988; Maccoby & Jacklin, 1974), which also suggests that sexual selection is at work, which favored women who were able to distinguish between elaborate orators and mere babblers. High verbal abilities would, therefore, be phenotypic optima for both sexes, but for different reasons because of being created by different selection pressures. Still, scientists such as Wallentin (2009) puzzle about female changes of verbal proficiency during the menstrual cycle, even though sexual selection theory provides a reasonable explanation for this from an ultimate perspective.

(3) All of these considerations refer to sex differences in mean values. But average mean numbers are not the only important aspect here. Even though, women slightly outperform men in verbal proficiency *on average*, men are overrepresented in fields in which high status can be gained by high verbal proficiency, as stated above. As (1) there is higher male than female variance with respect to verbal proficiency and (2) verbal proficiency probably affects male more than female mate value, at least by trend, sexual selection theory provides a valid explanation for language nonetheless.

Apart from mate choice itself, other explanations are available for the circumstance that men do not outperform women on average regarding verbal proficiency. One of them focuses on the division of labor between the sexes, to be precise the female affinity to the home base and women's role as mothers. The female obligation for child rearing might have favored verbally proficient women, as children benefit from advanced linguistic input, at least in early stages of language acquisition, because especially words and phonemes are acquired in social interaction with the respective mother and by means of imitation (Pinker, 1994). Contrary to

these female activities, typical activities of ancestral men, such as hunting, do not necessarily require language but often mere silence (Joseph, 2000). Therefore, the fact that men do not outperform women in verbal tests must not be explained by primary mate choice mechanisms (Aitchison, 2000; Dabbs, 2000; Fitch, 2004; Joseph, 2000). In sum, several possible explanations exist for the fact that men do not outperform women lingustically.

6.2 Future research

Which future studies on language as a fitness indicator could be conducted? First, the presented result should be replicated. Second, several extensions of the current studies are imaginable. Some of them have already been mentioned in the discussion sections of the three studies.

Apart from that, one question remains, namely why men are verbally not more proficient than women on average. The current studies show preliminary support that male verbal proficiency and verbal displays are stronger under sexual selection than female ones. Several plausible explanations were presented for the puzzling fact that men do not outperform women verbally. Still, future research might give further insights into this matter.

Since external validity of laboratory experiments is limited, future research could also aim to replicate the present findings by means of field experiments or field studies. One could, for instance, study mate choice opportunities of male poetry slam competitors right after their competition.

Another possibility could be to focus on the genetic level in future studies. Fitness indicators phenotypically correlate with each other, and these correlations might be due to shared genetic influence (Miller, 2000a), which can be subsumed under the term "genetic correlation" (Falconer & Mackay, 1996; Plomin et al., 2001). There are high genetic correlations between general cognitive abilities and language skills (Butcher et al., 2006; Haworth, Dale, & Plomin, 2009; Haworth et al., 2009). As several studies reported correlations between physiological symmetry and intelligence (Bates, 2007; Prokosch et al. 2005), between physiological symmetry and developmental stability (Prokosch et al. 2005; Thoma et al., 2005), between health on the one hand and intelligence and verbal intelligence on the other hand (Kanazawa, 2006) and between vocabulary size and body symmetry (Prokosch et al., 2005), the question could be if there are also genetic correlations between verbal proficiency on the one hand and body or facial symmetry and health or other fitness indicators on the other hand. If language serves as a fitness indicator, the answer should be

yes (Miller, 2000a). Using multivariate genetic analyses, this question could be answered. Similar to estimations of heritabilities, a large sample of individuals with known degrees of relationships would be needed in order to determine how much of the co-variance of two traits, with verbal proficiency being one of them, is due to genetic co-variance (Butcher et al., 2006; Lynch, 1999; Plomin et al., 2001). This could be the next step in the study of verbal proficiency as fitness indicator.

7. Reference list

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8. Appendix

Appendix 1: Texts used by actor and actress

Level 1	Level 2	Level 3
Hallo, ich bin Stefan/ie. Ich bin 27/22 Jahre alt. [Ich / Und] habe grade mein … äh … Studium erfolgr … äh … mit Erfolg fertig gemacht. Ich bin … äh … stellvertetene/r Abteilungsleiter/in in einer … äh … angehenden … äh … aufgehenden Firma für Software. Die hat über Hundert Leute.	Hallo, ich heiße Stefan/ie. Ich bin 27/22 Jahre alt, und [ich] habe gerade mein Studium erfolgreich beendet. … Äh… Ich arbeit[e] als stellvertretende/r Abteilungsleiter/in in einer … äh … aufstrebenden Softwarefirma. Die hat über Hundert Mitarbeiter.	Hallo, mein Name ist Stefan/ie. Ich bin 27/22 Jahre alt, habe gerade mein Studium erfolgreich abgeschlossen und arbeite als stellvertretende/r Abteilungsleiter/in in einer aufstrebenden Softwarefirma, bei der über Einhundert Mitarbeiter tätig sind.
Ich verdiene nicht so viel als wie mein Chef. Aber so insgesamt … äh … sind es trotzdem sehr gut. Und ich glaub, dass [es] sehr bald … äh… sehr viel mehr sein wird. Und total viel muss es [ja] am Amfang [… äh… Anfang] ja nicht … äh… sein, ne?! Mein Chef hat mich bisher meistens gut gefunden. Also…äh …Das macht mich …äh… mir Hoffnung für die Zukunft.	Ich verdiene nicht ganz so viel als … [äh / ja] … wie mein Chef. Insgesamt verdiene ich trotzdem sehr gut. Und ich glaube, dass es sehr bald deutlich mehr sein wird. …Äh… Und übertrieben viel muss es am Anfang nicht unbedingt sein. Mein Chef hat mich bisher überwiegend gut bewertet. Das stimmt mich zuversichtlich.	Ich verdiene nicht ganz so viel wie mein Chef, aber insgesamt trotzdem sehr gut, wobei ich glaube, dass es sehr bald schon noch deutlich mehr sein wird, und exorbitant viel muss es [ja] für den Anfang nicht unbedingt sein. Bisher wurde ich von meinem Chef überwiegend positiv bewertet, was mich zuversichtlich stimmt.
[Ja] Ich bin wahnsinnig gerne unter Leute. Und ich gehe gerne [viel] weg oder …äh… mach Sport. Ich lese aber auch gern mal, …äh… z.B. Bücher vom Kochen oder …äh… Bücher, wo ich noch was […äh…] lernen kann fürn Beruf. Ich komm [so] ganz gut mit andere Leute [zurecht / klar] und … äh … [ja] weil ich so ganz offen bin. Und Musik mach ich auch … äh … mit Klavier.	Ich bin wahnsinnig gesellig und gehe gerne viel mit Freunden weg oder mach[e] Sport. …Äh… Ich lese aber auch gerne mal, z.B. Bücher übers Kochen oder welche, aus denen ich … äh… noch was lernen kann … äh … beruflich gesehen. Ich komme ziemlich gut mit anderen Leuten zurecht. Ähm… und bin insgesamt sehr offen. Musikalisch bin ich auch … Äh … ich spiele [nämlich] Klavier.	Ich bin ausgesprochen gesellig und gehe gerne [häufig] mit Freunden weg oder treibe Sport, lese aber auch gerne, z.B. Kochbücher oder solche zur beruflichen Weiterbildung. Ich bin sehr tolerant und offen anderen Menschen gegenüber. Außerdem bin ich musikalisch, denn ich spiele Klavier.

Appendix 2: German instruction read to the participants for the pre-rating of the video clips

Du wirst gleich ein Video sehen. Dabei geht es um sprachliche Fähigkeiten bzw. sprachliche Kompetenz bzw. sprachliche Gewandtheit bzw. sprachliche Begabung. Gib bitte an, wie hoch oder niedrig du die sprachlichen Fähigkeiten dieser Person einschätzt. Um zu wissen, was mit hohen sprachlichen Fähigkeiten gemeint ist, kannst du dich bspw. an einem bekannten Fernsehmoderator, einem Nachrichtensprecher oder an dem kommenden amerikanischen Präsidenten Barack Obama orientieren. Um zu wissen, was mit niedrigen sprachlichen Fähigkeiten gemeint ist, kannst du dich bspw. an den üblichen Talkshowgästen bei Oliver Geißen orientieren, also eben an Personen, die sprachlich sehr unbegabt sind. Ich spiele nun das Video ab.

[Abspielen eines der Videoclips]

Gib nun bitte an, wie hoch du die sprachlichen Fähigkeiten dieser Person einschätzt. Wenn du die sprachlichen Fähigkeiten dieser Person als hoch einschätzt, dann mache ein Kreuz bei „hoch". Wenn du die sprachlichen Fähigkeiten dieser Person als niedrig einschätzt, dann mache ein Kreuz bei „niedrig". Nutze ansonsten bitte die Kästchen dazwischen, um den Grad der sprachlichen Fähigkeiten anzugeben, indem du eines der anderen Kästchen ankreuzt.

Appendix 3: Scale used for the pre-rating

☐　　☐　　☐　　☐　　☐　　☐　　☐　　☐　　☐

hoch　　　　　　　　　　　　　　　　　　　　niedrig

IfP INSTITUT für PSYCHOLOGIE
UNIKASSEL
VERSITÄT

Lieber Studienteilnehmer,

Sie haben soeben ein Video mit einer Frau gesehen.

Geben Sie bitte an, wie attraktiv Sie diese Frau einschätzen. Gemeint ist die gesamte Attraktivität der Frau, d.h. die Akzeptabilität als Partnerin. Wenn Sie die Frau als hoch attraktiv einschätzen, machen Sie ein Kreuz bei „hoch". Wenn Sie die Frau als unattraktiv einschätzen, machen Sie ein Kreuz bei „niedrig". Nutzen Sie andernfalls bitte die Kästchen dazwischen, um den Grad der Attraktivität anzugeben, indem Sie eines der anderen Kästchen ankreuzen.

1. Geben Sie nun bitte an, wie attraktiv Sie die Frau einschätzen würden als Kurzzeitpartnerin (Affäre, Liebschaft, One-Night-Stand, unverbindlicher sexueller Kontakt usw.) für Sie.

☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

hoch   niedrig

2. Geben Sie nun bitte an, wie attraktiv Sie die Frau einschätzen würden als Langzeitpartnerin (feste, verbindliche Partnerin) für Sie.

☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

hoch   niedrig

INSTITUT für PSYCHOLOGIE

UNIKASSEL
VERSITÄT

Liebe Studienteilnehmerin,

Sie haben soeben ein Video mit einem Mann gesehen.

Geben Sie bitte an, wie attraktiv Sie diesen Mann einschätzen. Gemeint ist die gesamte Attraktivität des Mannes, d.h. die Akzeptabilität als Partner. Wenn Sie den Mann als hoch attraktiv einschätzen, machen Sie ein Kreuz bei „hoch". Wenn Sie den Mann als unattraktiv einschätzen, machen Sie ein Kreuz bei „niedrig". Nutzen Sie andernfalls bitte die Kästchen dazwischen, um den Grad der Attraktivität anzugeben, indem Sie eines der anderen Kästchen ankreuzen.

1. Geben Sie nun bitte an, wie attraktiv Sie den Mann einschätzen würden als Kurzzeitpartner (Affäre, Liebschaft, One-Night-Stand, unverbindlicher sexueller Kontakt usw.) für Sie.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

hoch   niedrig

2. Geben Sie nun bitte an, wie attraktiv Sie den Mann einschätzen würden als Langzeitpartner (fester, verbindlicher Partner) für Sie.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

hoch   niedrig

IfP INSTITUT für PSYCHOLOGIE
U N I K A S S E L
V E R S I T Ä T

Lieber Studienteilnehmer,

Im Folgenden werden Ihnen Aussagen präsentiert. Geben Sie bitte an, wie sehr Sie den einzelnen Aussagen zustimmen bzw. diese ablehnen, indem Sie jeweils eines der Kästchen ankreuzen. Wenn eine Aussage voll auf Sie zutrifft, machen Sie bitte ein Kreuz bei „Zustimmung". Wenn eine Aussage überhaupt nicht auf Sie zutrifft, machen Sie bitte ein Kreuz bei „Ablehnung". Nutzen Sie andernfalls bitte die Kästchen dazwischen, um den Grad der Zustimmung bzw. Ablehnung anzugeben, indem Sie eines der anderen Kästchen ankreuzen.

1. Mir ist wichtig, eine Partnerin zu haben, die ein Universitätsstudium absolviert hat.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Zustimmung   Ablehnung

2. Mir ist wichtig, eine Partnerin zu haben, die beruflich erfolgreich ist.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Zustimmung   Ablehnung

3. Mir ist wichtig, eine Partnerin zu haben, die gut verdient.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Zustimmung   Ablehnung

4. Mir ist wichtig, eine Partnerin zu haben, die gesellig ist.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Zustimmung   Ablehnung

5. Mir ist wichtig, eine Partnerin zu haben, die sportlich ist.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Zustimmung   Ablehnung

6. Mir ist wichtig, eine Partnerin zu haben, die gerne liest.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Zustimmung   Ablehnung

7. Mir ist wichtig, eine Partnerin zu haben, die kochen kann.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Zustimmung   Ablehnung

8. Mir ist wichtig, eine Partnerin zu haben, die sich bildet bzw. weiterbildet.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Zustimmung   Ablehnung

9. Mir ist wichtig, eine Partnerin zu haben, die tolerant und offen anderen Menschen gegenüber ist.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Zustimmung   Ablehnung

10. Mir ist wichtig, eine Partnerin zu haben, die musikalisch oder sonst irgendwie künstlerisch begabt ist.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Zustimmung   Ablehnung

11. Mir ist wichtig, eine Partnerin zu haben, die hohe sprachliche Fähigkeiten besitzt.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Zustimmung   Ablehnung

12. Mir ist wichtig, eine Partnerin zu haben, die körperlich attraktiv ist, also gut aussieht.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Zustimmung   Ablehnung

13. Mir ist wichtig, eine Partnerin zu haben, die intelligent ist.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Zustimmung   Ablehnung

Zum Abschluss bitte ich Sie um die Beantwortung einiger Fragen. Sie können versichert sein, dass alle Angaben anonym sind und eine Identifizierung Ihrer Person nicht möglich ist.

Wie alt sind Sie? _____

Sind Sie zurzeit in einer Partnerschaft?   □ ja   □ nein

Wenn ja, würden Sie sagen, dass es sich eher um eine Kurzzeitbeziehung (kurze Affäre usw.) oder eher um eine Langzeitbeziehung (feste, verbindliche Partnerschaft) handelt, in der Sie sich momentan befinden?

  □ Kurzzeitbeziehung   □ Langzeitbeziehung

Wenn Sie momentan in keiner Partnerschaft sind, aber gerne in einer wären, würden Sie sich eher eine Kurzzeitbeziehung (kurze Affäre usw.) oder eher eine Langzeitbeziehung (feste, verbindliche Partnerschaft) wünschen?

  □ Kurzzeitbeziehung   □ Langzeitbeziehung

Wie viele Sexualpartnerinnen hatten Sie bisher in Ihrem Leben? _____

Welche sexuelle Orientierung haben Sie?   □ heterosexuell   □ homosexuell

Vielen Dank für Ihre Teilnahme
Benjamin P. Lange

Lieber Studienteilnehmerin,

Im Folgenden werden Ihnen Aussagen präsentiert. Geben Sie bitte an, wie sehr Sie den einzelnen Aussagen zustimmen bzw. diese ablehnen, indem Sie jeweils eines der Kästchen ankreuzen. Wenn eine Aussage voll auf Sie zutrifft, machen Sie bitte ein Kreuz bei „Zustimmung". Wenn eine Aussage überhaupt nicht auf Sie zutrifft, machen Sie bitte ein Kreuz bei „Ablehnung". Nutzen Sie andernfalls bitte die Kästchen dazwischen, um den Grad der Zustimmung bzw. Ablehnung anzugeben, indem Sie eines der anderen Kästchen ankreuzen.

1. Mir ist wichtig, einen Partner zu haben, der ein Universitätsstudium absolviert hat.

   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

Zustimmung   Ablehnung

2. Mir ist wichtig, einen Partner zu haben, der beruflich erfolgreich ist.

   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

Zustimmung   Ablehnung

3. Mir ist wichtig, einen Partner zu haben, der gut verdient.

   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

Zustimmung   Ablehnung

4. Mir ist wichtig, einen Partner zu haben, der gesellig ist.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Zustimmung   Ablehnung

5. Mir ist wichtig, einen Partner zu haben, der sportlich ist.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Zustimmung   Ablehnung

6. Mir ist wichtig, einen Partner zu haben, der gerne liest.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Zustimmung   Ablehnung

7. Mir ist wichtig, einen Partner zu haben, der kochen kann.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Zustimmung   Ablehnung

8. Mir ist wichtig, einen Partner zu haben, der sich bildet bzw. weiterbildet.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Zustimmung   Ablehnung

9. Mir ist wichtig, einen Partner zu haben, der tolerant und offen anderen Menschen
gegenüber ist.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Zustimmung   Ablehnung

10. Mir ist wichtig, einen Partner zu haben, der musikalisch oder sonst irgendwie künstlerisch begabt ist.

☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

Zustimmung   Ablehnung

11. Mir ist wichtig, einen Partner zu haben, der hohe sprachliche Fähigkeiten besitzt.

☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

Zustimmung   Ablehnung

12. Mir ist wichtig, einen Partner zu haben, der körperlich attraktiv ist, also gut aussieht.

☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

Zustimmung   Ablehnung

13. Mir ist wichtig, einen Partner zu haben, der intelligent ist.

☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

Zustimmung   Ablehnung

Zum Abschluss bitte ich Sie um die Beantwortung einiger Fragen. Sie können versichert sein, dass alle Angaben anonym sind und eine Identifizierung Ihrer Person nicht möglich ist.

Wie alt sind Sie? _____

Sind Sie zurzeit in einer Partnerschaft?　　　　□ ja　　　　□ nein

Wenn ja, würden Sie sagen, dass es sich eher um eine Kurzzeitbeziehung (kurze Affäre usw.) oder eher um eine Langzeitbeziehung (feste, verbindliche Partnerschaft) handelt, in der Sie sich momentan befinden?

　□ Kurzzeitbeziehung　　　　　　　　□ Langzeitbeziehung

Wenn Sie momentan in keiner Partnerschaft sind, aber gerne in einer wären, würden Sie sich eher eine Kurzzeitbeziehung (kurze Affäre usw.) oder eher eine Langzeitbeziehung (feste, verbindliche Partnerschaft) wünschen?

　□ Kurzzeitbeziehung　　　　　　　　□ Langzeitbeziehung

Wie viele Sexualpartnerinnen hatten Sie bisher in Ihrem Leben? _____

Welche sexuelle Orientierung haben Sie?　　□ heterosexuell　　□ homosexuell

Vielen Dank für Ihre Teilnahme
Benjamin P. Lange

Appendix 6: German instruction read to the participants for the rating of the muted video clips

Hallo, vielen Dank für Ihr Kommen und Ihre Bereitschaft zur Teilnahme an meinem Experiment. Mein Name ist Benjamin Lange, und ich bin der Versuchsleiter. Lassen Sie mich vorab etwas zu dem Experiment sagen: Diese Studie dient der wissenschaftlichen Arbeit am Institut für Psychologie der Universität Kassel. Die Daten kommen meiner Doktorarbeit zugute. Alle Angaben, die Sie machen, werden vertraulich behandelt. Für die Veröffentlichung werden nur die statistischen Gesamtwerte verwendet. Die Angaben sind anonym, und eine Identifizierung Ihrer Person ist nicht möglich. Das Experiment wird nur wenige Minuten Ihrer Zeit in Anspruch nehmen. Ich werde Ihnen gleich einen Videoclip zeigen. Das Video enthält keinen Ton. Bitte wundern Sie sich also nicht, wenn Sie nichts hören. Ich spiele das Video jetzt ab. Sehen Sie bitte aufmerksam zu.
[Vorspielen eines der Videoclips, je nach Geschlecht]
Ich möchte Sie nun bitten, das Video zu bewerten. Dafür werde ich Ihnen gleich diesen Fragebogen vorlegen.
[Vorlegen des ersten Fragebogens, je nach Geschlecht]
Füllen Sie diesen Fragebogen bitte aus. Machen Sie bitte auf möglichst jeden Fall Angaben. Wenn Sie nicht sicher sind, was Sie ankreuzen wollen oder sollen, dann kreuzen Sie bitte das an, was am ehesten auf Sie zutrifft. Wenn Sie fertig sind, legen Sie den Fragebogen bitte mit der beschriebenen Seite nach unten in das vor Ihnen stehende Behältnis.
[Nach dem Ausfüllen des Fragebogens]
Ich möchte Sie nun bitten, noch einen weiteren Fragebogen auszufüllen.
[Vorlegen des zweiten Fragebogens, je nach Geschlecht]
Hier gilt das Gleiche wie eben: Füllen Sie diesen Fragebogen bitte aus. Machen Sie bitte auf möglichst jeden Fall Angaben. Wenn Sie nicht sicher sind, was Sie angeben wollen oder sollen, dann geben Sie bitte das an, was am ehesten auf Sie zutrifft. Ich werde Sie nun allein lassen, damit Sie den Fragebogen in Ruhe ausfüllen können. Wenn Sie fertig sind, legen Sie den Fragebogen bitte wieder mit der beschriebenen Seite nach unten in das vor Ihnen stehende Behältnis. Damit wäre Ihre Teilnahme am Experiment beendet, und Sie können dann den Raum verlassen und nach draußen zu mir kommen.

Appendix 7: German instruction read to the participants for the rating of the regular video clips

Hallo, vielen Dank für Ihr Kommen und Ihre Bereitschaft zur Teilnahme an meinem Experiment. Mein Name ist Benjamin Lange, und ich bin der Versuchsleiter. Lassen Sie mich vorab etwas zu dem Experiment sagen: Diese Studie dient der wissenschaftlichen Arbeit am Institut für Psychologie der Universität Kassel. Die Daten kommen meiner Doktorarbeit zugute. Alle Angaben, die Sie machen, werden vertraulich behandelt. Für die Veröffentlichung werden nur die statistischen Gesamtwerte verwendet. Die Angaben sind anonym, und eine Identifizierung Ihrer Person ist nicht möglich. Das Experiment wird nur wenige Minuten Ihrer Zeit in Anspruch nehmen. Ich werde Ihnen gleich einen Videoclip zeigen. Sehen und hören Sie bitte aufmerksam zu.

[Vorspielen eines der Videoclips, je nach Geschlecht]

Ich möchte Sie nun bitten, das Video zu bewerten. Dafür werde ich Ihnen gleich diesen Fragebogen vorlegen.

[Vorlegen des ersten Fragebogens, je nach Geschlecht]

Füllen Sie diesen Fragebogen bitte aus. Machen Sie bitte auf möglichst jeden Fall Angaben. Wenn Sie nicht sicher sind, was Sie ankreuzen wollen oder sollen, dann kreuzen Sie bitte das an, was am ehesten auf Sie zutrifft. Wenn Sie fertig sind, legen Sie den Fragebogen bitte mit der beschriebenen Seite nach unten in das vor Ihnen stehende Behältnis.

[Nach dem Ausfüllen des Fragebogens]

Ich möchte Sie nun bitten, noch einen weiteren Fragebogen auszufüllen.

[Vorlegen des zweiten Fragebogens, je nach Geschlecht]

Hier gilt das Gleiche wie eben: Füllen Sie diesen Fragebogen bitte aus. Machen Sie bitte auf möglichst jeden Fall Angaben. Wenn Sie nicht sicher sind, was Sie angeben wollen oder sollen, dann geben Sie bitte das an, was am ehesten auf Sie zutrifft. Ich werde Sie nun allein lassen, damit Sie den Fragebogen in Ruhe ausfüllen können. Wenn Sie fertig sind, legen Sie den Fragebogen bitte wieder mit der beschriebenen Seite nach unten in das vor Ihnen stehende Behältnis. Damit wäre Ihre Teilnahme am Experiment beendet, und Sie können dann den Raum verlassen und nach draußen zu mir kommen.

Attractiveness variance as accounted for by different verbal proficiency given as F- / χ^2- and η_p^2-values, by type of relationship ($N = 138$)

Relationship type		
Short-term	Long-term	Total[1]
$F = 3.29^*$, $\eta_p^2 = .047^a$	$F = 15.85^{***}$, $\eta_p^2 = .194^a$	$F = 12.75^{***}$, $\eta_p^2 = .162^a$
$F = 3.99^*$, $\eta_p^2 = .057^b$	$F = 16.77^{***}$, $\eta_p^2 = .203^b$	$F = 13.21^{***}$, $\eta_p^2 = .167^b$
$\chi^2 = 4.46$, $\eta_p^2 = .033^c$	$\chi^2 = 23.90^{***}$, $\eta_p^2 = .174^c$	$\chi^2 = 15.13^{**}$, $\eta_p^2 = .110^c$

$^*\ p < .05$; $^{**}\ p < .01$; $^{***}\ p < .001$
For all F-values $df = 2, 132$; for all χ^2-values $df = 2$
1 Mean score of short-term and long-term ratings
a Results obtained by running an ANOVA using the original data
b Results obtained by running an ANOVA using the logarithmically transformed data
c Results obtained by running a Kruskal-Wallis test using the original data. η_p^2-values were calculated by dividing the χ^2-values by $N - 1$.

Appendix 9: Sex differences regarding mate choice criteria

Means and statistical values (one-tailed) for the sex differences pertaining to the obtained mate choice criteria

Preference for a mate…	Means		Differences	
	Men	Women	t	d
	($n = 138$)	($n = 138$)		
…holding a university degree	4.51	4.73	− 0.74	< − 0.1
...being professionally successful	5.63	6.59	− 4.14 ***	− 0.50
…making good money	4.57	5.76	− 5.00 ***	− 0.60
…being sociable	7.66	7.59	0.39	< 0.1
…being sporty	6.60	6.15	2.05 *	0.25
…enjoying to read	5.32	5.46	− 0.54	< − 0.1
…being able to cook	5.93	5.41	2.01 *	0.24
…educating himself/herself	7.38	7.71	− 1.97 *	− 0.24
…being tolerant	7.84	8.46	− 4.39 ***	− 0.53
…being artistically talented	4.33	4.59	− 1.00	− 0.12
…being attractive	7.53	6.81	4.11 ***	0.49
…being intelligent	7.83	8.02	− 1.41	− 0.17
…being verbally proficient	5.77	5.63	0.57	< 0.1

Note: Sex refers to the sex of participant.
* $p < .05$; *** $p < .001$

Appendix 10: Correlations between the preference for verbally proficiency and other mate choice criteria

Correlations (Pearson, two-tailed) between self-reported preference for a mate being verbally proficient and other mate choice criteria

Preference for a mate…	Men ($n = 138$)	Women ($n = 138$)
…holding a university degree	$r = .24$ **	$r = .33$ ***
...being professionally successful	$r = .15$	$r = .12$
…making good money	$r = .16$	$r = .26$ **
…being sociable	$r = .05$	$r = -.08$
…being sporty	$r = .26$ **	$r = -.03$
…enjoying to read	$r = .36$ ***	$r = .35$ ***
…being able to cook	$r < .01$	$r = .18$ *
…educating himself/herself	$r = .37$ ***	$r = .16$
…being tolerant	$r = .24$ **	$r = .13$
…being artistically talented	$r = .27$ **	$r = .33$ ***
…being attractive	$r = .16$	$r < .01$
…being intelligent	$r = .35$ ***	$r = .26$ **

Note: Sex refers to the sex of participant.
* $p < .05$; ** $p < .01$; *** $p < .001$

Appendix 11: Questionnaire used in the fertility experiment (Chapter 4)

Liebe Studienteilnehmerin,

Sie haben soeben ein Video mit einem Mann gesehen.

Geben Sie bitte an, wie attraktiv Sie diesen Mann einschätzen. Gemeint ist die gesamte Attraktivität des Mannes, d.h. die Akzeptabilität als Partner. Wenn Sie den Mann als hoch attraktiv einschätzen, machen Sie ein Kreuz bei „hoch". Wenn Sie den Mann als unattraktiv einschätzen, machen Sie ein Kreuz bei „niedrig". Nutzen Sie andernfalls bitte die Kästchen dazwischen, um den Grad der Attraktivität anzugeben, indem Sie eines der anderen Kästchen ankreuzen.

1. Geben Sie nun bitte an, wie attraktiv Sie den Mann einschätzen würden als Kurzzeitpartner (Affäre, Liebschaft, One-Night-Stand, unverbindlicher sexueller Kontakt usw.) für Sie.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

hoch   niedrig

2. Geben Sie nun bitte an, wie attraktiv Sie den Mann einschätzen würden als Langzeitpartner (fester, verbindlicher Partner) für Sie.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

hoch   niedrig

Liebe Studienteilnehmerin,

Im Folgenden werden Ihnen Aussagen präsentiert. Geben Sie bitte an, wie sehr Sie den einzelnen Aussagen zustimmen bzw. diese ablehnen, indem Sie jeweils eines der Kästchen ankreuzen. Wenn eine Aussage voll auf Sie zutrifft, machen Sie bitte ein Kreuz bei „Zustimmung". Wenn eine Aussage überhaupt nicht auf Sie zutrifft, machen Sie bitte ein Kreuz bei „Ablehnung". Nutzen Sie andernfalls bitte die Kästchen dazwischen, um den Grad der Zustimmung bzw. Ablehnung anzugeben, indem Sie eines der anderen Kästchen ankreuzen.

1. Mir ist wichtig, einen Partner zu haben, der ein Universitätsstudium absolviert hat.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Zustimmung   Ablehnung

2. Mir ist wichtig, einen Partner zu haben, der beruflich erfolgreich ist.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Zustimmung   Ablehnung

3. Mir ist wichtig, einen Partner zu haben, der gut verdient.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Zustimmung   Ablehnung

4. Mir ist wichtig, einen Partner zu haben, der gesellig ist.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Zustimmung   Ablehnung

5. Mir ist wichtig, einen Partner zu haben, der sportlich ist.

☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

Zustimmung   Ablehnung

6. Mir ist wichtig, einen Partner zu haben, der gerne liest.

☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

Zustimmung   Ablehnung

7. Mir ist wichtig, einen Partner zu haben, der kochen kann.

☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

Zustimmung   Ablehnung

8. Mir ist wichtig, einen Partner zu haben, der sich bildet bzw. weiterbildet.

☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

Zustimmung   Ablehnung

9. Mir ist wichtig, einen Partner zu haben, der tolerant und offen anderen Menschen gegenüber ist.

☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐   ☐

Zustimmung   Ablehnung

10. Mir ist wichtig, einen Partner zu haben, der musikalisch oder sonst irgendwie künstlerisch begabt ist.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Zustimmung   Ablehnung

11. Mir ist wichtig, einen Partner zu haben, der hohe sprachliche Fähigkeiten besitzt.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Zustimmung   Ablehnung

12. Mir ist wichtig, einen Partner zu haben, der körperlich attraktiv ist, also gut aussieht.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Zustimmung   Ablehnung

13. Mir ist wichtig, einen Partner zu haben, der intelligent ist.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Zustimmung   Ablehnung

14. Eine Person, die Schriftsteller ist, ist ein interessanter potentieller Partner für mich.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Zustimmung   Ablehnung

15. Ich lese gerne Romane oder sonstige belletristische Literatur wie Theaterstücke.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Zustimmung   Ablehnung

16. Stellen Sie sich vor, Sie treffen einen Menschen, den Sie bereits auf den ersten Blick als Traumpartner bezeichnen würden, so dass Sie, wenn Sie dessen Attraktivität beurteilen müssten, die Wertung „hoch" vergeben würden. Während der ersten Unterhaltung merken Sie jedoch, dass Ihr Gegenüber sich schlecht artikulieren kann, permanent auf der Suche nach den richtigen Worten ist und zahlreiche sprachliche Fehler wie das Verwechseln von Wörtern begeht, also sprachlich unbegabt ist. Wie hoch bewerten Sie nun die Attraktivität dieses Menschen?

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

hoch   niedrig

17. Lesen Sie bitte folgendes Gedicht und geben Sie danach an, wie gut es Ihnen gefallen hat:

Am Grunde der Moldau wandern die Steine
Es liegen drei Kaiser begraben in Prag.
Das Große bleibt groß nicht und klein nicht das Kleine.
Die Nacht hat zwölf Stunden, dann kommt schon der Tag.

Es wechseln die Zeiten. Die riesigen Pläne
Der Mächtigen kommen am Ende zum Halt.
Und gehn sie einher auch wie blutige Hähne
Es wechseln die Zeiten, da hilft kein Gewalt.

Am Grunde der Moldau wandern die Steine
Es liegen drei Kaiser begraben in Prag.
Das Große bleibt groß nicht und klein nicht das Kleine.
Die Nacht hat zwölf Stunden, dann kommt schon der Tag.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

gut   schlecht

Zum Abschluss bitte ich Sie um die Beantwortung einiger Fragen. Sie können versichert sein, dass alle Angaben anonym sind und eine Identifizierung Ihrer Person nicht möglich ist.

Wie alt sind Sie? _____

Sind Sie zurzeit in einer Partnerschaft? □ ja □ nein

Wenn ja, würden Sie sagen, dass es sich eher um eine Kurzzeitbeziehung (kurze Affäre usw.) oder eher um eine Langzeitbeziehung (feste, verbindliche Partnerschaft) handelt, in der Sie sich momentan befinden?

□ Kurzzeitbeziehung □ Langzeitbeziehung

Wenn Sie momentan in keiner Partnerschaft sind, aber gerne in einer wären, würden Sie sich eher eine Kurzzeitbeziehung (kurze Affäre usw.) oder eher eine Langzeitbeziehung (feste, verbindliche Partnerschaft) wünschen?

□ Kurzzeitbeziehung □ Langzeitbeziehung

Wie viele Sexualpartner hatten Sie bisher in Ihrem Leben? _____

Welche sexuelle Orientierung haben Sie? □ heterosexuell □ homosexuell / lesbisch

Verwenden Sie zurzeit hormonelle Verhütungsmittel (Pille, Verhütungspflaster, Verhütungsimplantate, Verhütungsring, hormonelle Injektion zur Verhütung etc.)?
□ ja □ nein

Sind Sie zurzeit schwanger? □ ja □ nein

Stillen Sie zurzeit? □ ja □ nein

Für die Beantwortung der folgenden Fragen möchte ich Sie bitten, sehr genau zu überlegen, da diese Information sehr wichtig ist:

Vor wie vielen Tagen begann Ihre letzte Menstruation? _____

In voraussichtlich wie vielen Tagen wird Ihre nächste Menstruation beginnen? _____

<div align="right">

Vielen Dank für Ihre Teilnahme
Benjamin P. Lange

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Erklärung

Hiermit versichere ich, dass ich die vorliegende Dissertation selbständig und ohne unerlaubte Hilfe angefertigt und andere als die in der Dissertation angegebenen Hilfsmittel nicht benutzt habe. Alle Stellen, die wörtlich oder sinngemäß aus veröffentlichten oder unveröffentlichten Schriften entnommen sind, habe ich als solche kenntlich gemacht. Kein Teil dieser Arbeit ist in einem anderen Promotions- oder Habilitationsverfahren verwendet worden.

Ein Teil der im dritten Kapitel präsentierten Daten war Gegenstand eines Vortrags von mir auf der 27. Jahrestagung der Deutschen Gesellschaft für Phoniatrie und Pädaudiologie in Aachen vom 17. bis 19. September 2010. Eine Kurzfassung dieses Vortrags wurde veröffentlicht als: Lange, B. P. (2010). Sprache als Fitnessindikator - experimentelle Befunde zur Evolutionspsychologie der Sprache. In A. am Zehnhoff-Dinnesen & M. Gross (Hrsg.), *Aktuelle phoniatrisch-pädaudiologische Aspekte 2010, Band 18* (S. 232-234). Warendorf: Darpe.

Ein Teil der im fünften Kapitel präsentierten Daten war Gegenstand einer Posterpräsentation von Harald A. Euler und mir auf der 22. Jahrestagung der Human Behavior and Evolution Society in Oregon, USA, vom 16. bis 20. Juni 2010 sowie eines Vortrags von mir auf der 11. Tagung "Menschliches Verhalten in Evolutionärer Perspektive" in Berlin vom 22. bis 24. März 2010.

Benjamin P. Lange