CHAPTER 1

Introduction: Evolved Responses to an Uncertain World

This dissertation incorporates research from behavioral decision-making, evolutionary psychology, and behavioral ecology to improve our understanding on human decision-making behavior. Throughout the chapters of my dissertation, different topics will be covered, but they will all deal with the aspect of how our psychology attends to risks and uncertainties in the environment. Most of the time, a special emphasis will be given to evolutionary thinking since it directs researchers to identify socially and ecologically important domains and as well as psychologically important dimensions. As an example for how such an evolutionary approach can help us to reveal important features of human decision-making behavior and provide insights into the nature of human decision rationality, I will review a theory from evolutionary biology—life-history theory. Here, we will learn how the uncertainty in decision-makers' personal and ecological environment determines adaptive individual differences in the rate of future discounting and how this relates to the selection of different reproductive strategies and risk-taking behavior. Subsequently, I will introduce the main research chapters of my dissertation.

The Evolution of Life Histories

Life-history theory, a theory subset of evolutionary biology and behavioral ecology, argues that biological aspects of the life course (e.g. age at maturation) result from trade-offs when allocating finite effort among survival, current reproduction, and future reproduction (Horn, 1978; Roff, 1992; Stearns, 1992; Low, 2000). The underlying logic is that patterns of birth, growth and death (i.e. life-histories) result from competing costs and benefits of different allocations at different times in the life cycle. At any given point of time, the organism can decide whether to spend energy on its own body (*somatic effort*: thermo-regulation, eating, avoiding predators, etc.) or to spend energy in reproduction, which can be attracting a mate (*mating effort*) or in caring for offspring (*parental effort*) (Low, 1978; Roff, 1992, 2002; Stearns,

1992). Another typical trade-off, well studied in behavioral ecology, includes deciding how much energy to allocate to producing 'more offspring' vs. spending 'more energy to each of fewer offspring' (MacArthur & Wilson, 1967; Daan & Tinbergen, 1997).

Which patterns of expenditure are most effective for long term reproductive success depends on the environment the organism is facing: in environments with longer life expectancy it might pay to invest effort in growth and development, whereas in an environment with shorter life expectancy, it might be advantageous to reproduce earlier (e.g. Harvey & Zammuto, 1985).

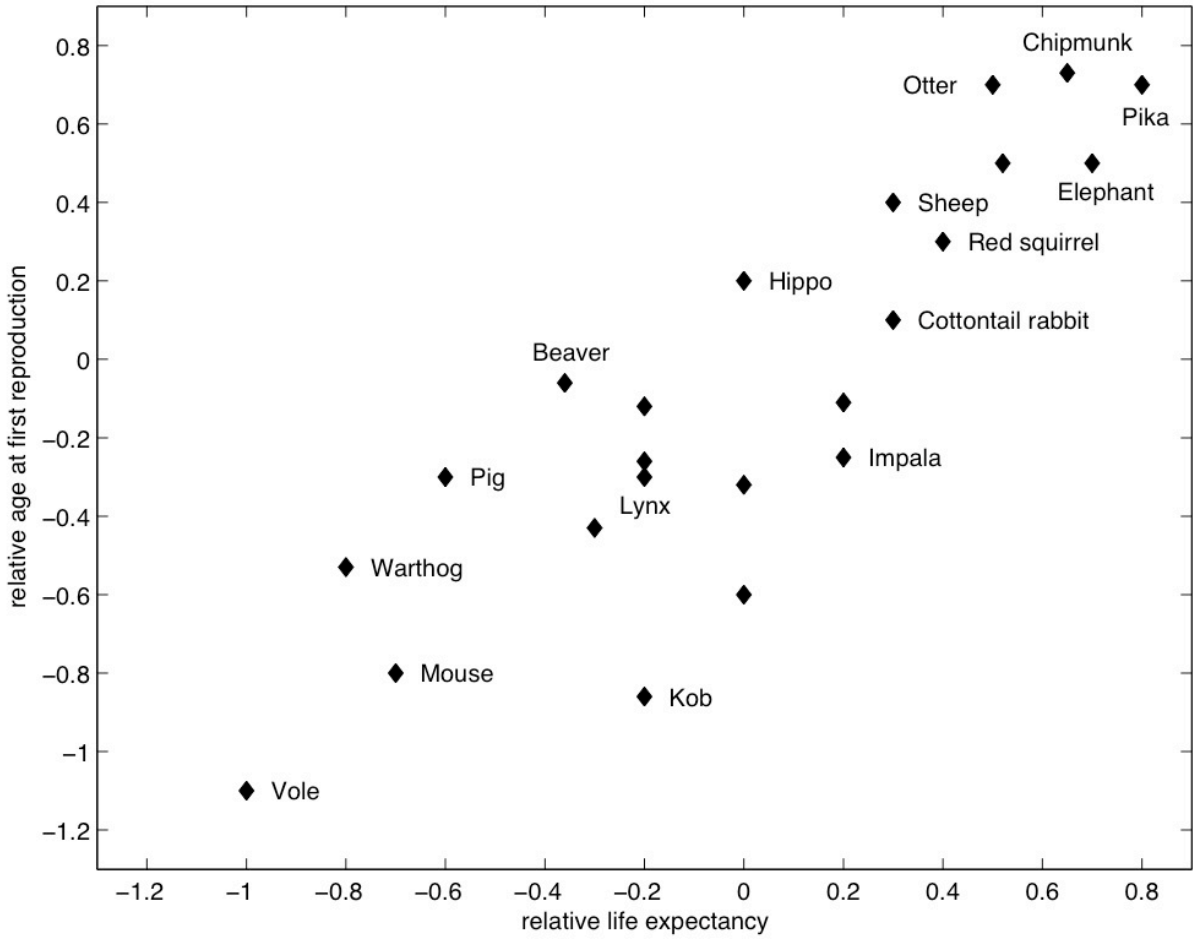

Figure 1.1 Relative age at first reproduction plotted against relative life expectancy at birth for 24 species of mammals (after Harvey and Zammuto, 1985), adapted from Stearns (1992).

Life-history theory can be applied to risk-taking decisions in general since risk-taking is clearly related to survival and reproduction. There is good evidence that patterns of risk-taking are correlated to variables which are also important life-history theory variables such as sex, age, marital status and parenting (Wilson & Daly, 1985; Byrnes, Miller & Schafer, 1999; Allman, Rosin, Kumar & Hasenstaub, 1998; Chisholm, 1993; Daly & Wilson, 2001) and including life-history theory into existing models of risk-taking has already been shown to be advantageous

(e.g. Hill, Ross & Low, 1997; Hill & Chow, 2002). For instance, Hill and colleagues (1997) found that persons with higher future unpredictability beliefs and shorter lifespan assessments are more risk prone in their behaviors—even after accounting for classic predictors of risk taking (e.g., sex or risk propensity). This study is especially significant since it shows that a functional perspective encompasses characteristics both from the person and from the environment: Peoples' perceptions about the future are informed by their environment and these perceptions in turn affect how people adapt their (risk-) behaviors to local life circumstances.

Related findings have been raised in other studies: Life expectancy itself may be a salient determinant of risk-taking and the timing of life transitions (Wilson & Daly, 1997; Stearns, 1992). Wilson and Daly (1997) looked at demographic data for 77 Chicago neighborhoods in the years 1988-1993. More specifically, they looked at how male life expectancy and homicide rates go together in any of these districts. They could show that life expectancy at birth (ranging from 54 to 74 years) and homicide rates (ranging from 1 to 156 per 100.000 per year) are highly negatively correlated, even when controlling for deaths directly resulting out of homicides. Adding measures of economic inequality increased predictive power, but life expectancy itself was the stronger (and better) predictor (Wilson & Daly, 1997). The finding suggests that in neighborhoods with low life expectancy, which means in neighborhoods where the future is uncertain, men are more prone to end up in risky behaviors, are more likely to get killed. This effect becomes particularly strong when appearing in proximity of relative youth and poverty (Bell & Bell, 1993) and has been termed by some authors as the *young male syndrome* (Wilson & Daly, 1985). Further, Wilson and Daly (1997) collected evidence that when homicide rates go up, not only life expectancy goes down, but also does age at reproduction, which means women give birth to children already at younger ages. Such shifts in time of reproduction, such trade-offs can be predicted via evolutionary life-history theory as described above. Wilson and Daly (1997, p. 1273) conclude that

> people behave as if they have adjusted their rates of future discounting and risk acceptance thresholds in relation to local life expectancy, and that they do so in the nonviolent domain of reproductive decision making as well as in the potentially violent domain of social competition. (p. 1273)

and that "adjustment of discount rates in relation to age and other variables is just what we should expect of an evolved psyche functioning normally" (p. 1271). When the future is uncertain (i.e. when one is young) then it might be rational from a life history perspective to

discount the future more strongly, to be more impulsive and more risk prone. Many life-history variables can act as (temporal) reference points for adaptive choices. Reduction in the values of these reference points can make survival and reproductive goals more eminent and risky options worth taking. Hence, similarly to risk-sensitive foragers in the animal world that adjust their risky choices according to energy-budgets and requirements (see Stephens & Krebs, 1987), humans perceive risks and make risky choices in accordance with their (reproductive) goals and deadlines in life.

Dealing with uncertainty in domains of everyday life

Subjective expectations about survival probability (i.e. lifespan assessment) and environmental resource unpredictability (i.e. future unpredictability) seem to affect the ways individuals engage in risky behavior (e.g. Hill, Ross & Low 1997; Wilson & Daly, 1997), but is risk-taking really a domain general phenomenon? Along the lines of evolutionary psychologists who stress the role of domain-specificity in human judgment and choice as one of their central tenets (e.g. Cosmides, 1989), recent work from behavioral decision-making suggested that there are inter- and intra-individual differences in people's risk propensity for different content domains (Blais & Weber, 2002; Weber, Blais, & Betz, 2002). People who exhibit a strong risk-seeking tendency in one domain might not necessarily be risk-averse in other domains. The second chapter of my dissertation will deal with these claims and report on the development of a psychometric instrument that assesses how people deal with risks and uncertainties in different domains of everyday life.

Dealing with uncertainty regarding mate quality

For sexually reproducing animals, mate choice is among the most important (risky) decision-making domains since it entails combining one's own genes with another individuals' genes to produce offspring (Miller & Todd, 1998). However, there is not only risk in which mate to choose, but individuals are also often willing to take risks to get a potential mate's interest—a behavior well known from males in their teens and twenties (e.g., Wilson & Daly, 1985). The question of *why* young males engage into these often dangerous kinds of behaviors (e.g., driving cars or motorcycles too fast, binge drinking or engaging in extreme sports) has not only been a magnet for sociologists and personality psychologists, but also received interest from evolutionary psychologists, because these sex differences in human risk-taking suggest a sexually selected trait.

Evolutionary psychologists argued that males engage into these high levels of risk-taking, because they want to advertise their genetic quality by demonstrating a high-cost signal and that such a signal (i.e., a sexual cue) might be part human mating behavior. Only these costly "handicap" signals are evolutionarily stable indicators of their producer's quality, because cheap signals are too easy for low-quality imitators to fake (Zahavi and Zahavi, 1997). In the third chapter of my dissertation we will focus on such sexual cues and, more specifically, will investigate if risk-taking behavior acts as a cue for mate quality.

Dealing with uncertainty in resources

Decision-making under risk and uncertainty is a topic that is also of high interest to biologists, in particular those in the field of cognitive and behavioral ecology. A well-studied decision-making problem in the animal literature is one that's faced by food-seeking (or resource-seeking) organisms, which is to time the moment of leaving a patch of food and moving to the next (Bell, 1991). In the animal world, resources are often distributed unevenly and there is uncertainty in the quality of such resource patches. Animals have to decide between continuing to search at their current location, and risk that it's empty, or risking to voyage out into the unknown in an attempt to find a new, better patch. Research in biology has analyzed these kinds of patch-departure decisions by modeling the mechanisms animals could utilize and has calculated in which environments they work well (e.g., Iwasa, Higashi, & Yamamura, 1981).

The research program of the Center for Adaptive Behavior and Cognition (ABC) also accentuates this relation between mechanisms and environments (Gigerenzer, Todd, ABC Research Group, 1999; Gigerenzer, 2001; Todd, 2000). The research program argues that strategies modern individuals (unconsciously) use and the behaviors they express are a result of the interaction between their evolved psychology and the environment in which they live. Along these lines, the fourth dissertation chapter applies concepts from behavioral ecology to psychological research on human decision-making under uncertainty to investigate if humans apply ecologically rational decision rules—here, patch-leaving rules for deciding when to give up on one patch (or task) and move to the next—when foraging in variable resource environments.