

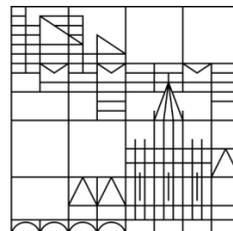
Risky or not?

Characterizing Intuitive Health Risk Perception

Dissertation zur Erlangung
des akademischen Grades eines
Doktors der Naturwissenschaften

vorgelegt von
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an der

Universität
Konstanz



Mathematisch-naturwissenschaftliche Sektion
Fachbereich Psychologie

Tag der mündlichen Prüfung: 29. Juli 2015

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DANKSAGUNG

Liebe Britta Renner und lieber Harald Schupp, als Doktoreltern seid Ihr mit mir durch die Höhen und Tiefen der Erstellung dieser Dissertation gegangen - mit wissenschaftlichem Rat, aber auch mit freundschaftlicher Unterstützung. Vielen lieben Dank für alles!

Lieber Ralf Schmäzle, vielen lieben Dank für all die guten Gespräche, Fachsimpeleien, aufmunternden Worte, für ehrliches Lob und manchmal auch berechtigten Tadel! Ohne Dich hätte es diese Dissertation nicht gegeben, Punkt!

Vielen lieben Dank an Angela Whale! Without you, I would still be lost in translation.

Vielen lieben Dank an meine Arbeitsgruppe(n), an Ursula Kirmse, Susanne Heinzelmann, Tobias Fleisch, Christoph Becker, Martin Imhof und insbesondere an meinen Mitstreiter Frank Häcker. Vielen Dank an Gudrun Sprösser, Katrin Ziesemer, Marijn Stok, Bettina Ott, Helge Giese und insbesondere an Freda-Marie Hartung, die mir so viel geholfen hat. Ich danke Euch allen für Eure vielfältige Unterstützung bei der Erstellung dieser Dissertation, für schöne Kaffeepausen und die vielen guten Gespräche! Mein besonderer Dank an dieser Stelle gilt dabei meiner Kollegin und Freundin Martina Gamp! Liebe Martina, ich weiß nicht, woher Du all Deine Energie nimmst, aber ich danke Dir sehr dafür, dass Du mir immer wieder so viel davon abgegeben hast. Danke auch an alle unsere hervorragenden Hilfswissenschaftler, insbesondere an Julia Mohs, die mir immer wieder so viel Arbeit abgefangen hat.

Vielen lieben Dank an meine Mutter Christine! Statt vieler Worte möchte ich Dir einfach diese Dissertation widmen - vielen Dank für alles! Vielen lieben Dank an meine große Schwester Verena! Danke, dass Du immer für mich da bist – als Schwester, als Mentorin, als Vorbild, als Freundin. Vielen lieben Dank an meinen Vater Rainer! Du hast mir vorgelebt, wie man mit Freude über das schreibt, was einen interessiert. Vielen Dank für Deine Unterstützung! Vielen lieben Dank an meine Großmutter Edeltraud! Danke für Deinen unerschütterlichen Stolz auf mich!

Vielen lieben Dank an meine Freunde, insbesondere an Rebecca Wäldin, eine wunderbare Diplomandin und Freundin, an Martin Kiesel, den besten Freund, den man sich nur vorstellen kann, an Adrian Kaufmann und Stefan Escher, an René Greiss und an alle anderen, die mich unterstützt haben. Vielen Dank!

ABSTRACT

Previous research on health risk perception has revealed that people make snap judgments about potential health threats resulting from encounters with unacquainted people. Since HIV is still a dangerous threat in this context, many studies trying to broaden the understanding for the mechanisms underlying these judgments concentrated on this infectious disease. Recent research examined HIV risk perception by measuring neural responses while participants performed evaluations of HIV risk. Results showed that individuals perceived as 'risky' regarding HIV elicit a differential brain response compared to those perceived as 'safe'. Since these brain responses preceded conscious thinking, the results supported the notion that these responses are based on intuitive processes. Although these findings provided elementary insights into the mechanisms underlying health risk perception, they have also raised new and important questions. Therefore, further studies were conducted for the present dissertation in order to establish a broader understanding of these processes.

The first study addressed the question of whether previously observed differential ERP responses to unacquainted people being perceived as either 'risky' or 'safe' are specific to infectious, life-threatening diseases, such as HIV, or a general mechanism also triggered by life-threatening but non-infectious diseases. Therefore, dense sensor EEG was recorded while participants evaluated photographs of unacquainted individuals for either HIV or leukemia risk. While the ERP results replicated previous findings by revealing differential brain responses towards individuals perceived as risky in terms of HIV, no such differences could be found for leukemia risk. These findings suggest that intuitive risk judgments are at least in part specific to infectious diseases (e.g. HIV) rather than reflecting a generic response to terminal diseases.

The second study addressed possible gender differences in intuitive impressions of HIV risk. Results from studies on evaluations of attractiveness and trustworthiness, a trait closely related to HIV risk ratings, revealed differences in ratings associated with the target's gender as well as the perceiver's gender. However, previous studies on HIV risk impressions only employed opposite-sex paradigms, precluding the investigation of possible gender differences. To address this issue, the second study used a paradigm containing same sex as well as opposite sex evaluations to investigate the effect of perceiver's sex vs. target person's gender. Female and male participants rated perceived HIV risk as well as seven risk-related trait characteristics for 120 photographs of target persons (half female and half male). Results revealed that male targets were perceived as more risky than female targets and that male perceivers gave higher HIV risk ratings for both male and female targets as compared to female perceivers. These

findings support the notion that health risk perception actually is influenced by both the perceiver's and the target's gender.

The third study investigated the influence of contextual cues on HIV risk perception. Towards this end, three groups of participants viewed one of three different picture sets. The first group viewed pictures of persons in a natural context. For the second and the third groups the same pictures were then edited to obtain two further picture sets: one set showing only the stimulus person, with the background masked, and one set only showing only the background, with the stimulus person masked. According to their stimulus set participants were asked to either evaluate the HIV risk of the presented person or the probability that a risky person might find themselves in the presented context. The HIV risk ratings for the original pictures and the person-only pictures were highly correlated. Furthermore, context ratings significantly predicted HIV risk impressions for the original pictures whenever the mean ratings of the context pictures opposed those of the person only pictures. Accordingly, contextual cues can influence the risk evaluation of a person in specific situations.

The results reported in this dissertation provide important steps towards establishing a broader understanding of the underlying mechanisms of health risk perception which has been assumed to be part of the so-called behavioral immune system. This system gathers cues underlying snap judgments about unacquainted people. According to the reported findings, this system is not only able to make discriminations based on differentiations between healthy and sick people but also between infectious and non-infectious diseases. Furthermore, the system is dependent on the gender of the perceiver and the perceived target and occasionally even uses contextual information. These findings broaden the understanding of intuitive health risk perception and should be considered in theoretical models as well as in practical health promoting campaigns.

ZUSAMMENFASSUNG

Studien zur Gesundheitsrisikowahrnehmung haben gezeigt, dass man sich in Bezug auf potenzielle Gesundheitsrisiken, die von fremden Personen ausgehen, blitzschnell ein Urteil bildet. Da HIV in diesem Zusammenhang immer noch eine gefährliche Bedrohung ist, haben sich viele Studien auf diese Infektionskrankheit konzentriert, um das Verständnis für die den Urteilen zugrunde liegenden Mechanismen auszubauen. Neuere Studien haben die Risikowahrnehmung in Bezug auf HIV durch die Aufzeichnung von Hirnreaktionen während der Einschätzung des HIV-Status von fremden Personen untersucht. Die Resultate dieser Studien zeigten, dass Personen, die als gefährlich wahrgenommen werden, eine andere Hirnreaktion hervorrufen als solche Personen, die als ungefährlich empfunden werden. Da diese Hirnreaktionen der bewussten Wahrnehmung zeitlich vorrausgehen, kann man davon ausgehen, dass sie auf intuitiven Prozessen basieren. Obwohl diese Ergebnisse elementare Einblicke in die grundlegenden Mechanismen der Gesundheitsrisikowahrnehmung ermöglichten, haben sie zudem noch weitere neue und wichtige Fragen aufgeworfen. Daher wurden im Rahmen der vorliegenden Dissertation weitere Studien durchgeführt, die zu einem breiteren Verständnis für diese Prozesse führen sollen.

Studie I widmete sich der Frage, ob zuvor beobachtete unterschiedliche Hirnreaktionen in Bezug auf fremde Personen, die entweder als gefährlich oder ungefährlich in Bezug auf HIV wahrgenommen werden, spezifisch sind für ansteckende Krankheiten oder einen generellen Mechanismus darstellen, der unabhängig vom Grad des Ansteckungspotenzials für alle Krankheiten beobachtbar ist. Dazu wurde mittels Hochdichte-Elektroenzephalographie untersucht, wie Versuchspersonen auf Bilder von fremden Personen reagieren, während sie diese in Bezug auf eine mögliche HIV- und Leukämieerkrankung einschätzten. Die EKP-Resultate replizierten den Befund, dass als riskant in Bezug auf HIV eingeschätzte Personen eine modulierte Hirnreaktion hervorrufen. Dieser Effekt ließ sich jedoch nicht für Leukämie zeigen. Die Ergebnisse legen nahe, dass intuitive Risikobewertungen zumindest teilweise spezifisch für sexuell übertragbare Krankheiten (wie HIV) sind und nicht eine generelle Reaktion auf Krankheiten widerspiegeln.

Die zweite Studie befasste sich mit potenziellen Geschlechtsunterschieden bezogen auf den intuitiven HIV-Risikoeindruck. In Studien zur Attraktivität und Vertrauenswürdigkeit (eine Eigenschaft, die eng mit dem wahrgenommenen HIV-Risiko verknüpft ist) hatten sich Unterschiede gezeigt, die mit dem Geschlecht sowohl der Zielperson als auch des Beurteilenden in Verbindung gebracht werden können. Allerdings verwendeten die bisherigen Studien zur

HIV-Risikowahrnehmung nur gegengeschlechtliche Paradigmen, mit denen man nicht nach systematischen Geschlechtsunterschieden suchen konnte. Daher beinhaltete die zweite Studie sowohl gegen- als auch gleichgeschlechtliche Personenbewertungen. Weibliche und männliche Probanden bewerteten 120 Personenbilder (hälftig weibliche und männliche Personen) in Bezug auf das wahrgenommene HIV-Risiko und sieben weitere risikobezogene Eigenschaften. Dadurch konnten Geschlechtsunterschiede aufgeschlüsselt werden. Die Ergebnisse zeigten, dass Männer als riskanter eingeschätzt werden als Frauen und dass die Probanden negativerer HIV-Einschätzungen machten als die Probandinnen. Diese Ergebnisse unterstützen die Annahme, dass die gesundheitsbezogene Risikowahrnehmung beeinflusst wird von sowohl dem Geschlecht des Betrachters als auch von der betrachteten Person.

Die dritte Studie untersuchte den Einfluss der Umgebung auf die HIV-Risikowahrnehmung. Dazu sahen sich drei Probandengruppen je einen von drei verschiedenen Bildersätzen an. Die erste Gruppe betrachtete Bilder von Personen in natürlichen Umgebungen. Für die zweite und dritte Gruppe wurden die Bilder so bearbeitet, dass die zweite Gruppe nur die Personen auf den Bildern zu sehen bekamen und die dritte Gruppe nur die Umgebungen ohne die jeweiligen Personen. Je nach Bildersatz sollten die Probanden dann das von der gezeigten Person ausgehende HIV-Risiko beurteilen oder beurteilen, mit welcher Wahrscheinlichkeit sich in der jeweiligen Umgebung eine HIV-positive Person aufhalten könnte. Die Beurteilungen für den Originalbildersatz und für Personenbildersatz zeigten eine hohe Korrelation. Zudem prädizierten die Umgebungsbewertungen signifikant die Beurteilungen für die Originalbilder immer dann, wenn die mittlere Personenbewertung und die mittlere Umgebungsbewertung nicht übereinstimmten. Die Umgebung kann also in bestimmten Fällen die risikobezogene Personenwahrnehmung beeinflussen.

Die in dieser Dissertation berichteten Ergebnisse sind ein wichtiger Schritt auf dem Weg zu einem umfassenderen Verständnis für Mechanismen, die der Wahrnehmung von Gesundheitsrisiken zugrunde liegen und von denen man annimmt, dass sie Teil des sogenannten Verhaltens-Immunsystems sind. Dieses System sammelt Informationen, um blitzschnell Personenbeurteilungen vorzubereiten. Gemäß den Ergebnissen wird dabei nicht nur zwischen krank und gesund unterschieden sondern auch zwischen ansteckend und nicht ansteckend. Zudem zeigt sich das System geschlechtsabhängig und nutzt wenn nötig Umgebungsinformationen. Diese Ergebnisse erweitern das Verständnis für die intuitive Gesundheitsrisikowahrnehmung und sollten daher sowohl in theoretischen Modellen als auch in praxisbezogenen Gesundheitskampagnen Beachtung finden.

GENERAL INTRODUCTION

More than thirty years after discovering HIV, there is still no cure for the disease. Residents of western countries might feel comparably safe due to considerable achievements in medical science and wide-spread knowledge about how to avoid an infection. However, pure knowledge does not always appear to be sufficient to induce risk reduction or risk avoidance. Risky behaviors like unsafe sexual intercourse demonstrate how people put their health at stake despite sufficient knowledge about possible negative consequences. Hence, a broader understanding about mechanisms of health risk perception is needed.

The Importance of Health Risk Perception

Over the course of human history, infectious diseases have always been one of the main causes of death. Hence, the risk of being infected and dying from a disease has always triggered risk assessment and the quest for adequate avoidance strategies. Unfortunately, risk cannot be sensed directly; we cannot hear, see, or taste risk. Nevertheless, people gauge risks, then respond and react to risky situations. Accordingly, risk perception, even without a distinct sense for risk, must exist. So what is risk perception?

Risk perception has been defined as the “*ability to sense and avoid harmful environmental conditions*”, which is a therefore necessary ability for all living organisms (Slovic, 1987). In fact, the ability to sense and react to risky situations represents a clear evolutionary advantage and helps humans survive in an environment rich in threats to both health and life. Early studies on risk perception have shown how risk perception substantially affects behavior (Fischhoff, Slovic, Lichtenstein, Read, & Combs, 1978). In addition, the human brain commands another risk perception related skill: the ability to foresee and gauge even abstract risks. Accordingly, humans are able to protect themselves from being infected with a multitude of diseases like HIV just by knowing that specific behaviors, like unprotected sex, might lead to an infection. Hence, most models of risk perception and subsequent decision making focus on this ability when explaining or defining risk or risky behaviors. While classic cognitive models propose that people decide deliberately and rationally how to react to risky situations, more recent approaches suggest that emotions shape risk-related decisions (Evans, 2008).

How do we perceive Risks?

Cognitive imprinted models explain risk with two basic factors: the probability of a harmful future event and the extent of damage caused by that event. According to this definition of risk, decisions depend on judgments about different possible reactions to a risky situation. These judgments are made according to their respective assumed outcome. In this consequentialist perspective, feelings have no influence on the decision making process (Loewenstein, Weber, Hsee, & Welch, 2001). Decisions are made analytically, meaning risk is rated explicitly, consciously and in a controlled and voluntary fashion. This process of risk evaluation requires high levels of effort and therefore has a rather slow performance rate. Accordingly, the analytic method only works when there is enough time to become well acquainted with someone. Such models of risk perception are popular in economics, where it is necessary and - to some extent - possible to measure and describe risk in concrete figures.

However, research on risk perception has revealed that people do not perceive risk according to numbers and statistics about risk probabilities (French & Marteau, 2007; Renner, Schüz, & Sniehotta, 2008). In everyday life situations, people often simply lack the time or expertise to perform complex risk assessing processes and therefore must react promptly. As a consequence, behaviors in risky situations often deviate from a logical or rational reaction and appear to be inadequate when considering to the consequences of the shown behavior (Loewenstein et al., 2001). Especially in risky situations, decisions might be strongly influenced by emotions, thereby preventing us from rational and considered decisions. Accordingly, the risk-as-feelings theory describes emotions and cognitions as equivalent factors influencing decision making processes (Loewenstein et al., 2001). In contrast to other models viewing emotions as a consequence of decisions, emotions are here seen as gut feelings which are present at the moment of a decision and therefore influential in the decision making process. Accordingly, such ratings work implicitly, preconsciously and in a spontaneous and mainly affective fashion (Evans, 2008).

Affective reactions are faster and more automated than cognitive reactions (Zajonc, 1984). People might show affective reactions even before they are aware of the emotional content of a stimulus. According to the Feelings-as-Information theory, such affective processes are a source of information for subsequent risk judgments (Schwarz, 2010). It has been proposed, that emotional reactions on risk stimuli might even occur completely without cognitive processing except for basic perceptual processes (Loewenstein et al., 2001). Hence, most everyday behavior might be influenced by affective reactions although we are not even aware of these reactions (Slovic & Peters, 2006). Supporting evidence for the existence of such

affective reactions comes from electroencephalographic studies. Here, it has been revealed that affective stimulus processing, e.g. while viewing high risk stimuli compared to low risk stimuli, is associated with enlarged late positive potentials (LPP) between 300 and 700 ms after stimulus onset (Schmälzle, Schupp, Barth, & Renner, 2011). Accordingly, a multitude of studies have consistently revealed that emotional stimuli such as natural scenes, facial expressions, words and symbolic gestures elicit larger LPPs as compared to neutral control stimuli (Flaisch, Häcker, Renner, & Schupp, 2011; Kissler, Herbert, Peyk, & Junghöfer, 2007; Schupp, Junghöfer, Weike, & Hamm, 2004; Schupp et al., 2007; Wieser, McTeague, & Keil, 2011).

The Social Nature of Health Risk Perception

Humans are social creatures. Living and working together has allowed man to successfully populate the entire planet. Nevertheless, being within striking distance of other people has often resulted in disputes, wars and devastating infectious diseases, all of which have caused untold deaths over the course of human history. Accordingly, people need to be able to gauge the risk of other people. They do so by processing relevant sensory information, making judgments about social meaning and relevance and subsequently deciding whether to interact or not (Adolphs, 2005). But there is one crucial problem: virtually all information is relevant for social behavior (Adolphs, 2005). Hence, research on risk-related person perception must examine how people reach judgments about the riskiness of an unacquainted person and precisely what information they rely on.

A multitude of studies have shown that people easily reach evaluations of traits or psychological states simply by viewing the face of a target person (Zebrowitz, 2006). Furthermore, when responding to the perceived attractiveness of a target person, people displayed distinct assumptions about the possibility of specific life-events that might occur in the future of the respective target person – the more attractive, the brighter the future (Dion, Berscheid, & Walster, 1972). These judgments might of course be imprecise and defective, but they lead to the notion that person perception is to some extent pattern-based and intuitive instead of being deliberate and founded in objective information. Actually, some studies have shed light on how fast this systems actually works. The beholder of a stimulus person comes to a consistent impression in less than one second (Bar, Neta, & Linz, 2006; Willis & Todorov, 2006), e.g. when evaluating the risk deriving from that person. The risk judgment was stable regardless of whether the stimulus person was presented for just a few hundred milliseconds or an unlimited duration (Bar et al., 2006). The same results apply for the evaluation of trustworthiness (Willis & Todorov, 2006). In contrast to perceived risk and trustworthiness,

these results could not be found for perceived intelligence (Bar et al., 2006). It has been suggested that this result reveals the evolutionary importance of intuitive judgments about unacquainted people. Evaluations of intelligence are not important for survival, while the perception of a potential risk is essential and therefore automatic and intuitive (Bar et al., 2006).

With respect to the importance of intuition in everyday thinking (Bargh & Chartrand, 1999; Frith & Frith, 2008), especially in the broad field of social and sexual thinking processes (Ariely & Loewenstein, 2006; Ditto, Pizarro, Epstein, Jacobson, & MacDonald, 2006; Stacy, Ames, Ullman, Zogg, & Leigh, 2006), it has been suggested that impressions of a partner's safety may stem from intuitive stimulus processing (Schmälzle, Renner, & Schupp, 2012). According to these findings, recent neuroscientific studies revealed that a differentiation in brain responses between individuals being perceived as risky or safe in terms of HIV risk occurs faster than 300 ms (Renner, Schmälzle, & Schupp, 2012; Schmälzle et al., 2012; Schmälzle et al., 2011). This early processing precedes conscious and therefore deliberate brain activities, supporting the notion of an intuitive and pattern-based risk evaluation. Accordingly, explicit and deliberate ratings of a person might be based on preceding spontaneous intuitive evaluations. Actually, it was even assumed, that a greater share of our spontaneous everyday behavior depends on this implicit evaluation system (Bargh & Chartrand, 1999; Gilovich & Griffin, 2002). As such, a broad range of literature suggests that peoples' understanding of risk derives more from an 'intuitive sensing' than 'deliberate analysis' (Loewenstein et al., 2001; Slovic & Peters, 2006).

Studying Intuitive Health Risk Perception: HIV as a Model System

Infectious diseases are one of the main social sources of risk for human beings. While some, e.g. chlamydia, are easy to handle with antibiotics, others are complicated to treat and can even become life-threatening, like hepatitis or HIV. In the case of the latter, despite enormous progresses in the treatment, there is still no cure in sight. While the disease seems to be out of control in some African countries like in Swaziland, where every fourth person is HIV positive, the situation in Western countries is comparatively harmless (WHO, 2014). Nevertheless, with about 80 000 infected people in Germany, infection rates are currently on the rise again (Robert Koch-Institut, 2014). In 2013, there was an increase of ten percent in the infection rate from 2012. Furthermore, despite a substantial reduction of AIDS rates since the 1990s from about 2500 per year to about 500 today, the disease still is a serious challenge and the required life-long treatment comes at a considerable cost (Robert Koch-Institut, 2014).

In lieu of a cure, health promotion organizations rely on prevention strategies in order to protect people from becoming infected. Accordingly, they try to inform the population about

the risks and infection routes in order to increase risk perception, which is a precondition for the adequate motivation to adjust protective behaviors (Renner & Schupp, 2005; Renner & Schwarzer, 2003c). Actually recent studies have shown that a relatively good factual knowledge about routes of transmission and measures of protection (Weinstock, Berman, & Cates, 2004) raised understandings of adequate protection behaviors. Nevertheless, some findings revealed seemingly ‘irrational’ behaviors shown by sexually active people in real-world. Despite the risk of becoming infected with a mortal disease, many of these people circumvent condom use by relying on illusory strategies such as ‘getting to know the partner’ or ‘learning about his or her sexual history’ (Donovan, 2000; Swann, Silvera, & Proske, 1995; Thompson, Kent, Thomas, & Vrungos, 1999). Unfortunately, these strategies are not effective but rather induce a false sense of control over the risk. Hence, people often tend to consider their own sexual partners to be safe (Gold, Karmiloffsmith, Skinner, & Morton, 1992; Maticka-Tyndale, 1991; Swann et al., 1995; Thompson et al., 1999) and therefore feel safe. Accordingly, people who are infected with HIV often report that they were convinced that their partners were safe (Gold et al., 1992). Since HIV positive persons do usually not show overt signs of infection and since recent research has proposed that the sensing of risk builds on affective and intuitive processes (Renner et al., 2012; Slovic & Peters, 2006), HIV risk perception is an ideal model for studying intuitive risk perception.

Supporting evidence for the intuitive character of HIV risk perception comes from electroencephalographic studies showing that unacquainted target persons differing in HIV risk already elicited systematic differences in brain responses around 180 ms (Schmälzle et al., 2011). As conscious stimulus representation is presumed to depend on several 100 ms of processing time (Chun & Potter, 1995), the differential brain responses to high and low risk stimuli occur too early to be based on deliberate and conscious reasoning (Neely, 1977). Thus, the stimulus-driven engagement of neural networks by facial stimuli revealed implicit differentiations systematically related to perceived HIV risk. Overall, the differentiation of risky and safe persons within split seconds provides compelling evidence for a rather fast process: a defining feature of intuition. A further characteristic of intuition is its reliance on immediate affective reactions (Lieberman, 2000; Slovic & Peters, 2006). Previous research has consistently revealed that affective stimulus processing is associated with enlarged late positive potentials (LPP) between 300 and 700 ms after stimulus onset (Schupp, Flaisch, Stockburger, & Junghöfer, 2006). Accordingly, larger LPPs were found for high risk stimuli, relating to a large array of studies which consistently revealed that emotional stimuli such as natural scenes, facial expressions, words and symbolic gestures elicit larger LPPs as compared to neutral

control stimuli (Flaisch et al., 2011; Kissler et al., 2007; Schupp et al., 2004; Schupp et al., 2007; Wieser et al., 2011).

Challenges for HIV Risk Perception Research

The pioneering findings of the studies mentioned above raise further interesting questions that need to be addressed (Renner et al., 2012; Schmäzle et al., 2012; Schmäzle et al., 2011). First, the observed ERP differences might not be specific to HIV, a serious life-threatening disease, but a more general reaction towards people assumed to be sick. In fact, studies about social reactions towards many different kinds of diseases show that sickness in general is often stigmatized and sick persons are subject to stereotypes which lead to discrimination (Crandall & Moriarty, 1995; Menec & Perry, 1995; Meyerowitz, Williams, & Gessner, 2006; Sloan & Gruman, 1983; Weiner, Perry, & Magnusson, 1988). Nevertheless, HIV has evolved a unique position as a highly stigmatizing disease because of its reported association with negatively presented groups like gay men or IV drug users (Skelton, 2006). This has important implications for the paradigm used so far to study the role of intuition in the perception of health dangers. This paradigm demanded that the subjects make judgments only about the HIV status of unacquainted persons but no other comparable disease. Based on the important role of contagiousness in lay disease representations (Bishop, 1991), one might speculate that the findings relate specifically to sexually-transmitted diseases or even only to HIV because it is categorized as contagious/life threatening (Bishop, 1991). Thus, the current paradigm needs to be expanded in order to answer the question whether intuitive health risk perception is disease-specific or relates more generally to serious diseases.

A further question referring to health risk perception arises from the notion that intuitive risk perception depends on visual cues triggering snap judgments about unacquainted people (Renner et al., 2012; Schmäzle et al., 2012; Schmäzle et al., 2011). One of the most salient cues obviously comprises the gender of the opposite person. In fact, gender-related biases in person perception are a broadly discussed phenomenon in a multitude of psychological studies. For example, women are usually perceived as being more trustworthy than men (Shinners, 2009). Since trustworthiness is held to be one of the key features of an HIV risk stereotype (Renner & Schwarzer, 2003b), rating patterns for HIV risk might also differ as a function of gender. However, previous research on HIV-related snap judgments has so far mostly used opposite-sex designs in which male perceivers evaluate female targets and female perceivers evaluate male targets (Renner et al., 2012; Schmäzle et al., 2012; Schmäzle et al., 2011). To

date, it remains therefore unclear whether gender-induced effects might also be observable for the evaluation of the perceived riskiness of an acquainted person.

As stated, intuitive risk perception depends on cues for snap judgments about the riskiness of unacquainted people (Renner et al., 2012; Schmäzle et al., 2012; Schmäzle et al., 2011). While some previous studies on this issue only presented faces as stimuli (Schmäzle et al., 2011; Todorov, Pakrashi, & Oosterhof, 2009; Willis & Todorov, 2006), more recent studies show persons embedded in a natural scenery (Schmäzle et al., 2012) to enhance ecological validity. This approach raises the question, to which extent risk evaluation depends on features associated with the displayed person or the presented context. Previous studies have shown, that the interpretation of facial expressions varies substantially with the presented background of the stimulus person (Munn, 1940). In one of the most stunning studies referring to the importance of contextual information for risk evaluations, policemen were surveyed on how they reach their evaluations of potentially dangerous situation (Rozelle & Baxter, 1975). The exploration of their answers revealed that the policemen rely more on cues from the environment and the behavior of the suspicious person than on cues derived from the suspect's face. With regard to these studies, person perception does not seem to be merely dependent on the perceived person, but also on the context. Hence, further examination of person perception, contextual cues and the combination of the two is required.

In sum, previous studies have provided exciting first steps towards an understanding of intuitive health risk perception. These studies have demonstrated the automaticity and rapidness of intuitive processes underlying health risk perception (Renner et al., 2012; Schmäzle et al., 2012; Schmäzle et al., 2011). Yet, in addition to answering questions about the mechanisms of risk perception, some new questions have been raised by these findings on the utilization of cues and the accuracy of the intuitive risk perception towards different illnesses. These questions are addressed in the studies of the present dissertation.

The Present Dissertation

The aim of the present dissertation is to broaden understanding of the processes underlying risk perception, especially regarding health-related risks such as HIV. Previous research has already detailed the fast and automatic routines through which HIV risk is evaluated when people view unacquainted others. Neuroimaging methods, such as EEG and fMRI, revealed the neural mechanisms and substrates of intuitive HIV risk perception (Häcker, Schmäzle, Renner, & Schupp, 2014; Renner et al., 2012; Schmäzle et al., 2012; Schmäzle et al., 2011). However, these findings have also drawn attention to some important questions about

the complex functional principles of health risk perception. The following three studies were designed in order to resolve this complexity and answer the respective questions.

The first study contrasts the neural correlates of perceived HIV and leukemia risk in order to identify whether intuitive risk perception processes are specific to contagious life-threatening diseases or a general mechanism triggered by life-threatening but also non-contagious diseases. Therefore, brain signals were recorded while participants rated pictures of unknown individuals for either HIV or leukemia risk.

The second study explores gender-related differences in risk perception. Previous studies have provided a multitude of gender-related effects in person perception; however, most risk perception studies focused on opposite sex paradigms, which do not allow the systematic exploration of gender effects in the data. Therefore, this study used a paradigm combining same sex and opposite sex ratings and common risk related trait dimensions to capture the complete range of possible gender-related differences.

The third study addresses possible influences of contextual information on risk perception. In this study, ratings for a picture set of persons in a natural context were contrasted to ratings of the same pictures with either the background or persons masked to obtain ratings for the stimulus persons or context, respectively. This paradigm allowed us to test for the contribution of cues attached to the stimulus person in contrast to those attached to the context when considering the original picture rating.

STUDY I: NEURAL CORRELATES OF RISK PERCEPTION: HIV VS. LEUKEMIA

Abstract

Field studies on HIV risk perception suggest that people may rely on impressions they have about the safety of their partner. Previous studies show that individuals perceived as “risky” regarding HIV elicit a differential brain response in both earlier (~200–350 ms) and later (~350–700 ms) time windows compared to those perceived as safe. This raises the question whether this event-related brain potential (ERP) response is specific to contagious life-threatening diseases or a general mechanism triggered by life-threatening but non-contagious diseases. In the present study, we recorded dense sensor EEG while participants ($N = 36$) evaluated photographs of unacquainted individuals for either HIV or leukemia risk. The ERP results replicated previous findings revealing earlier and later differential brain responses towards individuals perceived as high risk for HIV. However, there were no significant ERP differences for high vs. low leukemia risk. Rather than reflecting a generic response to disease, the present findings suggest that intuitive judgments of HIV risk are at least in part specific to sexually transmitted diseases.

Introduction

Risk perception is a catalyst for protective health behaviors (Armitage & Conner, 2000; Renner & Schwarzer, 2003a), but its mechanisms remain insufficiently understood. By and large, risk perception has been conceptualized as beliefs about the probability and severity of certain health hazards (Renner & Schupp, 2011; Weinstein, 2000). Specifically, the “risk as analysis” view holds that risk perception is based on a deliberate gauging of the likelihood that one will be affected by a negative event (e.g., being infected with HIV) and the severity of that event (e.g., lethal). However, recent theories of risk suggest that peoples’ understanding of risk derives more from an “intuitive sensing” than “deliberate analysis” (Loewenstein et al., 2001; Slovic & Peters, 2006). According to this perspective, the intuitive perception of risk is a rapid, automatic, incidental and affectively charged process, as opposed to much slower, controlled, voluntary, and cognitive consideration of probability and severity (Hodgkinson, Langan-Fox, & Sadler-Smith, 2008; Lieberman, 2000).

Risk perception in the context of HIV provides a highly relevant real-world example supporting the notion that risk perception builds on intuitive processing: Studies using focus groups and retrospective interviews with HIV positive people reveal that people usually have spontaneous impressions about risk—i.e., they often reported that they were convinced that their partners were safe (Gold, 1993; Gold et al., 1992; Keller, 1993; Maticka-Tyndale, 1991). These impressions about a potential partner’s HIV risk may make people prone to rely on “illusory control strategies” (Thompson, Kyle, Swan, Thomas, & Vrungos, 2002), such as skipping condom use or selecting safe-looking partners. Recently, a new line of research examined the mechanisms behind these pervasive impressions of HIV risk by measuring neural responses while participants performed evaluations of HIV risk. Specifically, recording event-related brain potentials (ERPs) allows studying key features of intuitive processing, such as the fast and frugal processes that unfold during the first few hundred milliseconds after stimulus onset (e.g., the first sighting of a risky- or safe-looking person). Recent ERP studies of HIV risk perception revealed that differentiation between risky and safe individuals occurs early in the processing stream (< 300 ms) (Renner et al., 2012; Schmäzle et al., 2012; Schmäzle et al., 2011). This early onset precedes systematic reasoning about health risks and supports the notion of intuitive as opposed to analytic processing, the latter being more laborious, time consuming and deliberate (Slovic & Peters, 2006). Moreover, one specific ERP component, the late positive potential (LPP), has been consistently observed as a cortical marker of affective significance across a wide range of stimuli (i.e., natural emotional scenes, facial expressions, and symbolic gestures) (Flaisch, Schupp, Renner, & Junghöfer, 2009; Kissler, Assadollahi, &

Herbert, 2006; Schupp, Junghöfer, Weike, & Hamm, 2003). Consistent with these findings, portraits of individuals perceived as highly risky elicited significantly larger LPPs compared to pictures of individuals believed to be safe (Renner et al., 2012; Schmälzle et al., 2012; Schmälzle et al., 2011). Finally, there is also evidence suggesting that differences between risky and safe individuals reflect implicit processes, i.e., that they occur in the absence of a specific processing goal (Schmälzle et al., 2012). Overall, these results point to the intuitive nature of HIV risk perception.

The finding that HIV risk perception builds on intuitive impressions raises the question, what kind of information provides the foundation for these impressions? Due to the absence of overt signs, HIV cannot be reliably detected by visual inspection. Thus, we hypothesize that people base their judgments of risk on a high-risk stereotype containing a set of interrelated personality characteristics related to responsibility and trustworthiness (Renner et al., 2012; Renner & Schwarzer, 2003a). Research on social person perception shows that inferences about such traits are remarkably efficient and could be obtained with minimal processing time. For instance, as little as 33 ms is sufficient to infer trust or threat (Bar et al., 2006; Willis & Todorov, 2006). Accordingly, when people report that they “just know” the risk posed by a certain individual, their risk ratings could actually reflect an implicit assessment of person characteristics related to the HIV risk stereotype. This perspective contains the critical assumption that intuitive impressions of HIV risk are domain-specific to implicit meaning structures of HIV, or life-threatening contagious diseases more generally (Bishop, 1991). An alternative possibility is that HIV risk perceptions reflect general and rather unspecific evaluations of health status.

The present study was designed to determine whether the quick and affect-related impressions of a person’s riskiness are specific to HIV or reflect a more generic process. The key characteristics of the HIV risk stereotype and intuitive sensing of HIV risk relate to the contagiousness dimension of disease representation (Bishop, 1991). As a contrast, leukemia was chosen as a sufficiently similar non-contagious disease with specific key differences (Skelton, 2006). First, leukemia is life-threatening, which rules out confounds related to differences in seriousness (i.e., contrasting a serious with a non-serious disease). Second, like HIV, the early stages of leukemia are not associated with overt symptoms. Third, both HIV and leukemia are diseases which are widely known but have a low incidence rate. Following this logic, we adapted the so-called AIDS-Leukemia paradigm, which originally was devised to examine attitudes towards individuals with HIV (Skelton, 2006). Participants in separate conditions were asked to evaluate the riskiness of unknown individuals for either HIV or

leukemia (balanced across participants). Based on participants' idiosyncratic judgments, safe and risky categories for HIV and leukemia were formed. The hypothesis that intuitive impressions of HIV risk are domain-specific to implicit meaning structures of sexually transmitted diseases predicts a significant interaction of Risk Level (low vs. high) and Disease (HIV vs. leukemia). With regard to HIV, the replication of previous findings of increased LPPs amplitudes for risky individuals and early differentiation between the risk categories (< 300 ms) were predicted. However, no significant effects were expected for low and high leukemia risk. Alternatively, if previous findings reflect a generic disease related process, both HIV and leukemia should elicit similar ERP differences for high and low risk individuals, resulting in a significant main effect of Risk Level.

Material and Methods

Participants

Forty-two volunteers (aged 20–27 years, $M = 22.5$, $SD = 2.0$, 23 females) were recruited at the University of Konstanz. Participants received either 15 € or course credits as compensation. Six participants were excluded due to excessive EEG artifacts or insufficient trials. Participants provided written consent, which was approved by the Ethics Review Board of the University of Konstanz.

Stimulus materials

The stimulus sets consisted of photographs of people in everyday scenes (Renner et al., 2012; Schmäzle et al., 2012). The photographs were retrieved with permission from a popular online photo-sharing community¹ and each showed a single young adult of Caucasian appearance. Attire, socioeconomic cues, and context were intentionally included to provide naturalistic viewing conditions and facilitate impression formation. The two stimulus sets consisted of either 120 females or 120 males. Each set was complemented with 15 additional pictures comprising the task set for the implicit condition. Each participant evaluated the opposite sex to increase ecological validity.

Procedure

A within-subject design was used to collect explicit ratings of HIV and leukemia risk in two separate rating task conditions, counterbalanced across participants. Both conditions were identical with regard to stimulus materials, stimulus presentation, and format of data collection. In each condition, the 120 (opposite sex) pictures were presented for 2 s in a random order for each participant and condition following a fixation cross (1 s). After a delay period of 1 s, participants were asked to evaluate how likely the presented person is HIV positive or has leukemia on a 7-point rating scale ranging from “very unlikely” [1] to “very likely” [7]. The next trial was initiated after an Inter-trial interval (ITI) of 3.5 s. To minimize possible order effects due to the novelty of the stimulus materials, participants viewed the stimulus materials before conducting the risk rating conditions.

Categories of HIV and Leukemia risk

Stimuli were categorized separately for each condition and according to idiosyncratic risk ratings, whereby risk ratings of 1 to 3 were coded as “low risk” and 5 to 7 as “high risk”. There were no frequency differences between low (35.1 % and 35.2 %) and high risk (26.9 % and 27.5 %) categories for HIV and leukemia conditions. 2 (Disease) \times 2 (Risk Level) ANOVA analysis revealed only a significant main effect of Risk Level, $F(1,35) = 14.1, p < .001$, while neither the main effect of Disease, $F(1,35) = 0.2, p = .66$ nor the interaction of Disease \times Risk, $F(1,35) = 0.1, p = .8$, was significant. Initial analysis revealed no differences between male and female participants in HIV and leukemia risk judgments.

Electrophysiological recording and data reduction

Electrophysiological data were collected using a 257-lead HydroCel Geodesic Sensor Net (EGI: Electrical Geodesics, Inc., Eugene, OR). The EEG was recorded continuously with a sampling rate of 250 Hz, with the vertex sensor as reference electrode, and on-line filtered from 0.1–100 Hz using Netstation acquisition software and EGI amplifiers. Impedances were kept below 50 k Ω , as recommended for this type of amplifier. Electromagnetic Encephalography Software (EMEGS) (Junghöfer & Peyk, 2004) software was used for analysis. Data editing and artifact rejection were based on a method for the statistical control of artifacts specifically devised for analyzing dense sensor EEG recordings (Junghöfer, Elbert, Tucker, & Rockstroh, 2000). Preprocessing steps included low-pass filtering at 40 Hz, artifact detection, ocular artifact correction based on a multiple regression method (Miller, Gratton, & Yee, 1988), and bad sensor interpolation (Junghöfer et al., 2000). On average, 34.7 (SD = 7.5) out of 240 trials (14.5 %) were excluded with no difference between HIV and leukemia conditions (16.9 vs. 17.8, $t(35) = 0.9, p = .35$). Data reported were converted to an average reference and baseline-corrected for pre-stimulus (100 ms) ERP activity, and conversion to an average reference (Junghöfer et al., 2000).

ERP analysis

Two ERP components sensitive to HIV risk were identified by visual inspection and single sensor waveform analysis (Schupp et al., 2003). Careful inspection of the data revealed no ERP effects for the leukemia condition. Accordingly, two ERP components were scored and submitted to statistical analysis.

In a time interval between 200–300 ms post stimulus, the fronto-central component (low vs. high HIV risk) was scored including EGI sensors #144, 155, 164, 173, 181, 182, 183, 184, 185, 193, 194, 195, 196, 197, 202, 203, 204, 205, 206, 211, 212, 213, 214, 221, 222, 223 (right) and #40, 41, 42, 43, 44, 48, 49, 50, 51, 52, 53, 55, 56, 57, 58, 59, 60, 62, 63, 64, 65, 66, 69, 70, 71, and 72 (left). The effect appeared reversed in polarity over occipito-temporal sites and was assessed by collapsing across the following sensors #148, 156, 157, 158, 159, 165, 166, 167, 168, 174, 175, 176, 187 (right) and #113, 114, 115, 120, 121, 122, 123, 133, 134, 135, 136, 145, and 146 (left). The centro-frontal LPP component was indexed as mean activity from 390–510 ms comprising right (#9, 16, 17, 22, 23, 24, 29, 30, 35, 36, 40, 41, 42, 43, 44, and 49) and left (#4, 5, 6, 7, 14, 185, 186, 197, 198, 206, 207, 213, 214, 215, 223, and 224) EGI sensors.

The early ERP components were submitted to a repeated-measures ANOVA including the independent variables “Disease” (HIV vs. leukemia), “Risk Level” (low vs. high), “Location” (fronto-central vs. occipito-temporal), and “Laterality” (left vs. right). The late ERP component was entered in ANOVA analysis including the independent variables of “Disease”, “HIV Level”, and “Laterality”. Initial analyses included also the factor Gender. However, there were no higher-order interactions of Disease \times Risk Level \times Gender in the ERP analysis, and this factor was not further considered. Where appropriate, degrees of freedom were adjusted using the Greenhouse–Geisser method to correct for violations of sphericity.

Results

Explicit risk perception: HIV and Leukemia risk ratings

In a first step, risk rating distribution across both conditions was compared to confirm substantial variance. Taking an idiosyncratic perspective, we first calculated the risk ratings' variance and range of each participant's risk ratings before ordering them by rank. In a second step, to illustrate the data at the group-level, we calculated mean responses for each rank across participants. As shown in Figure 1, mean HIV risk ratings increased from very low (minimum = 1) to very high (maximum = 6.94). Similarly, as shown in Figure 1, ratings of leukemia risk range from very low (minimum = 1.02) to very high risk (maximum = 6.83). These analyses demonstrate that the naturalistic stimuli produced broad variations both in perceived HIV and leukemia risk within and across participants. At the group level, HIV risk ratings ($M = 3.67$, $SD = .39$) and leukemia risk ratings ($M = 3.68$, $SD = .45$) were in the medium risk range and did not differ significantly, $t(35) = -.084$, $p = .93$. Furthermore, neither the minima or maxima, slope ($M = .05$ and $M = .05$) nor intercept ($M = .79$ and $M = .69$) of the rank ordered risk ratings for HIV and leukemia were significantly different, $t(35) = -.61$, $p = .54$ (slope) and $t(35) = .81$, $p = .42$ (intercept).

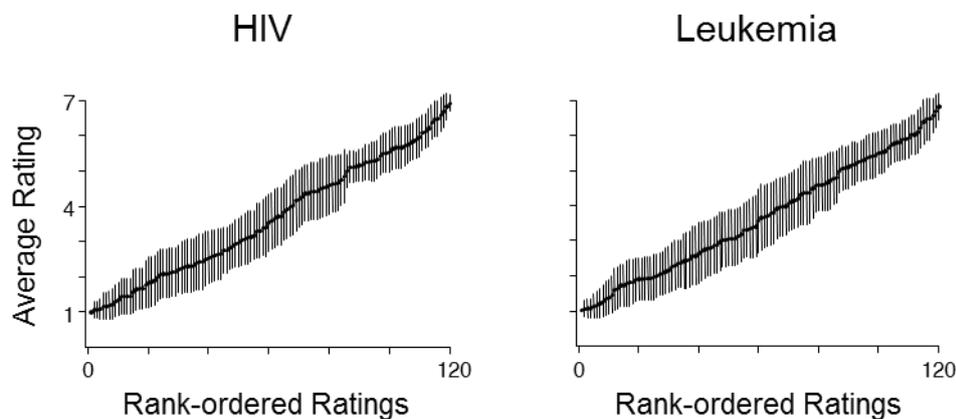
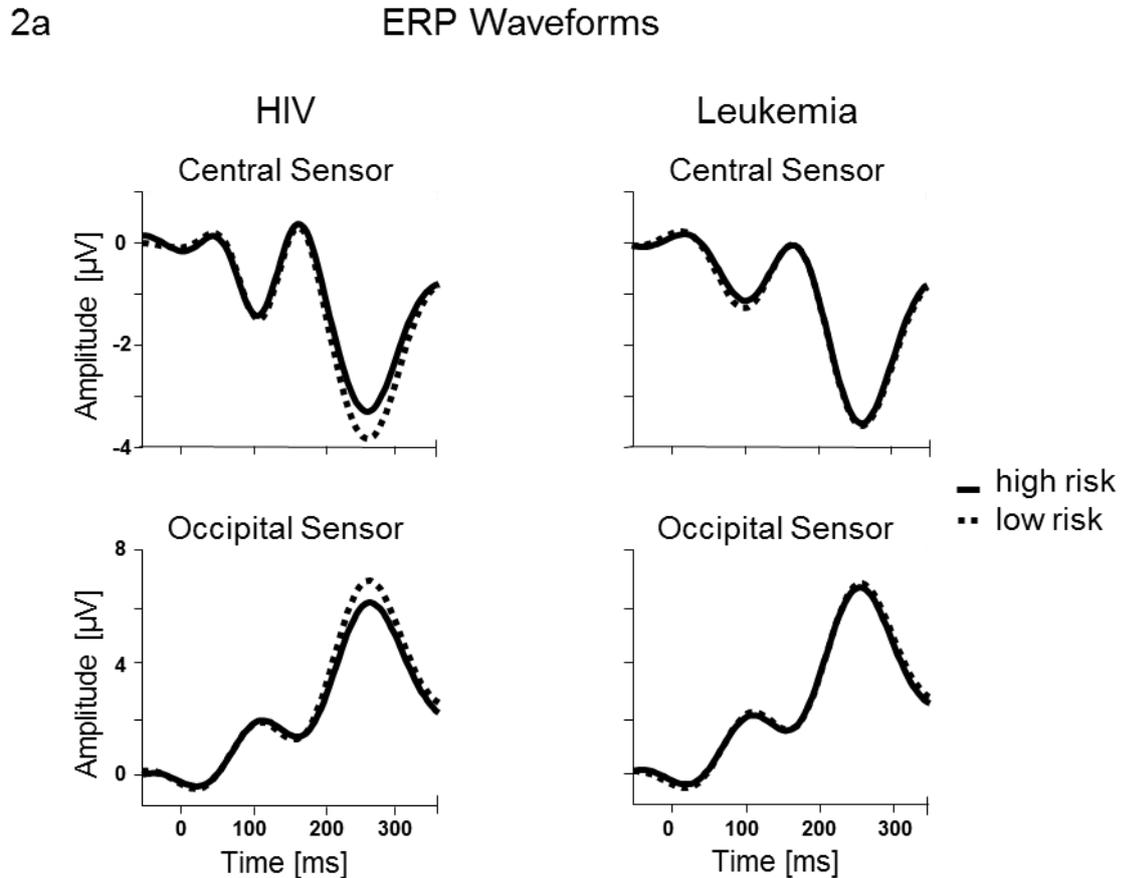


Figure 1: Average ratings of HIV and leukemia risk and associated standard errors after rank-ordering each participant's ratings by HIV and leukemia risk, respectively. Participants' ratings of HIV and leukemia risk similarly varied across the full range of the scale (1—low risk; 7—high risk).

Intuitive risk perception: ERPs**Fronto-central and occipito-temporal component (200–300 ms)**

As illustrated in Figure 2, the present study obtained evidence for a relatively early modulation of the ERP waveform by HIV risk. Overall, the ERP waveform presents a positive polarity over posterior sensors and a negative polarity over anterior sites. However, encoding risky stimuli resulted in a negative shift in the ERP waveform over occipito-temporal sensor regions and a corresponding positive shift over fronto-central sensor sites. The topography of the differential ERP activity (i.e., relative posterior negativity and anterior positivity) for high HIV risk is further illustrated by the calculation of difference maps (high —low HIV risk; see Figure 2). Of most interest, as shown in Figure 2, there was no difference in ERP waveforms between low and high risk categories for the leukemia condition. Substantiating these observations, the overall ANOVA analysis revealed a significant interaction for the factors Disease \times Risk Level \times Location, $F(3,105) = 10.71$, $p < .01$, partial $\eta^2 = 0.23$. Accordingly, separate ANOVAs were calculated for both diseases.



2b Scalp Difference Maps: High - Low Risk

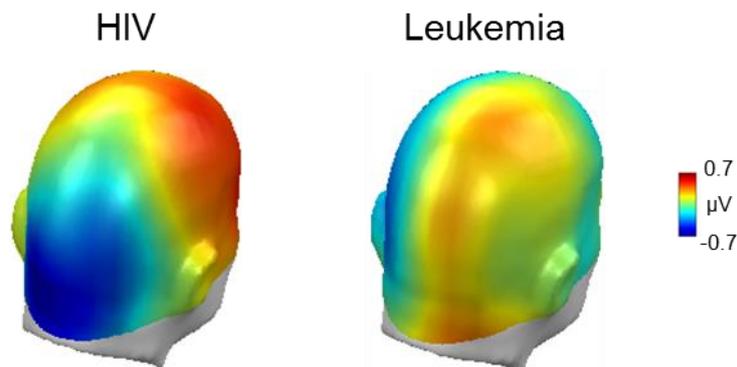


Figure 2: Early ERP effects of risk for HIV and leukemia risk. (A) ERP waveforms from representative central (#197) and occipital (#135) sensors contrasting high and low risk categories for HIV and leukemia. (B) The scalp potential map shows the topography of the difference between the high and low risk categories for HIV and leukemia risk averaged across the time window from 200–300 ms.

For HIV, the ANOVA analysis revealed a significant interaction of Risk Level \times Location, $F(1,36) = 8.75$; $p < 0.01$, partial $\eta^2 = 0.20$, indicating that the effects of high and low HIV risk appeared with reversed polarity over fronto-central and occipito-temporal sites. A

main effect of HIV risk, $t(36) = 3.47, p < .01$, partial $\eta^2 = 0.26$, was observed over fronto-central leads, indicating a less negative potential for high HIV risk stimuli ($M = -2.02, SD = 1.37$) compared to low HIV risk ($M = -2.32, SD = 1.57$). The HIV risk effect reversed in polarity over occipito-temporal sites, $t(36) = 2.48, p < 0.05$, partial $\eta^2 = 0.15$. High HIV risk stimuli ($M = 4.47, SD = 2.84$) elicited a less positive potential compared to low HIV risk stimuli ($M = 4.94, SD = 2.70$). While the effect appeared to be more pronounced over right fronto-central sites, no effects involving the variable “Laterality” reached significance in these analyses.

For leukemia risk, ANOVA analysis revealed no significant interaction of Risk Level \times Location, $F(1,36) = 1.01; p = 0.32$, partial $\eta^2 = 0.03$. For exploratory reasons, separate analyses were conducted for fronto-central and occipito-temporal sensor clusters. There was no significant difference for high ($M = 5.08, SD = 2.82$) and low ($M = 5.18, SD = 2.85$) leukemia risk over occipito-temporal sites, $t(36) = 0.46, p = 0.65$, partial $\eta^2 < 0.01$. However, a significant main effect of leukemia was observed over fronto-central leads, $t(36) = 2.16, p < .05$, partial $\eta^2 = 0.12$. Interestingly, with a more negative potential for high leukemia risk stimuli ($M = -2.25, SD = 1.33$) compared to low leukemia risk stimuli ($M = -2.10, SD = 1.49$), the effect appeared with opposite polarity to the HIV risk modulation.

Centro-frontal component (390–510 ms)

A second modulation of the ERP by perceived HIV risk status appeared in a time window between 390 and 510 ms over centro-frontal sensor sites. Differential ERP activity (high - low HIV risk), illustrated in Figure 3, shows that the processing of risky stimuli is associated with a relative positive potential. Again, these effects were specific to the HIV condition and judgments of high leukemia risk were associated with relatively negative potential, unlike positive potential observed for high HIV risk. The significant interaction of Disease \times Risk Level, $F(1,35) = 6.17, p < .05$, partial $\eta^2 < 0.15$, was followed up by a separate analysis of both diseases.

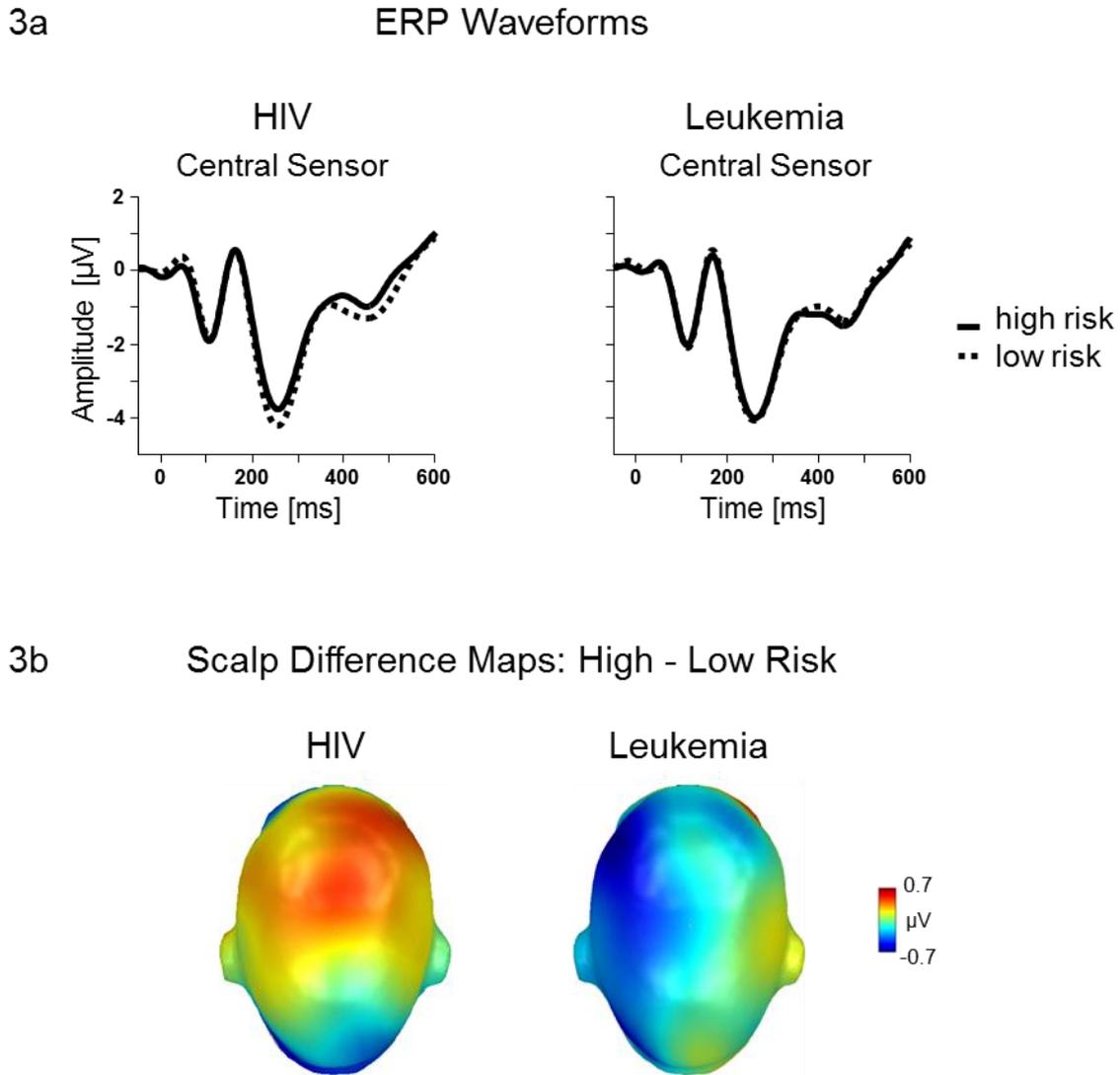


Figure 3: Late ERP effects of risk for HIV and leukemia risk. (A) ERP waveforms from representative central (#198) sensor contrasting high and low risk categories for HIV and leukemia. (B) The scalp potential map shows the topography of the difference between the high and low risk categories for HIV and leukemia risk averaged across the time window from 390–510 ms.

For HIV, statistical analysis confirmed significant differences for high ($M = -1.21$, $SD = 1.97$) and low HIV risk stimuli ($M = -1.53$, $SD = 1.89$), $t(36) = 2.00$, $p = .05$, partial $\eta^2 = 0.10$. For leukemia, high ($M = -1.76$, $SD = 1.76$) and low ($M = -1.45$, $SD = 2.17$) risk stimuli differed only at a marginal significance level, $t(36) = 1.87$, $p = .07$, partial $\eta^2 = 0.09$, indicating however an opposite polarity as observed for HIV risk (see Figure 3).

Discussion

The present study contrasts the perception of HIV and leukemia risk. To shed light on their neural correlates, brain signals were recorded while participants evaluated pictures of unknown individuals for either HIV or leukemia risk. In line with previous findings, differential brain responses towards high vs. low HIV risk individuals were observed. In contrast, there were no significant ERP differences towards individuals with high vs. low leukemia risk.

The physical appearance of individuals provides a rich source of information and it has been widely acknowledged that inferences about personality characteristics based on first impressions are second nature to humans. However, it is far less widely recognized that such impressions might also extend to the domain of health risk perception and trigger feelings of risk or impulses towards disease avoidance. For instance, taking an evolutionary perspective, Schaller (2011) proposes a “behavioral immune system” that links perceivable signs of disease and infection to feelings of risk and avoidance behaviors, similar to the functions of the immune system. Avoiding an infectious disease provides an obvious advantage for survival and accordingly represents an adaptive mechanism. However, implicit processes linking person appearance cues to health risk are manifold. In some cases, these perceptual cues might be misleading since they are linked to perceived personality characteristics rather than actual signs of infection and disease. Specifically, research revealed that people may base the risk of a potential partner being infected by HIV on an intuitive mode of processing, i.e., the feeling of risk or safety, and ERP studies revealed corresponding neural correlates accompanying the differentiation between risky and safe HIV judgments. One interpretation of these findings is the assumption that implicit HIV risk stereotype knowledge contains personality characteristics amenable to snap judgments, which provide the basis for the intuitive sensing of risk or safety in the context of sexually transmitted diseases (Renner et al., 2012). This reasoning assumes that the brain correlates associated with HIV risk judgments are specific to sexually transmitted diseases rather than based on general tagging mechanisms of disease or illness. The current ERP results are in favor of such a disease-specific view of first impressions about HIV risk in that the differential processing of high and low risk was specific to HIV whereas no significant effects were found for leukemia.

With regard to the neural precursors of HIV risk judgments, the current results indicate that two ERP components, an early occipital negativity (200–300 ms) and a mid-latency central positivity (390–510 ms), were significantly larger for risky as compared to safe individuals. This is in line with previous findings (Renner et al., 2012; Schmäzle et al., 2011) and provides further support to the hypothesis of an intuitive mode of risk perception with regard to key

features of intuition. Specifically, the risk as feeling hypothesis proposes a central role of affect in the intuitive sensing of danger and risk. In this respect, both ERP differentiations are similar to what is observed during ERP studies of emotional stimulus processing. Research with highly arousing emotional scenes such as erotica or mutilations as well as low and moderately arousing materials such as emotional faces, gestures, words, or clashing moral statements revealed these two ERP components to have similar topography, polarity, and latency (Flaisch et al., 2011; Junghöfer, Bradley, Elbert, & Lang, 2001; Kissler et al., 2007; Schupp et al., 2003, 2004; Van Berkum, Holleman, Nieuwland, Otten, & Murre, 2009). These findings suggest that risky-looking individuals elicit the brain signature of emotional significance, which is linked to selective visual attention. Furthermore, these findings support the notion of a negativity bias in that stimuli signaling danger are more effective in engaging affect processing than stimuli signaling safety (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001; Cacioppo, Gardner, & Berntson, 1999). A further characteristic of intuition is speed and fast processing time. The short time in which the brain discriminates between risky and safe individuals (~200 ms) clearly precedes the opportunity for systematic reasoning about health risks. Together, these findings support the fast and efficient processing of HIV risk related information.

While the ERP results support the hypothesis of the intuitive perception of HIV risk, a different pattern of results emerged for the perception of leukemia risk. Low and high risk for leukemia was not associated with a significant modulation of the ERPs. Specifically, there was no significant effect for the two ERP components differentiating high and low HIV risk categories or any other ERP component reliably differentiating between high and low leukemia risk. The lack of significant ERP modulation for leukemia risk seems not to be secondary to a lack of differentiation in reported risk as leukemia risk ratings showed similarly broad variations within and across participants. Interestingly, contrasting the risk judgments for both diseases revealed a remarkable similarity of data distribution with respect to mean values, variance, and range of risk ratings (Figure 1). However, the explicit risk ratings are in clear contrast to the ERP recordings, which indicate pronounced differences in the ERP waveforms accompanying risk judgments for HIV but not leukemia. To elicit the brain signature of affect processing, i.e., enhanced LPPs, and rapidly discriminate low and high HIV risk categories, the brain has to rely on stored memory representation, which supports fast and frugal heuristic processing during initial perceptual encoding. The finding that leukemia was not related to such ERP differences suggests that the memory representation leading to systematic ERP differences for high and low HIV risk is disease specific.

The present study is a first attempt to probe the structure and type of information supporting intuitive sensing of HIV risk. Lay disease representations (contagiousness and seriousness) (Bishop, 1991) were acknowledged by selecting a life threatening but not contagious disease. This variance in contagiousness captured a central characteristic of disease in order to discriminate whether the ERP correlates associated with high HIV risk are at least in part specific to HIV and sexually transmitted diseases or simply reflect a generic process. The life-threatening nature of leukemia also assured that the ERP differences are not secondary to differences in seriousness. Furthermore, leukemia is well known, minimizing the potential confound of the control condition being unknown to college students. Control questions, collected at the end of the study, revealed that all participants were familiar with the disease. Finally, HIV and leukemia are low-incidence diseases, minimizing the risk that pronounced differences in incidence may confound interpretation. In this respect, the findings reveal that the memory representations accessed by intuition are distinct for contagious and non-contagious diseases. Future studies may follow up these findings by contrasting different kinds of contagious diseases. The domain specific view proposed here would assume that the ERP differences related to HIV primarily occur for sexually transmitted diseases given that there is evidence for shared representations of a high risk stereotype among sexually transmitted diseases (Bishop, 1991; Renner & Schwarzer, 2003a). Furthermore, the present study specifically selected leukemia for its lack of overt signs in the early stage. As such, it might be informative to contrast HIV with diseases associated with perceivable signs of infection to compare the neural correlates across different types of intuitive processes.

It has been suggested that a high-risk stereotype of HIV based on interrelated person characteristics provides the basis for intuitive judgments of HIV risk (Renner et al., 2012; Renner & Schwarzer, 2003a). In particular, perceptions of HIV risk are strongly related to perceived lack of responsibility and low trustworthiness (Renner et al., 2012; Schmälzle et al., 2011). Several studies show that person characteristics, in particular trust, can be extracted quickly and with little effort, making people prone to form first impressions (Bar et al., 2006; Willis & Todorov, 2006). In a previous study, categorizing EEG data based on ratings of responsibility and trustworthiness showed similar ERP effects as obtained for HIV risk (Schmälzle et al., 2011), suggesting that HIV risk, trustworthiness, and responsibility share common meaning structures. Furthermore, a recent fMRI study of HIV risk perception (Häcker, Schmälzle, Fleisch, Schupp, & Renner, 2010) revealed that high HIV risk was associated with increased activations in the insular cortex, a structure that has also been implicated in perceptions of trust (Castle et al., 2012). Notably, increased insular activations for high HIV

risk were observed during implicit and explicit processing conditions and a similar finding was obtained in an earlier ERP study (Schmälzle et al., 2011). Likewise, implicit and explicit trustworthiness perceptions were related to the activation of the amygdala and insular cortex (Todorov, Said, Engell, & Oosterhof, 2008; Winston, Strange, O'Doherty, & Dolan, 2002). Thus, inferences about HIV risk and related person characteristics may build upon a partially shared representation associated with a general disposition for avoidance behavior (Todorov et al., 2008). Future work should explore which cues are utilized as signs of high or low HIV risk as well as a broader range of person characteristics such as trustworthiness, aggressiveness, sexual orientation, or attractiveness (Rule & Ambady, 2008; Willis & Todorov, 2006).

Conclusion

HIV continues to be a serious challenge. To date, prevention remains the main strategy to dam rising infection rates. Therefore, it is indispensable to understand any barrier to effective preventive behaviors. Intuition about HIV risk may oppose consistent condom use by inducing a false sense of control. The present findings demonstrate that the heuristic processing underlying such intuitions is at least in part domain specific for sexually transmitted diseases.

STUDY II: WHO PERCEIVES WHOM: GENDER DIFFERENCES IN THE PERCEPTION OF HIV RISK

Abstract

Research indicates that many people do not use condoms consistently but instead rely on intuition to identify sexual partners high at risk for HIV infection. The main aim of the present study was to examine gender differences of intuitive impressions about HIV risk. Towards this end, male and female perceivers evaluated portraits of unacquainted persons (male and female targets) regarding their risk for HIV, several trait characteristics (trust, responsibility, attractiveness, valence, arousal, and health) and willingness for interaction. Results revealed that male targets were perceived as more risky than female target pictures for both perceiver genders. Furthermore, male perceivers reported higher HIV risk perception for both male and female target pictures as compared to female perceivers. Multiple regression indicated gender differences regarding which person characteristics are associated with HIV risk. In male targets, HIV risk was predicted only by trustworthiness. In females, HIV risk was related to trustworthiness, attractiveness, health, valence (male perceivers), and arousal (female perceivers). Results are discussed with regard to gender differences in partner selection, trustworthiness, and the portrayal of HIV risk among the public. Considering gender differences in intuitive judgments of HIV risk may help devise effective strategies by shifting the balance from feelings of risk towards a more rational mode of risk perception and the adoption of effective precautionary behaviors.

Introduction

The human immunodeficiency virus (HIV) constitutes one of the world's major risks to human health. Around 2.1 million people are estimated to be living with HIV in North America and Western and Central Europe (UNAIDS, 2013). Despite increasing use of antiviral therapy, infection rates have remained virtually stable in these regions over the recent years. Furthermore, numerous campaigns have informed the public that unsafe sexual behavior is the primary way of contracting HIV (UNAIDS, 2013; WHO, 2014). However, while most people are well informed about safer sex practices and consistent condom use, various studies observed low perception of HIV risk and inconsistent and infrequent condom use in young adults (Adefuye, Abiona, Balogun, & Lukobo-Durrell, 2009; Civic, 2000; Gardner, Backburn, & Upadhyay, 1999; Keller, 1993; Nkomazana & Maharaj, 2014). These findings suggest that when it comes to HIV or other sexually transmitted diseases (STDs), knowing the facts is not sufficient to motivate consistent protective behavior.

Rather than relying consistently and reliably on safer sex practices, people appear to employ an array of strategies, such as 'getting to know the partner' or 'learning about his or her sexual history' (Swann et al., 1995; Thompson et al., 1999). Unfortunately, these strategies are not effective but may induce a false sense of control over the risk. One particularly concerning finding is that people are prone to form immediate impressions about HIV risk. Specifically, people who are infected with HIV often report that they were convinced that their partners were safe (Gold et al., 1992). Similarly, focus groups with college students revealed that these young adults often rely on their feelings about riskiness, i.e., they report that they 'just know' whether a person is risky or safe - even when they do not know much about the respective person's past sexual behavior or personality (Gold et al., 1992; Keller, 1993; Klepinger, Billy, Tanfer, & Grady, 1993; Maticka-Tyndale, 1991). Thus, it appears that HIV risk perception is at least partly based on spontaneous impressions of others, and that 'safe' impressions may undermine reliance on effective protection strategies.

Several recent studies investigated the mechanisms and neural correlates behind intuitive HIV risk perceptions. Presenting photographs of unacquainted opposite-sex individuals, it was consistently observed that people can easily form impressions about HIV risk (Barth, Schmäzle, Renner, & Schupp, 2013; Renner et al., 2012; Schmäzle et al., 2011). Furthermore, when probed at the end of the experiment, participants could not explain how they arrived at their risk judgments and reported severe difficulties verbalizing 'hunches' (Schmäzle et al., 2011). Functional magnetic resonance imaging revealed that individuals perceived as risky activated regions of the saliency network, i.e., the anterior insulae and medial frontal cortex,

which are also engaged by threatening and negative-affect related stimuli (Häcker et al., 2014). Event-related potential recordings (ERP) revealed that the brain responses to risky as compared to safe individuals diverged early in the processing stream (< 300 ms), preceding systematic reasoning about health risks (Schmälzle et al., 2011). Furthermore, the late positive potential, a specific ERP component that has been linked to affective evaluation processes, was larger for individuals perceived as risky (Renner et al., 2012; Schmälzle et al., 2011). While these findings demonstrate features of affect and speed in intuitive risk perception, further data demonstrated that these ERP correlates associated with perceived HIV risk were at least in part specific to sexually transmitted diseases rather than reflecting a generic response to disease (Barth et al., 2013). Perhaps the strongest support for the implicit nature of HIV risk perception is provided by the findings that ERP and fMRI correlates of risk processing occur implicitly, i.e., in the absence of any task (Häcker et al., 2014; Schmälzle et al., 2012). Taken together, there is increasing evidence to support the notion that HIV risk perception is based on intuitive as opposed to analytic processing.

Because an STD or HIV infection does not lead to immediate health problems, there are no overt or observable signs that accurately indicate HIV or STD risk status. Accordingly, when people report that they “just know” the risk posed by a certain individual, impressions about risk status are likely to be inferred from other personal characteristics. To address the issue, previous studies assessed the association of HIV risk with person trait characteristics such as attractiveness, valence, health, trustworthiness, and responsibility. A main finding was that HIV risk ratings self-reports of HIV risk, trust, and responsibility loaded on a common factor related to safeness in interpersonal relationship which was distinct from a ‘valence-approach’ factor which had high loadings of valence, attractiveness, perceived healthiness, and the behavioral approach dimension ‘willingness to interact’ (Renner et al., 2012). Previous research revealed that a low sense of responsibility and distrust was reliably named as a key feature characterizing persons with a high risk of HIV (Renner & Schwarzer, 2003b). Overall, there is growing evidence that the strategy to screen partners for their HIV risk may result from an intuitive, ‘gut-feeling’ mode of risk perception related to the activation of a high at risk stereotype.

Undermining reliance on intuitive HIV risk judgments in favor of effective protection strategies may be a target for public health campaign. In order to devise effective strategies to educate intuitive processes (Hogarth, Portell, Cuxart, & Kolev, 2011), it seems relevant to determine whether there are gender differences in snap judgments about HIV risk. However, the issue of systematic gender differences has yet to be explored. Previous research usually focused on HIV risk perception of potential sexual partners, providing no systematic

comparison of whether the gender of the perceiver or the target person results in systematic gender differences. Yet, reliable and consistent gender differences with regard to partner selection, resource distribution and trust in social life as well as the portrayal of HIV risk in the public have been reported (Buss, 1989; Higgins, Hoffman, & Dworkin, 2010), raising the possibility for gender differences in HIV risk perception. One source for gender differences may lie in the portrayal of HIV risk in the public. For instance, public campaigns in the recent past often emphasized an increased risk in female raters due to an increased biological susceptibility for infection in women and gendered power dynamics (Higgins et al., 2010). Alternatively, risk ratings may reflect infection rates, which are much higher for men as compared to women in Germany (Robert Koch-Institut, 2014). A further source for gender differences regards systematic mean differences in perceived trustworthiness. Previous research showed that women are perceived as more trustworthy than men by male and female perceivers (Shinners, 2009). According to the strong relationship of HIV risk and trustworthiness, one may accordingly posit gender differences when rating the HIV risk of men and women. Finally, one most important aspect of gender difference may not relate to systematic differences in mean ratings of HIV risk but rather concern differences in the kind of information associated with HIV risk. For instance, it is well established that attractiveness and health is more relevant for female than male partner selection, possibly reflecting the conjoint influence of evolutionary and socio-cultural factors (Buss, 1989). This raises the intriguing hypothesis of gender differences regarding the relationship of trait personality characteristics to HIV risk.

The main aim of the present study was to examine possible differences between the genders in the operation of snap judgments about HIV risk. To this end, perceivers (men and woman) were asked to spontaneously rate target pictures (male and female) regarding their risks for HIV, several trait characteristics (trust, responsibility, attractiveness, valence, arousal, and health) and willingness for interaction as proximal measure for approach or avoidance behavior. Regarding perceived HIV risk ratings, a first line of analysis examined mean differences of HIV risk as a function of Perceiver Gender and Target Gender. In a second stream of analysis, multiple regression analysis was conducted for the four groups (i.e., female perceiver/female target, male perceiver/female target, female perceiver/male target, male perceiver/male target) to determine whether there are gender differences in the relationship of personality characteristics to HIV risk among genders.

Material and Methods

Participants

Ninety-two volunteers, 49 female, aged 18 - 28 years ($M = 21.45$, $SD = 1.79$), and 43 male, aged 19 - 27 years ($M = 21.72$, $SD = 1.96$), were recruited on campus at the University of Konstanz. Eighty-nine participants (48 females) reported regarding themselves as heterosexual, one female and one male participant as homosexual, and one male participant regarded himself as bisexual at the time of data acquisition. Participants received either monetary reimbursement or course credits as compensation. Seven participants had to be excluded from analysis because they did not comply with instructions, i.e., lack of variance in the data. Participants provided written consent to the study protocol, which was approved by the Ethic Review Board of the University of Konstanz.

Stimulus Materials

The stimulus set consisted of colored photographs depicting 60 males and 60 females, which has been utilized in previous research (Barth et al., 2013; Häcker et al., 2014; Renner et al., 2012; Schmälzle et al., 2011). The photographs were retrieved with permission from a popular online photo-sharing community (www.flickr.com). To assure high ecological validity, stimuli showed a colored photo of a single person located in the foreground, with their face clearly visible. To be representative of the study's target population in terms of age and race, only photographs of Caucasians between 18 and 35 years old were included. To resemble naturalistic viewing conditions and to facilitate impression formation, self-portraits exhibiting attire, socioeconomic status cues, and situational context features were included. Each perceiver viewed the entire picture set showing same and opposite sex persons (male and female target pictures).

Procedure

The perceivers were asked to evaluate the picture set according to the following trait characteristics: (1) HIV risk, (2) healthiness, (3) trustworthiness, (4) responsibility, (5) valence, (6) arousal, and (7) attractiveness. In addition, as proximal variable for behavior, participants rated (8) their willingness to interact with the target person. Each picture was presented for 2 s, preceded by a fixation cross, shown for 1 s. After a delay of 1 s, perceivers were asked to evaluate the pictures on the rating scales. A screen with a smaller version of the photograph and the respective rating scale was displayed until the rating was made. All ratings were given on a

7-point scale, with greater numbers indicating that the respective characteristic is more pronounced. The order of the rating scales varied randomly from trial to trial.

Statistical Analyses

To determine whether the risk rating distributions of the four experimental groups defined by the factors 'Target Gender' and 'Perceiver Gender' show substantial variation in ascribed HIV risk, minimum, maximum, mean range, and variance of the risk ratings was calculated for each participant. Intra-class correlations (*ICC*, two-way random, mean) were calculated to determine inter-rater agreement for each of the groups comprising the 2 (Target Gender) and 2 (Perceiver Gender) combinations. Mean HIV risk ratings were analyzed using repeated measure analyses of variance with the within factor 'Target Gender' (male vs. female) and the between factor 'Perceiver Gender' (men vs. women). Relationship between HIV risk ratings to other trait person characteristics was examined by calculating Pearson correlation coefficient and multiple regression analysis.

Results

HIV risk rating distribution

To examine gender differences it is necessary to demonstrate that the four groups defined by the factors of 'Perceiver Gender' and 'Target Gender' show substantial variation in ascribed HIV risk. As shown in Figure 4, mean HIV risk ratings increased from very low (minimum = 1.26) to very high (maximum = 5.84), in each group. Furthermore, participants in all four groups used the full range of the scale ($x = 5.0$) and showed substantial variance ($s^2 = 1.76$) in perceived HIV risk. Overall, providing the grounds to examine gender differences, these analyses demonstrate that perceived HIV risk showed substantial variance for female and male target pictures as well as female and male perceivers.

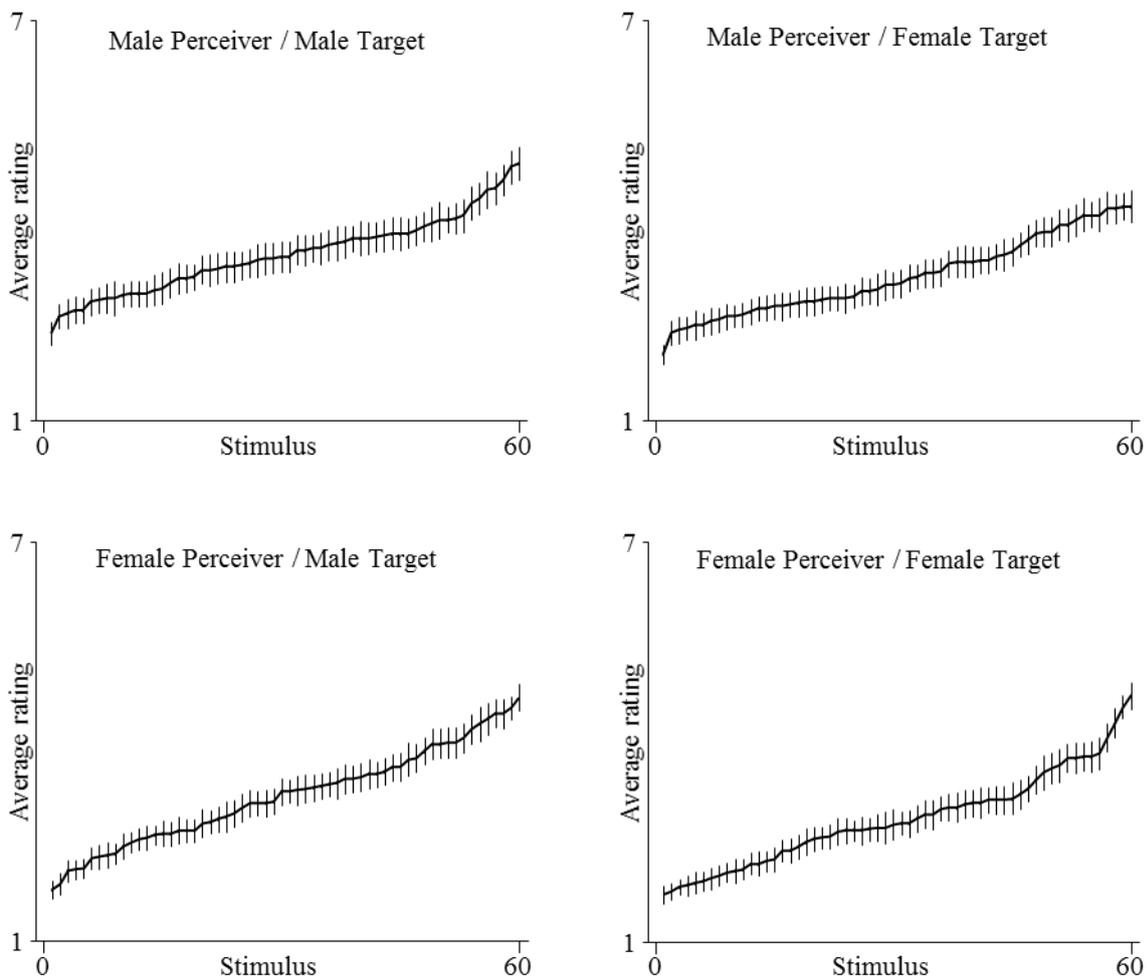


Figure 4: Mean HIV ratings rank-ordered for each subgroup

Inter-rater agreement

Inter-rater agreement for HIV risk was high and comparable across the four groups: $ICC = .88$ for male perceivers rating male targets, $ICC = .91$ for male perceivers rating female targets, $ICC = .95$ for female perceivers rating male targets, and $ICC = .95$ for female perceivers rating female targets.

HIV risk perception

A significant main effect of ‘Target Gender’ was observed, $F(1,118) = 15.23$, $p < .01$, $\eta^2 = .11$, which indicated that male targets were perceived as more risky than female targets (see Table 1). Furthermore, a significant main effect of ‘Perceiver Gender’ was observed, $F(1,118) = 17.5$, $p < .01$, $\eta^2 = .13$, indicating that male perceivers provided higher HIV risk ratings as compared to female perceivers. However, the two factors did not interact, Target Gender x Perceiver Gender, $F(1,118) = .003$, $p = .96$, $\eta^2 < .01$.

Table 1: Mean HIV ratings and SDs for the respective subgroups

	Male Targets		Female Targets		All Targets	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Male Perceivers	3.48	1.3	3.15	1.2	3.32	1.25
Female Perceivers	3.17	1.27	2.85	1.24	3.01	1.25
All Perceivers	3.32	1.28	2.99	1.22	3.16	1.25

Association of perceived HIV risk and other trait person characteristics

In order to determine the association of perceived HIV risk with trait person characteristics, correlations coefficients were calculated separately for all of the four groups, i.e., female perceiver/female target, male perceiver/female target, female perceiver/male target, male perceiver/male target. As shown in Table 2, there was a robust and consistent relationship between perceived HIV risk and perceived trustworthiness and responsibility in each of the four groups (r 's $> .85$, $p < .001$). While the profile of correlations across the four groups showed overall similarities, there were however also group differences. Specifically, correlations of

perceived HIV risk and perceived attractiveness, valence, arousal, health, and willingness for interaction varied between the groups.

Table 2: Correlations between mean ratings of the seven trait dimensions with HIV risk ratings for the respective rating groups.

	Male Targets		Female Targets	
	Male Perceivers	Female Perceivers	Male Perceivers	Female Perceivers
Trustworthiness	-.86**	-.89**	-.88**	-.92**
Health	-.56**	-.64**	-.65**	-.77**
Valence	-.69**	-.71**	-.45**	-.80**
Arousal	.66**	.60**	.47**	.87**
Attractiveness	-.42**	-.43**	-.13	-.35**
Interaction	-.66**	-.60**	-.30*	-.72**
Responsibility	-.85**	-.91**	-.87**	-.91**

* $p \leq .05$; ** $p \leq .01$

To determine whether there are reliable differences between the groups regarding the association of perceived HIV risk with trait person characteristics, multiple regression models were calculated separately for each group. As shown in Table 3, the results indicated target-related differences primarily with respect of target gender. For male targets, trustworthiness was the only significant predictor in the male and female perceiver group, $\beta_{male_perceivers} = .75, p = .02$; $\beta_{female_perceivers} = .89, p = .01$. For female targets, HIV was also significantly predicted by trustworthiness. In addition, several further person characteristics emerged, which, however varied between male and female perceiver groups. For male perceivers, HIV was predicted significantly by health, $\beta_{male_perceivers} = .38, p < .01$, valence, $\beta_{male_perceivers} = .78, p < .01$, attractiveness, $\beta_{male_perceivers} = -.63, p = .01$, and trustworthiness, $\beta_{male_perceivers} = .54, p = .02$. For female perceivers, HIV was predicted significantly by health, $\beta_{female_perceivers} = .41, p < .01$, arousal, $\beta_{female_perceivers} = .27, p = .01$, attractiveness, $\beta_{female_perceivers} = -.34, p < .01$, and also trustworthiness, $\beta_{female_perceivers} = .77, p = .01$.

Table 3: Predictors of HIV for the respective rating groups

	Male Targets							
	Male Perceivers				Female Perceivers			
	B	SE	β	t	B	SE	β	t
Trustworthiness	-.525	.226	-.752*	-2.324	-.639	.242	-.886*	.242
Health	-.181	.120	-.265	-1.508	-.120	.100	-.161	.100
Valence	.481	.282	.525	1.707	.118	.235	.139	.235
Arousal	.352	.197	.230	1.789	-.250	.184	-.148	.184
Attractiveness	.044	.125	.068	.349	.039	.125	.069	.125
Interaction	-.156	.235	-.201	-.665	.176	.219	.253	.219
Responsibility	-.077	.193	-.106	-.401	-.276	.174	-.362	.174
R ²	.772				.849			

* $p \leq .05$

	Female Targets							
	Male Perceivers				Female Perceivers			
	B	SE	β	t	B	SE	β	t
Trustworthiness	-.463	.186	-.543*	-2.497	-.561	.222	-.766*	-2.534
Health	-.286	.095	-.378**	-3.017	-.333	.071	-.414**	-4.674
Valence	-.709	.233	-.783**	-3.044	.292	.222	.307	1.315
Arousal	-.086	.152	-.074	-.565	.462	.158	.274**	2.928
Attractiveness	.362	.137	.628*	2.634	.247	.082	.335**	3.021
Interaction	.306	.192	.449	1.590	-.154	.186	-.186	-.830
Responsibility	-.030	.188	-.035	-.158	.093	.142	.121	.658
R ²	.855				.920			

* $p \leq .05$; ** $p \leq .01$

Discussion

The main finding of the present study was the observation of target and perceiver differences in perceived HIV risk. Perceived HIV risk was increased for male targets and male perceivers. Furthermore, the association of perceived HIV risk and trait person characteristics differed for male and female target pictures. For male targets, HIV risk was only associated with ratings of trustworthiness, in multiple regression analysis, and no other personality characteristic made an independent, further contribution. A much richer and multi-faceted web of relationships characterized the face of risk for woman. In addition to trustworthiness, attractiveness, health, valence (male perceivers), and arousal (female perceivers) were predictive of HIV risk ratings. Thus, first impressions about HIV risk for female and male target pictures were based on different sources of information. These gender differences may be relevant to the design and evaluation of HIV prevention campaigns. Such campaigns often convey high- risk stereotype information, which may contribute to the associative structure of personality characteristics underlying first impressions of HIV risk.

A key question raised by the present data is how to account for the gender-differentiated face of HIV risk. While a cogent explanatory framework is missing, evolutionary and socio-cultural considerations of a) differences between the genders related to partner selection and resource distribution and trust in social life (Buss, 1995) and b) the portrayal of HIV risk in the public (Higgins et al., 2010) are potentially important to consider. Gender differences related to partner selection have been well documented in cross-cultural studies (Buss, 1989). Specifically, physical attractiveness and health are more important for partner selection in woman than men, while women consider social status and financial resources more important than men (Shackelford, Schmitt, & Buss, 2005). These gender differences in person characteristics related to partner selection may be reflected in the association of perceived HIV risk and trait person characteristics. Specifically, attractiveness and health were only significant contributors in predicting HIV risk in female targets and were not observed for the male target pictures. Interestingly, these gender differences in target picture evaluation were similarly observed for female and male perceivers. Thus, rather than being strongly related to partner selection, the associative network structure underlying HIV risk and trait person characteristics seem to be shared between female and male perceivers. The present data also help to clarify the relationship of perceived attractiveness and perceived HIV risk. Neither the hypothesis that attractiveness increases HIV risk (i.e., higher likelihood of many partners), nor the 'what is beautiful is good'-heuristic has received strong support in previous research (Agocha & Cooper, 1999; Blanton & Gerrard, 1997; Dijkstra, Buunk, & Blanton, 2000; Schmälzle et al., 2011).

While correlation analysis suggested a moderate relationship between attractiveness and perceived HIV risk, this analysis does not account for shared variance among related constructs such as health and valence. In contrast, when using multiple regression analysis to identify predictors of HIV risk, attractiveness and health conjointly contribute to HIV risk, but only in female targets. While multiple regression analysis is well-suited to identify variables making significant contributions to the prediction of HIV risk, due to multicollinearity, exact interpretation of standardized beta-weights is limited (Kraha, Turner, Nimon, Zientek, & Henson, 2012). Using stimuli in which relevant trait characteristics are systematically varied, the issue needs to be addressed in future research.

A somewhat different perspective on the present findings arises from considering how HIV and AIDS are portrayed in public media. Especially in the early phase of the disease's history, HIV and AIDS have always been strongly connected with sexual intercourse between males, particularly as it was even referred to in the media as 'The gay plague'. Even today, public discussion in western countries is still dominated by men-related topics, like debates about the usefulness of pre-exposure prophylaxis for gay men (Holt et al., 2014). The extensive and continued consideration of HIV risk factors for homosexual and heterosexual men may accordingly have contributed to a clear picture of men's HIV risk (i.e., male targets) as being centered on variables of trustworthiness and responsibility. Conversely, women did not initially appear in public perception and discussion of HIV (Corea, 1992; Treichler, 1988), and for almost a decade women did not even take part in neuropsychological studies on HIV (Fox-Tierney, Ickovics, Cerrata, & Ethier, 1999). Only recently have women received more attention (Marshall, 2007); however, this view is restricted to women from the global south and does not extend to women in western countries. Furthermore, the 'vulnerability paradigm' added a further imbalance to the gender-related perception of HIV (Higgins et al., 2010). Specifically, women are often referred to as having less sexual autonomy and being more vulnerable while men are seen as active transmitters of the disease (Wenzel & Tucker, 2005). Thus, women appear to be in need of protection while men appear to pose a potential threat. Accordingly, the nuanced multi-faceted association of personality characteristics and perceived HIV risk in women (i.e., female targets) may be the result of social-cultural factors related to sexual autonomy and social status as well as a less developed high HIV risk stereotype. Obviously, these hypotheses are speculative and need to be examined in future research.

A further main finding of the present study was that HIV risk ratings differed for genders. Male target images received higher risk ratings as compared to female images and the effect was similarly observed for male and female perceivers. The finding may reflect

knowledge, i.e., 4:1 infection ratio of men/woman in Germany (Robert Koch-Institut, 2014) or the view that men are the active transmitters of the disease. In addition, male and female raters differed significantly in their risk ratings, with male raters providing higher risk ratings than female raters. This finding somehow contrasts with previous research showing that woman felt more at risk than men when asked about their personal feelings of safety (Masaro, Dahinten, Johnson, Ogilvie, & Patrick, 2008). These conflicting may be reconciled by differentiating between perceived risk in another person, i.e., other-person risk, and feelings of vulnerability for the self (Renner & Schupp, 2011). Furthermore, while the interaction among the factors 'Perceiver Gender' and 'Target Gender' was not significant, it is noteworthy that the respective group of potential partners for the predominantly heterosexual sample received rather similar risk ratings.

Understanding the mechanisms of first impressions of HIV risk seems to be important with respect to the possibility to resolve the conflict between 'risk-as-analysis' and 'risk-as-intuition'. The consideration of key characteristics of intuition helped to resolve the paradox that people know how to protect but occasionally refrain from safer sexual practices because of the feeling that the partner does not pose a risk. Intuitions are often reached effortlessly, at high speed without conscious awareness, and experienced with a high sense of confidence (Hogarth et al., 2011). Along with additional situational constraints, i.e., shame and embarrassment regarding talking about HIV testing or protection (Bontempi, Mugno, Bulmer, Danvers, & Vancour, 2009), dislike and negative attitudes towards condoms (Civic, 2000; Gardner et al., 1999) and the heat of the moment (Ariely & Loewenstein, 2006), the impression of safety may induce a false sense of control and risk protection (Thompson et al., 2002). Furthermore, it seems that there are no preconditions for acquiring first impressions of HIV risk. The low base rate of HIV, the under-representative sampling, and the lack of corrective feedback strongly question reliance on intuition in this domain. Thus, unlike many other areas of social life in which first impressions may appear highly valid (Schaller, 2011), intuitive HIV risk perception is fallible and provides an illusory control of risk. Simulating the failure of intuition may be one strategy for bringing people to use a rational mode of risk analysis. Furthermore, HIV risk campaigns portraying high risk stereotypical information may form an implicit HIV risk stereotype with consequences for the ease and confidence with which the associative structure is engaged. The present findings add the perspective of gender differences to the discussion and raise the issue of whether the observed differences in the information which fuels first impressions can help shift the balance from intuition towards analysis.

Conclusion

The present research examined gender differences in first impressions of HIV risk. The findings revealed gender differences in snap judgments of HIV risk. Ratings of HIV risk and trait person characteristics to same and opposite sex persons revealed increased risk ratings for male perceivers as well as male targets, and indicated systematic gender differences in the structure of person characteristics associated with HIV risk. While trustworthiness was the only variable predictive of perceived HIV risk in male target images, a more refined pattern of relationship emerged for female targets including trustworthiness as well as attractiveness and health. Considering these gender differences may help to devise effective strategies shifting the balance from intuition to a more rational mode of risk perception and the adoption of effective precautionary behaviors.

STUDY III: CONTEXTUAL INFLUENCES ON RISK PERCEPTION

Abstract

Studies on HIV risk perception reveal that people rely on the impressions they have about the ‘safety’ or ‘riskiness’ of potential partners. Previous research has examined these impressions and intuitive snap judgments showing that they are based on visual cues related to a person’s appearance such as facial cues and clothing. However, the environmental context of the perceived person might also present an important source of information. To date, it remained unclear, if people also use contextual cues when evaluating the riskiness of an unacquainted person. Hence, we conducted a study comparing the contributions of contextual cues and visual cues of the depicted person to HIV risk perception. Three groups viewed one out of three picture sets. The first group viewed a set of unedited pictures of persons in everyday environments. The second group viewed the same pictures but with the environment masked, and the third group viewed a set with the persons masked. According to the respective stimulus set, participants were asked to either evaluate the HIV risk emanating from the presented person or the probability that a risky person would reside in the presented context. In order to compare the relevance of person and context for risk perception, we examined, if their respective ratings predicted HIV risk ratings for the unedited pictures. We found, that HIV risk ratings for the unedited pictures were predicted significantly by the ratings for the person-only pictures, while context-only picture ratings were no significant predictor. However, some pictures were attributed opposing (high vs. low) mean ratings for person and context. Here, the context ratings significantly predicted risk ratings for the unedited pictures. Hence, contextual cues gain importance when a person is perceived as being out of context. The present findings suggest, that contextual cues in general play an inferior role in HIV risk perception except for the case of conflicting evaluations for person and context. Regarding the very small sample of pictures matching this criterion in the present study, further research on this issue is needed.

Introduction

Since the appearance of HIV in the early eighties, uncounted campaigns about condom use as an effective strategy to avoid the disease have been launched. As these campaigns have successfully informed the public about transmission routes, most people are currently aware that unsafe sexual behaviors bear the risk of HIV infection. However, this knowledge is not sufficient to motivate consistent protective behavior. Studies on safer sex behavior have painted a rather sobering picture, revealing high rates of negative attitudes towards condoms (Civic, 2000; Lust & Bartholow, 2009) and infrequent use of condoms (Chandran et al., 2012). Hence, further research is needed to come to an understanding of the mechanisms behind this phenomenon.

Despite the risk of becoming infected with a mortal disease, studies show that many people circumvent condom use by relying on illusory strategies such as ‘getting to know the partner’ or ‘learning about his or her sexual history’ (Donovan, 2000; Swann et al., 1995; Thompson et al., 1999). Unfortunately, these strategies are not effective but rather induce a false sense of control over the risk. Following unprotected sexual encounters people often report that they were convinced that their partners were safe (Gold et al., 1992). Thus, it appears that HIV risk perception is at least partly based on spontaneous and intuitive impressions of others, and that ‘safe’ impressions can override active use of effective protection strategies (i.e. condom use). It has been suggested that intuitive risk perception is part of a so called behavioral immune system, which utilizes visual cues in order to automatically evaluate the riskiness of the environment (Schaller, 2011). Accordingly, the lack of overt cues signaling an infection in the case of HIV might lead to a reliance on cues related to a pattern-based stereotype of an HIV carrier, e.g. assumed homosexuality or drug use. In the absence of such cues, people might just feel safe. This raises questions about which cues are actually used for evaluating HIV risk?

As there is an almost infinite number of retrievable cues for perceiving a person, it is impossible to utilize them all at once. Accordingly, Brunswik (1943) suggests a holistic approach in his classic lens model: depending on the perceiver only some of the cues are used to gather impressions from the environment. Hence, how the world is perceived depends on the cues selected and how they are combined. According to this model, situations may occur in which a person’s perception mainly depends on cues related to the perceived person (Vicente, 2003). Moreover, inferences about the traits and psychological states of a person seem to be only possible on the basis of minimal information, such as the face (Zebrowitz, 2006). Although these evaluations might be imprecise and defective, they appear to be logic in a highly complex environment. Here, an evaluation system conveying snap judgments seems to be appropriate.

Actually, studies revealed that the perceiver reaches a consistent impression in less than one second when viewing a stimulus person (Bar et al., 2006; Willis & Todorov, 2006), e.g. when evaluating the potential risk of a person. Risk judgments appear to be the same whether a stimulus person is presented for just a few hundred milliseconds or an unlimited duration (Bar et al., 2006). Recent neuro-scientific studies of HIV risk perception revealed a differentiation in brain responses to both risky and safe individuals occurring after less than 300 ms (Renner et al., 2012; Schmälzle et al., 2012; Schmälzle et al., 2011). This early processing precedes conscious and therefore also deliberate brain activities, supporting the notion of an automatic and pattern-based risk evaluation.

While several studies investigating risk perception only used faces as stimuli (Schmälzle et al., 2011; Todorov et al., 2009; Willis & Todorov, 2006), more recent studies proceeded to show persons framed by normal activities in order to enhance ecological validity (Häcker et al., 2014; Renner et al., 2012; Schmälzle et al., 2012). Previous studies have revealed that the context also provides a rich resource of information (Doherty & Kurz, 1996). It has been demonstrated that evaluations of perceived emotions substantially vary depending on the presence or absence of a context. In addition, the rater's consent was higher when a context was available (Munn, 1940). Further studies explored effects of contextual, visual information on perceived attractiveness. If a picture of a target person was presented surrounded by other pictures showing attractive people, the target person was rated as more attractive than when surrounded by pictures showing less attractive people (Geiselman, Haight, & Kimata, 1984). Another study indicated, that the same person standing in front of a middle-class house is evaluated more positively than when standing in front of a run down or lower SES house (Cherulnik & Bayless, 1986). Furthermore, it has been demonstrated that people infer traits even in the absence of a stimulus person when viewing the room in which that person is said to live (Gosling, Ko, Mannarelli, & Morris, 2002). Importantly, even risk-related perception seems to be influenced by contextual cues: Policemen were surveyed about how they reach their evaluations of potentially dangerous situations. Exploration of their answers revealed that they rely more on contextual cues and the behavior of a suspicious person than facial cues (Rozelle & Baxter, 1975). According to these studies, risk-related person perception does not seem to be merely dependent on the perceived person. In sum, these findings support the notion that contextual cues can have considerable influence on impression forming.

The presentation of a natural context provides an additional source of information for the perceiver and has greater ecological validity. Previous studies have already used images of people embedded in natural scenes (Häcker et al., 2014; Schmälzle et al., 2012). However, it is

still unclear to which extent risk evaluation depends on features associated with the presented person or whether features associated with the shown context also play a role. Hence, this approach requires an examination of which perceptual features contribute to the detection of potential risk. Accordingly, the main aim of the present study was to examine the influence of contextual, visual information on health risk judgments of non-acquaintances people. To this end, we conducted a study with three picture sets showing either people in everyday scenes, people with the backgrounds masked, or the backgrounds with the people masked. Participants were asked to spontaneously rate perceived HIV risk for pictures of one of the three picture sets. Then, we examined correlations between the three picture sets in order to examine the interrelations between the three conditions. In addition, multiple regression analysis was conducted to determine the predictive power of both the stimulus people and their respective environments for the rating of the unedited pictures. Since we used pictures of both women and men, data was also analyzed referring to possible gender differences.

Material and Methods

Participants

Seventy-eight volunteers, aged 20 - 27 years ($M = 22.34$, $SD = 5.46$, 62 females), were recruited on campus at the University of Konstanz. Participants received either monetary reimbursement or course credits. Six participants had to be excluded from analysis because rating patterns indicated non-task-related ratings. Participants provided written consent for the study protocol, which was approved by the Ethic Review Board of the University of Konstanz.

Stimulus material

The stimulus set consisted of 60 photographs of people (gender balanced) in everyday scenes. The photographs were retrieved with permission from two popular online photo-sharing communities (www.flickr.com, www.usgang.ch). All photographs depicted one single young adult of Caucasian appearance. Attire, socioeconomic cues, and context were intentionally included to provide naturalistic viewing conditions. The stimuli were selected from a larger database (Schmälzle et al., 2012) following risk values of the depicted backgrounds which had been determined in a preliminary study. Thirty stimuli showed people with high risk backgrounds, thirty further pictures showed people with low risk backgrounds. Both background conditions contained half female and half male stimulus persons. This picture set ('original') was then edited to obtain two further picture sets: one set showing only the stimulus person, with the background masked ('person'), and one set only showing only the background, with the stimulus person masked ('context').

Procedure

A between-subject design was used to collect explicit ratings of HIV. Seventy-eight participants were randomly assigned to the three conditions 'original' (24 subjects), 'person' (26 subjects), and 'context' (28 subjects). In each condition, participants viewed the 60 pictures of their respective set in a random order. For the conditions 'original' and 'person', participants were asked to evaluate the risk that the depicted person might be HIV positive on a 6-point Likert scale ranging from "very unlikely" [-3] to "very likely" [3]. The same scale was used for the 'context' condition, but participants were asked to evaluate the likelihood that a HIV positive person would frequent the presented environment.

Data were acquired in small groups of twelve subjects using EFS survey software (Globalpark AG) for stimulus presentation and data collection. Stimuli were presented on 19" TFT Monitors, placed approximately 60 cm in front of participants. This resulted in a vertical visual angle of 21° and a horizontal visual angle of 16°. Participants were instructed to rate the stimuli spontaneously and to use the full range of the rating scale according to their own perceived risk differences in the presented stimuli. The rating procedure was completed with the acquisition of socio-demographic data and the debriefing of the participant.

Results

Context Risk Categorization

In a preliminary study, stimuli used in this study had been categorized separately for female and male models as “low risk” and “high risk” referring to the perceived riskiness of the context. In order to examine the consistency of this categorization, the same procedure was conducted again in this study.

For 83.3% of the male stimuli, mean context ratings in the present study yielded the same risk category as the a priori ratings. Three pictures categorized a priori as ‘high risk’ were now categorized as ‘low risk’, while two ‘low risk’ pictures were categorized as ‘high risk’.

For the female stimuli set, picture ratings showed an even higher consistency (96.7%). Only one of the pictures categorized as ‘high risk’ a priori ended up a posteriori as ‘low risk’.

There were no frequency differences between low (52.3% and 52.3%) and high risk (46.7% and 46.7%) categories for female and male context pictures.

Inter-rater Agreement

It has been suggested, that the inter-rater agreement for trait evaluations should rise with increasing availability of information, facilitating impression formation (Munn, 1940). Accordingly we assumed, that inter-rater agreement on HIV risk perception might also rise with increasing availability of visual cues. Intra-class correlation coefficients (*ICC*) were thus computed for all three conditions.

In all three conditions *ICCs* were highly reliable ($ICC_{original} = .91$; $ICC_{person} = .92$; and $ICC_{context} = 0.91$; all p -values $< .01$). Importantly, *ICC* values for the conditions ‘original’ and ‘person’ did not differ significantly ($z = -.28$; $p = .78$).

Interrelations between the rating conditions

In order to examine interrelations between risk ratings for the original pictures and the respectively related edited pictures, correlations were computed. Risk ratings for the ‘original’ and ‘person’ conditions were highly correlated, $r = .88$; $p < .01$. Bootstrapping ($N = 1000$) indicated that this value lay within the 95% confidence interval, $CI [0.787; 0.930]$. High correlations could also be found for risk ratings of the ‘original’ and ‘context’ condition, $r = .47$; $p < .01$; $CI [0.221; 0.663]$ and for ratings of the ‘context’ and ‘person’ condition, $r = .45$;

$p < .01$; CI [0.195; 0.666]. A separate analysis for female and male pictures showed no substantial deviation from these results, as can be seen in *Table 4*.

Table 4: Correlations between risk ratings of the three rating conditions

	All pictures		Female pictures		Male pictures	
	r	CI	r	CI	r	CI
Original / Person	.88**	0.787; 0.930	.87**	0.774; 0.936	.89**	0.602; 0.954
Original / Context	.47**	0.221; 0.663	.47**	0.136; 0.770	.51**	0.151; 0.741
Person / Context	.45**	0.195; 0.666	.49**	0.140; 0.802	.42*	0.015; 0.683

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

Overall, the correlation for ratings of the ‘original’ and ‘person’ conditions was substantially higher than for ‘original’ and ‘context’ conditions ($z = 4.62$, $p < .01$) and for ‘person’ and ‘context’ conditions ($z = 4.76$, $p < .01$). In contrast, correlations for the ratings of the ‘original’ and ‘context’ conditions and for the ‘person’ and ‘context’ conditions yielded comparable values ($z = .14$, $p = .89$). *Figure 5* illustrates these results.

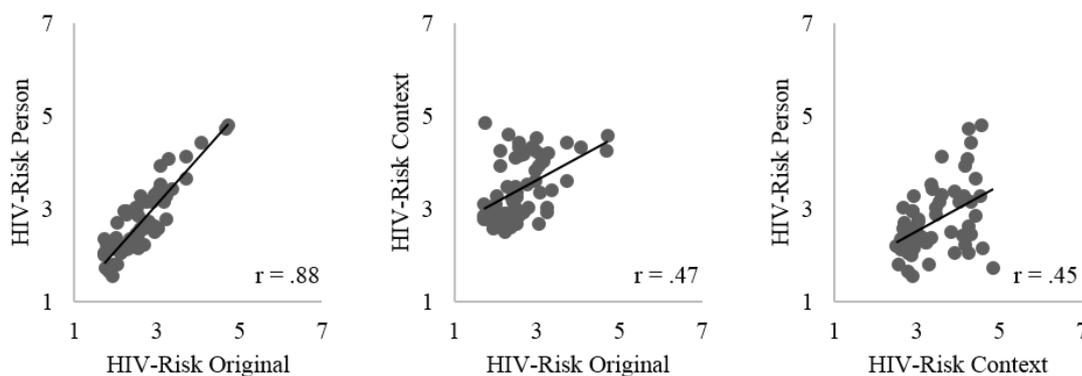


Figure 5: Correlations of the mean risk ratings by rating conditions

Since high risk stimuli are processed more intensely than low risk stimuli (Schmaelzle et al, 2012) and therefore also their specific components, such as person and context, higher interrelations between the three picture sets for high risk stimuli were expected. Hence, ‘original’ pictures were sorted by mean HIV risk rating values and correlations were computed

separately for ratings of high and low risk pictures. Mean HIV risk ratings for the ‘original’ condition varied from ‘low risk’ ($M = 1.72$) to ‘high risk’ ($M = 4.72$). The ten lowest rated pictures yielded only a non-significant correlation for ‘original’ and ‘person’ ratings, $r = -.04$; $p = .91$, which rises to a highly significant value for the ten highest rated pictures, $r = .88$; $p < .01$. The same phenomenon could be observed for the correlations of ‘original’ and ‘context’ risk ratings. Here, the ten lowest rated pictures yielded a non-significant value of $r = -.31$; $p = .38$, while the ten highest rated pictures had a significant value of $r = .64$; $p < .05$.

Person and context as predictors for HIV risk ratings

HIV ratings for the ‘original’ condition were assumed to be predictable from the respective ratings of the ‘person’ and ‘context’ conditions and possibly the combination of both components. Accordingly, a multiple regression model was calculated including the ratings of the ‘person’ and the ‘context’ conditions and the interaction of both conditions. Results of this analysis were not interpretable due to collinearity tolerance values of $T < .06$. Hence, a sequential regression analysis was conducted including only ‘person’ and ‘context’ conditions as predictors. Data were again examined for collinearity. With a tolerance value of $T = .80$ this could be excluded. Results revealed that the ratings of the ‘context’ condition are only a weak predictor ($\beta_{\text{context}} = .094$) for the ratings of the ‘original’ condition and not significant ($p = .181$). In contrast, the ratings for the ‘person’ condition emerged as a valuable predictor for the ratings of the ‘original’ condition, $\beta_{\text{person}} = .838$; $p < .01$, as can be seen in *table 5*.

Table 5: Predictors for HIV risk ratings in the ‘original’ condition

	Original				
	<i>B</i>	<i>SE</i>	β	<i>t</i>	<i>p</i>
Person	.740	.061	.838**	12.110	.00
Context	.091	.067	.094	1.354	.81
R^2	.781				

** $p < .01$

Discussion

Studies examining the processes underlying person-related health risk perception mostly selected pictures of faces on a neutral background as experimental stimuli (Schmälzle et al.,

2011; Todorov et al., 2009; Willis & Todorov, 2006). Since previous research on person perception has revealed the importance of contextual information (Cherulnik & Bayless, 1986; Rozelle & Baxter, 1975), more recent studies started using more ecologically valid stimuli, such as people located in everyday settings (Renner et al., 2012; Schmälzle et al., 2012). Since contextual cues have not been examined so far regarding their possible influence on health risk evaluations, the present study was designed to shed light on this issue.

According to the results of the present study, only the person without contextual information is in part predictor for evaluations of the complete picture. Vice versa, the context does not appear to be a significant predictor. In addition, inter-rater agreement was not higher for pictures in the ‘original’ condition including person and contextual cues compared to inter-rater agreement on person only pictures. Hence, contextual information does not seem to have a detectable influence on HIV risk perception. Since ‘person’ and ‘context’ conditions were extracted from the original pictures, correlations between ratings in the ‘person’ and ‘context’ conditions and ratings in the ‘original’ condition were expected and could also be found according to the results. Furthermore, the results even revealed correlations between ratings in ‘person’ and ‘context’ conditions. However, bootstrap analyses only indicate the correlation between ratings in the ‘original’ and the ‘person’ condition as being significant.

A closer look at the correlations of ratings in the ‘context’ and ‘original’ conditions reveals that the highest correlations can be found for those pictures receiving the highest mean risk ratings in the ‘original’ condition. In contrast, no significant correlations could be detected for the pictures with the lowest risk ratings in the ‘original’ condition. The same results were found for the correlations between the ‘original’ and the ‘person’ conditions. Hence, high HIV risk ratings in the ‘original’ condition seem to require high risk ratings for both person and context while low risk ratings in the ‘original’ condition appear to be more independent from person and context evaluations. It has been suggested that a congruent context significantly influences face ratings (Koji & Fernandes, 2010). Accordingly, the evaluation of pictures in the ‘original’ condition is presumably preceded by a rating cascade: a ‘risky’ background triggers the perceiver of a ‘risky’ person to rate that person even higher, resulting in a very high original picture rating. Here, contextual cues might work as an amplifier.

Previous research dealing with the influence of contextual information on trait judgments (Munn, 1940) suggested a higher inter-rater agreement for the original pictures compared to the person only pictures because of the presence of the context. However, the data of the present study showed no significant differences between the three conditions. Instead, comparably high *ICC* values could be found for all of them. Hence, the participants might have similar HIV risk

perception concepts. Importantly, there was no difference in rater's consent between the original and the person condition. Previous research revealed that people mentally add unavailable contextual information in order to reach a better understanding and interpretation of a setting (Carroll & Russell, 1996). Accordingly, it can be hypothesized that subjects might imagine a suitable context while viewing person only pictures. Since the pictures of the present study were not artificially composed, such a mentally added context should come close to the actual context, except for the few pictures where the person-context fit was perceived as unnatural.

In general, contextual information can alter the impression of the person being displayed (Cherulnik & Bayless, 1986; Rozelle & Baxter, 1975). Hence, a clearly detectable influence of the context on risk ratings was expected. However, the predictive power of the context is, according to the results of this study, quite small and not significant. It has been demonstrated that a setting evokes certain expectations about what fits in and what does not (Bar, 2004). Hence, a context which does not match the target person should draw more attention and might therefore be more important for the evaluation of the original picture. Accordingly, we conducted an explorative post hoc regression analysis using only pictures showing opposite mean ratings for 'person' and 'context' conditions. Here, "opposite" refers to pictures where in one of the two conditions the mean rating of the respective picture was higher than the mean rating of all pictures in that condition and lower in the other one. Sixteen pictures fulfilled these requirements, showing either 'low risk' persons with a 'high risk' context or vice versa. Except for one outlier all of these pictures yielded the same risk category in the 'original' as in the 'context' condition. Accordingly, we assumed that the predictive value of the context should be higher for these pictures. Results revealed a still not significant but higher value of $\beta_{\text{context}} = 0,409$; $p < .21$. In addition, the predictive value of the 'person' ratings rose up to $\beta_{\text{person}} = 1.028$; $p = .01$. With regard to the very small sample, this value was calculated again for another subset omitting the outlier. Here, a significant predictive value was found for 'context', $\beta_{\text{context}} = 0,686$; $p = .03$, and for 'person', $\beta_{\text{person}} = 1,281$; $p < .01$. In sum, a pronouncedly higher predictive value of 'context' and 'person' was found for pictures with opposite ratings, especially regarding 'context'. *Table 6* illustrates these results.

Table 6: Predictors of the original pictures in two subsets containing 'opposite' pictures

	Opposite				Opposite (outlier omitted)			
	<i>B</i>	<i>SE</i>	β	<i>t</i>	<i>B</i>	<i>SE</i>	β	<i>t</i>
Person	.921	.278	1.028**	3.310	1.079	.236	1.281**	4.580
Context	.282	.214	.409	1.318	.459	.187	.686*	2.452
<i>R</i> ²	.781				.682			

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

The results of this analysis show that when person and context ratings point in different directions, both elements become better predictors. Hence, a safe person in a risky context, or vice versa, might lead the observer to pay more attention to both person and the context. Furthermore, original pictures with opposite mean ratings in the 'person' and 'context' conditions were rated according to the context rating. Hence, a safe person in a risky context is rated as risky and a risky person in a safe context is rated as safe. These findings support the notion, that an emotional background can alter the perception of a person stimulus (Righart & de Gelder, 2006). Applied to the results of this study, a risky context can change the safe impression of a person and finally lead to a risky evaluation of the whole scene, while a safe context allows the person to appear less risky.

Conclusion

The present study provides insights into the influence of contextual information on health risk perception. Results show that health risk related ratings of person pictures can be predicted in the majority of cases by the presented person, while for the most part contextual cues are not a reliable predictor. Yet, contextual cues become more important when risk ratings for person and context point in different directions. With regard to the findings that people often rely on implicit impressions when deciding whether to protect themselves or not (Gold, 1993), a 'safe' environment might therefore encourage the underestimation of risk, even when the perceived person is assumed to be 'risky'. Future campaigns promoting condom use and safer sex should therefore remind people that a 'safe' environment might induce a false sense of safety.

GENERAL DISCUSSION

The Present Dissertation

The aim of the present dissertation was to broaden the understanding for underpinning mechanisms of intuitive health risk perception. Pioneering studies in this field have revealed that people are performing fast and automatic snap judgments referring to perceived riskiness of unacquainted people (Schmälzle et al., 2011). These findings raised further questions towards how this intuitive rating system works. Hence, three major questions were addressed in this dissertation.

The first study was designed to answer the question whether intuitive health risk perception towards unacquainted individuals simply distinguishes between healthy or unhealthy or whether it is even more subtle, distinguishing between infectiously sick and non-infectiously sick. Accordingly, dense sensor EEG was recorded while participants evaluated pictures of unacquainted people for either HIV or leukemia risk. Results revealed earlier and later differential brain responses towards individuals perceived as being high in risk for HIV. However, there were no such differences for high vs. low leukemia risk. Hence, intuitive risk perception appears to be at least in part specific to infectious diseases and not a general automatic reaction to all kinds of illnesses.

The goal of the second study was to test for gender-related differences in intuitive health risk perception depending on both the gender of the perceiver as well as the perceived target person. To address this issue, we devised a study containing same-sex as well as opposite-sex evaluations. Female and male participants gave ratings for perceived HIV risk and seven risk-related trait characteristics for 120 photographs of target persons (half female and half male). The results revealed two noteworthy findings: First, women give more positive HIV evaluations for both female and male targets than men. Second, male targets receive more negative HIV evaluations than female targets from both women and men. Hence, HIV risk perception depends on both the perceiver's and the target's gender.

The third study aimed to address the question of which cues are used to gauge the health risk of an unacquainted person, particularly with regard to person-related and context-related cues. In order to investigate the influence of such extra-personal, contextual cues on HIV risk perception, a study was conducted in which participants viewed either a set of pictures showing persons in real life sceneries or one of two edited sets in which either only the person was shown without the context or only the context was shown without the stimulus person. Participants were asked to evaluate the HIV risk emanating from the respective pictures. According to the

results of this study, the presented person is a valuable predictor for the original picture evaluation while the context plays an inferior role. Nevertheless, there are some pictures with opposite risk ratings for the person and the context. Here, the context rating tends to be a much better predictor for the original picture rating. Hence, the context seems to gain importance, when the perceived person unexpectedly does not fit in that context.

Implications for Health Risk Perception

Risk perception has an important impact on actions towards health improvement or health preservation (Millstein, 2003; Weinstein, 2003). Traditional cognitive as well as more recent affective health behavior models agree on this assumption. Nevertheless, substantial differences can be observed between affective models and traditional models that strongly focused on cognitive processes. These cognitive processes are assumed to be slow, reflective and effortful and to build a valuable basis for deliberate and conscious decisions in risky situations (Steinberg, 2003; Wright, 1998). However, everyday life situations often necessitate fast, spontaneous and effortless decisions. Studies have shown that people are also able to perform quick and intuitive judgments (Renner et al., 2012; Schmäzle et al., 2012; Schmäzle et al., 2011; Willis & Todorov, 2006), which cannot be explained by the classic models of decision-making. Accordingly, more recent models of decision making examined the role of intuition (Gilovich & Griffin, 2002), affect, and emotion (Plessner, 2008; Weber & Johnson, 2009). These models, such as the ‘risk as feelings’ approach (Loewenstein et al., 2001) or the ‘affect heuristic’ model (Slovic, Peters, Finucane, & Macgregor, 2005), suggest that affect and intuitions trigger unconscious, automatic and fast decisions without any involvement of cognitive processes. Hence, the main difference between cognitive and affective models of health risk perception and behavior consists of diverging assumptions about the underpinning mechanisms, which are either assumed to be slow and reflective or fast and intuitive.

Intuitions and affective reactions are hard to capture, but neuro-scientific measures offer a way to tap into automatic and pattern-based intuitive reactions. Hence, in a series of pioneering studies, assumptions from affective health risk models have been adapted for the examination of health risk perception and behavior using neuropsychological measures (Häcker et al., 2014; Renner et al., 2012; Schmäzle et al., 2012; Schmäzle et al., 2011). In contrast to previous studies only concentrating on anticipated emotions (Cameron & Reeve, 2006; Chapman & Coups, 2006; Lerner & Keltner, 2001; Richard, de Vries, & van der Pligt, 1998), these more recent studies focused on emotions and intuitions that are present “in real time”, while health risks are actually being perceived and while risk judgments and risk-related decisions are being

made. The results of these studies provided important insights in the mechanisms underlying health risk perception and proved that these mechanisms are based on intuitions. The present dissertation follows these first steps on the way to a broader understanding of health risk perception and provides further support for the notion that affect and intuition are key features in the processing of risky stimuli. Furthermore, the presented studies reveal additional characteristics of health risk perception.

Health risk perception is highly adaptive regarding the relevance of health risks. Results of study I revealed differences in brain reactions to leukemia and HIV. Since both illnesses are high in severity, the main difference persists in their degree of infectiousness. Although both diseases cannot be detected directly because of the absence of overt signs, brain reactions indicated fast, spontaneous and affective reactions to target persons assumed to suffer from HIV and therefore to the infectious one of the two diseases. This again demonstrates the efficiency of health risk perception, since effortful avoidance strategies are only triggered by infectious and therefore threatening diseases. Furthermore, the findings reveal the adaptability of health risk perception. Although public information about HIV started only thirty years ago, people have obviously learned to gauge the risk of an HIV infection. Previous research suggested a reliance on perceptual patterns when gauging risks (Renner et al., 2012; Schmäzle et al., 2012). Since infectious diseases are usually associated with overt signs like rashes, reddened eyes or pale skin, HIV patterns must be different, for HIV positive people do not show such signs in the early phase of disease. According to these findings health risk perception shows a high degree of adaptability to different health risks.

Besides being adaptive, health risk perception appears to be also quite flexible according to the results of study II. In this study, we examined gender-related effects referring to health risk perception. Findings indicated that women are perceived as less 'risky' in terms of HIV. Accordingly, people command different risk patterns for women and men. Importantly, study II conveyed a paradigm with random presentation of female and male targets. Nevertheless, participants spontaneously showed pronounced and consistent gender differences within the ratings despite the random order of stimulus appearance. Hence, participants are quite flexible in applying their rating pattern. More evidence for the flexibility of health risk perception was found in the results of study III. Here, we found a remarkable flexibility in the usage of available cues. Contextual cues usually play an inferior role for risk judgments. However, in case of mismatch between risk ratings for person and context, the context becomes a significant predictor for the overall risk rating. Hence, risk perception reacts flexibly to the interplay of person and context.

Adaptability and flexibility could be subsumed under the term ‘efficiency’. Actually, the findings of the present dissertation present health risk perception as a very efficient system. The findings of study III provide a good example: When a target person is evaluated in terms of posing a potential health risk, an almost infinite amount of cues could potentially be regarded to come to a sufficient conclusion. Instead, only relevant cues attached to the perceived person are regarded but not cues from the environment, which reduces effort substantially. Only when there is a mismatch between person and background, contextual cues become relevant and are therefore incorporated in the decision process. Here, the context might provide additional information while in case of accordance of person and context, no relevant gain is expected from the processing of contextual cues.

Instead of always using the same cues and patterns, health risk perception adapts to the respective situation and environment, to the degree of infectiousness of an assumed illness and even reacts flexibly to the gender of the perceived person. Therefore, health risk perception models should not only emphasize the important role of affect and intuition (Loewenstein et al., 2001; Slovic et al., 2005), but also the efficiency, the adaptability, and the flexibility of health risk perception. Together, these characteristics provide the perfect framework for a system that ensures easy and effortless protection from illnesses and might therefore be described as a behavioral immune system (Schaller, 2011) in line with the biological immune system.

Intuitive Risk Perception as Part of the Behavioral Immune System

People easily make judgments about the HIV status of unacquainted persons without any possibility for an objective evaluation (Häcker et al., 2014; Schmälzle et al., 2012; Schmälzle et al., 2011). Although being aware of the fact that they lack actual and objective evidence for making well-founded judgments, they show an appalling overconfidence in their detection skills referring to HIV (Misovich, Fisher, & Fisher, 1997; Thompson et al., 1999; Thompson et al., 2002). In absence of objective indicators, they rely on implicit risk assumptions and perceived traits to estimate the risk level of a potential sex partner (Williams et al., 1992). Thus, it appears that HIV risk perception is at least partly based on spontaneous and intuitive impressions of others.

Intuitive impressions are a cardinal feature of the so-called behavioral immune system (Schaller, 2011). In contrast to the biological system reacting biochemically to immediate health threats, the behavioral immune system conveys cognitive and emotional mechanisms allowing to sense and detect potential threats even before being exposed to them. Therefore, the

environment is automatically scanned for cues signaling threats (Schaller, 2011). In case of infectious diseases, such signals could be specific physical cues which are assumed to mark an infection, like pale skin or reddened eyes. While many contagious diseases like measles, chickenpox or herpes show such obvious indicators, a person can be infected with HIV without showing any apparent sign of infection, especially in the early phase of the disease. Nevertheless, people still readily make decisions about whether an unacquainted stimulus person is infected with HIV (Renner et al., 2012). Here, in absence of obvious and objective indicators for an illness, the behavioral immune system relies on pattern-based intuitions. A higher risk is assumed to be indicated by low responsibility or high impulsivity (Agocha & Cooper, 1999; Renner & Schwarzer, 2003a; Thompson, Anderson, Freedman, & Swan, 1996). In contrast, people perceived as being trustworthy, responsible and drug free are assumed to be safe (Fishbein, Hennessy, Yzer, & Curtis, 2004). Accordingly, Edelman (1998) found that perceived HIV risk, trustworthiness, and responsibility share a substantial part of their variance at the implicit level. Hence, the HIV status of a partner is subject to a multitude of implicit assumptions people have about who is risky and who is not (Williams et al., 1992). This might help to explain the seemingly ‘irrational’ behaviors shown by sexually active people in real-world. They rely on cue-based implicit assumptions and illusory strategies (Donovan, 2000; Swann et al., 1995; Thompson et al., 1999). Unfortunately, these strategies are not effective but rather induce a false sense of control over the risk, indicating the limitations of the behavioral immune system.

Despite these limitations, the behavioral immune system commands some undeniable advantages, as suggested by the data of the present dissertation. Results showed how easily and quickly people form impressions and make judgments about the riskiness of unacquainted people, although it is objectively impossible to make fact-grounded judgments about the risk status of each person we meet. Hence, the behavioral immune system automatically scans the environment for cues signaling potential threats in order to facilitate approach or avoidance decisions (Schaller, 2011). To date, it had remained unresolved which cues are utilized by the behavioral immune system to arrive at health risk judgments. The data presented in this dissertation suggest that the gender of a perceived person is an important cue on which perceivers obviously rely. In general, women are assumed to be lower in risk than men. Furthermore, it was demonstrated in this dissertation that the context of a target person can provide valuable cues utilized by the behavioral immune system. Whenever there’s a mismatch between the perceived riskiness of a stimulus person and their context, perceivers increasingly rely on cues associated with the context.

Another advantage lies in the ability of the behavioral immune system to distinguish between potentially harmful and harmless sick people. Study I revealed that people are able to make quick and intuitive judgments about the degree of infectiousness of perceived diseases, e.g. HIV and leukemia. Participants showed substantial variance in their ratings referring to the HIV or leukemia status of target persons. These findings indicate that the participants actually perceive differences between the target persons. However, while people who are assumed to suffer from HIV induced pronounced affect-related brain responses, no such affective reactions could be found for those people assumed to suffer from leukemia. These findings demonstrate that the behavioral immune system, which is assumed to rely on such affective reactions, not only differentiates between sick or healthy, but even accomplishes more complicated tasks like differentiating according to the degree of infectiousness of a disease.

On the one hand, the results of the present dissertation paint a rather impressive picture of the usefulness of the behavioral immune system, flexibly utilizing cues in order to ease risk judgments. These judgments turn out to be rather complex as they are being made very quickly and automatically. On the other hand, the present findings deepen the understanding of potential downsides of the behavioral immune system, as it was found that the system can induce risk-related irrational behaviors. More specifically, although neither the gender of a person nor the context are objective indicators for an actual infection with HIV, the behavioral immune systems was shown to utilize both as more or less valuable cues. Hence, although providing support for the notion that people command an intuition-based behavioral immune system, which has the advantage of being quick and effortless, the present findings also show the dangerous limitations of this system. When it comes to judgments about a disease like HIV, which is not easy to detect because of the absence of obvious indicators of illness, automatic, pattern-based risk judgments might trigger risky behaviors.

Health Risk Perception and the Special Case of HIV

Diseases and pandemics have always been a part of life and are actually one of the major causes of death over the course of human history. Accordingly, they are one of the biggest threats people are faced with in everyday life. Previous research demonstrated that the behavioral immune system was developed in adaption to this threat (Schaller, 2011). In the case of HIV, the risk of getting infected partly depends on the risk status of one's sexual partner and can therefore be described as a 'social' risk. Accordingly, previous research used the perception of a potential HIV risk as a model system in order to examine how people gauge the riskiness of other persons and to explore, on which cues they base their judgments.

One of the most salient and obvious factors when viewing an unacquainted target person usually is the gender of that person (Buss, 1995). As history has shown an imbalance in the assumed relevance of HIV and AIDS between women and men, HIV constitutes a special case in the history of diseases. In the early eighties of the 20th century an inexplicable rise in Kaposi's sarcoma and pneumocystis pneumonia incidences was registered at the U.S. West Coast and New York City among gay men. The mysterious phenomenon was called Gay-related immune deficiency (GRID) and assumed to be restricted to the group of gay men (Friedman-Kien, 1981). After Barré-Sinoussi and colleagues had identified the HI-virus (1983), it gradually became clear that the disease does not affect only gay men. However, the media continued to be dominated by reports about the so called "Gay Plague". When Freddy Mercury, one of the most important rock musicians in that time, died from the consequences of AIDS in 1991, the wide-spread assumption, that HIV and AIDS affects mainly men having sex with men grew even stronger (Higgins et al., 2010). Back in that time, women did not appear in the public perception and discussion of HIV (Corea, 1992; Treichler, 1988) and for almost a decade women did not even take part in any neuropsychological study about HIV (Fox-Tierney et al., 1999). Even today, the public discussion in western countries is still dominated by men-related topics like debates about the usefulness of pre-exposure prophylaxis for gay men (Holt et al., 2014). Although women have recently received more and more attention in the context of HIV, and from a more global perspective are now considered the primary face of AIDS (Marshall, 2007), this view is currently restricted to women from the global south while women in western countries are still almost invisible in the HIV-context.

A further imbalance in the gender-related perception of HIV lies in the vulnerability paradigm (Higgins et al., 2010). Here, women are often referred to as having less sexual autonomy and being more vulnerable while men are seen as active transmitters of the disease (Wenzel & Tucker, 2005). Accordingly, women appear to be in need of protection while men appear to pose a potential threat. This view might be influential for HIV risk stereotypes and therefore account for gender-related differences in the perception of the disease. Taken together, men are predominant in the public discussion about HIV, at least in western countries, and in addition are seen as active transmitters of the disease. Such stereotypic assumptions might facilitate evaluations of HIV risk level for male targets. In contrast, the average person might not be able to discriminate between high- and low HIV risk levels in women.

The results of the present dissertation actually showed such differences. Men are perceived as higher in HIV risk than women. Female as well as male perceivers associate their judgments for male targets mainly with perceived trustworthiness. This reflects the assumption that men

are perceived as either active transmitters of the disease - and accordingly not trustworthy - or not. The picture that emerges for female targets is quite different. Here, perceivers base their ratings on various additional and more apparent traits, such as perceived healthiness and attractiveness. Hence, the perceivers might simply lack a consistent visual pattern of an HIV positive woman and therefore gather more information from several perceived traits than they do for male targets.

In sum, the social nature of HIV transmission routes and its gender-specific perception are features which distinguish it from other diseases. While other sexually transmitted diseases might in part share the feature of gender specificity, the severity of HIV compared to less dangerous STDs such as chlamydia, combined with the portrayal of HIV as a disease mainly affecting only the small group of men having sex with men, make HIV a special and unique case in terms of risk perception. Future research should therefore be aware of the uniqueness of HIV when using HIV risk perception as a model system for risk perception in general.

Perspectives for Research on Health Risk Perception

Mental representations of illnesses can be sorted according to two dimensions, severity and contagiousness (Bishop, 1991). Accordingly, HIV is classified as life-threatening and contagious (Bishop, Briede, Cavazos, & Grotzinger, 1987) and therefore finds itself in one category with pneumonia, malaria and polio. Previous research on health risk perception revealed that the way people think about diseases is strongly determined by the assumed degree of contagiousness of the disease. Furthermore, this assumed degree of contagiousness reliably predicts approach or avoidance tendencies (Bishop et al., 1987). Although HIV is by far not as infectious as many other contagious diseases such as Ebola, and can only be transmitted by blood transfusions or intense body contact like sexual encounters, people might still mentally treat HIV as any other contagious disease and therefore show the very same avoidance reactions as to highly infectious diseases. In fact it has been suggested that people in general have quite a crude idea of contagious diseases and do not make differentiations beyond a simple “contagious-or-not-scheme” (Bishop, 1991; Rozin, Markwith, & McCauley, 1994; Rozin, Markwith, & Nemeroff, 1992). In line with this notion, the results of the present dissertation showed that brain responses to stimulus persons perceived as risky in terms of HIV substantially differ from those perceived as potentially suffering from leukemia. These two diseases are of equal severity but differ in the degree of contagiousness. However, it remains unclear whether the brain responses found to be associated with HIV risk are specific for HIV, for sexually transmitted diseases, or for contagious diseases in general. Accordingly, further studies should

try to reveal whether the behavioral immune system might be able to distinguish not only between contagious or not contagious, but to make even more fine-grained distinctions between, for example, highly and moderately infectious diseases.

According to the data of the present dissertation and consistent with previous findings, the behavioral immune system has been found to be a highly sensitive system utilizing cues to gauge the riskiness of an unacquainted person (Renner et al., 2012; Schmäzle et al., 2012; Schmäzle et al., 2011). However, it had previously remained unclear which of the available cues are actually used by the behavioral immune system to come to these highly differentiated evaluations. According to the findings of study II, the gender of the target person is one of these cues, since women were found to be perceived as less risky than men. Since there have historically been, and still currently are, imbalances in coverage about HIV with regard to gender (Higgins et al., 2010), these findings might be restricted to HIV and might not be applicable to other diseases. Future research could address this issue by examining how easily people assimilate new information into their existing thought patterns, and whether the gender effects found in the present study might be extinguished by providing adequate information materials or persist in spite of receiving such additional information.

A further step towards an understanding for cue selection was to examine whether health risk perception regarding unacquainted people depends only on cues associated with a person or also on cues associated with the environmental context of that person. Findings of study III revealed that person perception clearly dominates health risk perception. Nevertheless, post-hoc testing of the data revealed that the context gains substantial importance whenever there is a mismatch between risk evaluations for person and context. Hence, a 'safe' context might override a negative person evaluation, and vice versa. Importantly, previous research has provided data about inconsistent condom use and other risky sexual behaviors of tourists (Hamlyn, Peer, & Easterbrook, 2007; Hawkes, Hart, Bletsoe, Shergold, & Johnson, 1995; Herold & Van Kerkwijk, 1992). Referring to the data of study III, these findings might be explained by a subjectively experienced safe context while being on holidays. Visual inspection of mean ratings for the context pictures revealed that rural or coastal sceneries are rated as less risky than urban sceneries. Typical vacation destinations might therefore induce a safe feeling. Even when the behavioral immune system detects a subjectively perceived risky person in such a context, the context might reverse this rating. Since only a small sample of the presented pictures in study III actually met the criteria of discordant risk values for person and context, further research is needed regarding this issue. Previous research viewing pictures of stimulus persons standing either in front of upper class or a lower class houses already showed

differences in trait evaluations for both picture sets (Cherulnik & Bayless, 1986). Accordingly, future studies might employ paradigms containing pictures with the same persons, presented either within a safe or a risky environmental context, allowing for more detailed conclusions about the influence of the context in risk-discordant and risk-concordant pictures.

Conclusion

Risk perception affects our lives in many everyday situations. For the most part, this happens automatically and we might not even be aware of the processes triggering our behavior. Some of these behaviors are seemingly irrational and might have severe consequences, as is the case with risky sexual behaviors. The present dissertation contributes to the emerging field of intuitive risk perception by unscrambling several processes underpinning risk perception. Results demonstrate that the behavioral immune system distinguishes between diseases which are of equal severity but differ in degree of infectiousness. Furthermore, the behavioral immune system was found to consider the gender of the target, while responses were also found to be dependent on the perceiver's gender. Finally, an exploration of the role of the context for risk perception showed that risk perception usually depends mainly on the target person, but that, in case of a mismatch between target person and context, the context gains substantial importance in risk perception judgment. In sum, the findings presented in this dissertation advance the understanding of risk perception in several ways and have important implications for future directions of intuitive health risk perception research.

EIGENABGRENZUNG

Diese Dissertation besteht aus drei empirischen Studien, die in eigenen Kapiteln dargestellt sind, und aus mehreren Rahmenteilern, die aus einer generellen Zusammenfassung (inkl. einer Übersetzung ins Deutsche), einer generellen Einleitung und einer generellen Diskussion bestehen. Die Konzeption und schriftliche Ausarbeitung dieser Rahmenteilern wurde eigenständig von mir durchgeführt.

Studie I wurde von mir selbständig unter Anleitung von Prof. Dr. Schupp konzipiert und ausgewertet. An der Datenerhebung für Studie I wirkten Rebecca Wäldin und Elena Heber als studentische Hilfskräfte mit. An der schriftlichen Ausarbeitung der Studie wirkten Dr. Ralf Schmäzle, Prof. Dr. Britta Renner und Prof. Dr. Harald T. Schupp als Koautoren mit.

Studie II wurde von mir selbständig konzipiert, durchgeführt und unter Anleitung von Dr. Freda-Marie Hartung und Prof. Dr. Britta Renner ausgewertet. An der schriftlichen Ausarbeitung der Studie wirkten Dr. Ralf Schmäzle, Dr. Freda-Marie Hartung, Prof. Dr. Britta Renner und Prof. Dr. Harald T. Schupp als Koautoren mit.

Studie III wurde von mir selbständig konzipiert und ausgewertet. An der Datenerhebung war Rebecca Wäldin als Diplomandin beteiligt. Die schriftliche Ausarbeitung erfolgte eigenständig.

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