

Social Perception in Personnel Selection:
Automatically Sensed Applicant Nonverbal Behavior and Its Role in Recruiter
Perception and Job Performance

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*To Boris who has been there for me every single moment,
even though most of the time the geographical distance couldn't have been bigger.*

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Abstract

The job interview is one of the most frequently used instruments in personnel selection. According to the subjective-social perception perspective (Anderson, 1992) the applicants' and the recruiters' behavior play an important role in impression formation during the job interview. For instance, previous research has shown that applicants' nonverbal immediacy behaviors have a powerful impact on recruiters' hiring decisions. However, coding each and every single nonverbal behavior of the applicant is still a time and cost-intensive undertaking. This calls for a behavioral observation method enabling researchers to automatically sense and extract nonverbal behavior expressed during the job interview. In the first part of this dissertation, I introduce the so-called nonverbal social sensing approach (Article 1) and I show how this novel method can be used in the job interview to automatically assess the applicant's nonverbal behavior (Article 2). Moreover, I examine to what extent automatically extracted applicant nonverbal behavior predicts job performance (Article 3). In this vein of research, I focus almost exclusively on the applicants and their nonverbal behavior expressed during the job interview. However, according to the subjective-social perception approach both the role of the applicant and the recruiter are important in the job interview.

In the second part of this dissertation, I focus on the role of the recruiter. More precisely, I examine the phenomenon of stereotypical expectations derived from recruiters' cultural background and how they impact the recruiter's hiring decision (Article 4). In a further article, I show that recruiters' characteristics can reduce the extent to which they apply stereotypes during the hiring process (Article 5). Finally, I focus on the fact that recruiters are highly accurate when assessing applicants' personality traits. In the last article, I uncover the effect of the applicant's resume photograph on the accuracy of recruiter's personality judgments (Article 6).

A new theoretical framework, practical implications of nonverbal social sensing in job interviews, and suggestions for future research ideas are discussed.

Key words: job interview, nonverbal behavior, impression formation, stereotype, culture, personality, accuracy judgment

Mots-clés: entretien d'embauche, comportement non verbal, impression, stéréotype, culture, personnalité, justesse de jugement

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A. Umbrella

1. Introduction

In personnel selection, practitioners have been using a wide array of different instruments to achieve the overarching goal of finding high performing employees (Gatewood, Feild, & Barrick, 2011). One of the most used selection methods is the job interview (Howard & Ferris, 1996; McDaniel, Whetzel, Schmidt, & Maurer, 1994), which can be seen from two theoretical perspectives: an *objective-psychometric* perspective and a *subjective-social perception* perspective (Anderson, 1992). For a long time, research has been focusing on the objective-psychometric approach, with the goal of improving the reliability and validity of the job interview (Motowidlo et al., 1992). However, according to Anderson (1992) this approach has neglected the fact that the job interview is, and most likely always will be, a social interaction including the applicant's and the recruiter's behavior, which are involved in the impression formation process during the job interview. As such, this point of view has received more attention through the social perception perspective.

According to the social perception approach job interview outcomes such as the applicant selection is mainly based on the applicant's verbal and nonverbal behavior shown during the job interview (Anderson, 1992). Although a lot of information can be inferred from verbal behavior, research shows that the nonverbal behavior is in many cases more reliable because it is less under conscious control of the sender, and thus less prone to be faked (Ambady & Rosenthal, 1992; DePaulo, 1992; Imada & Hakel, 1977). For instance, based on the applicant's nonverbal behavior job-related skills, personality, and motivation of the applicant are assessed by the recruiter. Moreover, the applicant's so-called *positive* nonverbal behavior, such smiling, gazing, nodding, and hand gesturing has shown to be positively related to the recruiter's hiring decision (e.g., Forbes & Jackson, 1980). Meta-analytical research reveals a substantial coefficient effect between the applicant's positive nonverbal behavior and the recruiter's hiring decision (Barrick, Shaffer, & DeGrassi, 2009; Frauendorfer & Schmid Mast, in prep.-b).

However, even if there is substantial evidence of such an applicant nonverbal behavior-hiring decision link, only a few studies used behavioral observations when investigating the job interview process. One explanation for this is that behavioral observation has always been a time and cost-intensive endeavor (Furnham, 2008; Reis & Charles, 2000). Every single behavior of every interaction partner still has to be coded by hand. To remedy this undertaking, I propose a so-called nonverbal social sensing approach, which is characterized by automatically sensing and extracting nonverbal behavior, without the need of human coders (Article 1). Moreover, I illustrate how nonverbal social sensing can be applied in the job interview (Article 2) and I examine to what extent automatically extracted applicant nonverbal behavior is indicative of future job performance (Article 3).

In the above mentioned articles, I focus almost exclusively on the role of the applicant. However, the social perception approach as a whole also takes into account the role of the recruiter (Anderson, 1992). In the second part of the present dissertation, I focus on the recruiter's perception including different stereotypical expectations they might harbor. For this purpose, I first present a study in which we focused on the so far little investigated cultural differences in recruiters' stereotypical expectations toward applicants and how these expectations impact the hiring decision (Article 4). Based on a further study, I provide first evidence of how recruiters can overcome gender-occupational stereotypes toward applicants (Article 5). Despite the cognitive biases recruiters might harbor, recruiters have shown the ability to assess applicants quite accurately. For example, recruiters are especially accurate at assessing personality traits of applicants (Schmid Mast, Bangerter, Bulliard, & Aerni, 2011). In a last section, I report a study in which we investigated the bright side of recruiter evaluation, namely the accuracy of personality assessment and whether it is influenced by application information, such as the resume photograph of the applicant (Article 6).

The present dissertation aims at contributing to the field of personnel selection by introducing a novel and innovative observational method that enables researchers (and practitioners) to automatically sense and extract the applicant's nonverbal behavior. Based on

this, I introduce a new theoretical framework, which illustrates the role of the applicant's nonverbal behavior in the job interview from a new perspective. The second part of this dissertation aims at illustrating new aspects of recruiters' perception and their role in future training programs.

2. The job interview from a social perception perspective

Research in personnel selection has been focusing for a long time on the job interview as a psychometric measurement. The main purpose was thereby to increase its reliability and validity, which up to then were relatively low due to the low structure of the job interview (Campion, Palmer, & Campion, 1997; Schmidt & Hunter, 1998). In order to structure the job interview, several methods were developed such as job analysis (Harvey, 1991), behavior-based questions (e.g., Campion, Cheraskin, & Stevens, 1994; Janz, 1982; Motowidlo et al., 1992), and standardized evaluations (Campion et al., 1997). According to Anderson (1992), these methods which focus on the psychometric aspect of the job interview can be allocated to the so-called objectivist-psychometric perspective.

The psychometric approach sees the job interview as a way to gather information objectively, with the aim to assess and control for errors in the recruiter's information processing. The applicant is considered to be a rather passive participant and is assigned only to the role of the information provider (Anderson, 1992). The psychometric perspective therefore does not account for the interpersonal aspect of the job interview. With respect to practice, research has shown that the psychometric aspect of the job interview is little preferred by practitioners, since recruiters share the opinion that highly structured job interviews decrease the informal and personal contact with the applicant (Lievens & DePaepe, 2004; Ryan, McFarland, Baron, & Page, 1999). As a result, highly structured job interviews are evaluated less favorably by practitioners than low structured job interviews (Lievens & DePaepe, 2004). In addition, applicants have been shown to prefer unstructured job interviews to structured job interviews as they perceive the interview and the organization more positively when being provided with

attributes of an unstructured job interview (Kohn & Dipboye, 1998). Thus, despite the great importance of increasing job interview reliability and validity (Lievens & Paepe, 2004), the psychometric approach faces one main drawback: it does not take into account the social interaction taking place between the applicant and the recruiter. Given this, Anderson (1992) suggests an alternative approach emphasizing the social interaction aspect of the job interview.

The so-called social perception perspective (Anderson, 1992) considers both the recruiter and the applicant as active participants. According to this approach the job interview is seen as a bilateral negotiation, which matches expectations about what the applicant and the recruiter can offer each other. Moreover, impression formation takes place in both the applicant and the recruiter. Typically, this impression is based on the verbal and nonverbal behavior displayed by the applicant and the recruiter during the job interview (e.g., Ambady & Rosenthal, 1992, 1993). Whereas the verbal behavior is known to deliver a wealth of information (Campion et al., 1997; Motowidlo et al., 1992), researchers argue that the nonverbal behavior is more important for the impression formation process, because valuable information is often better expressed nonverbally than verbally (Arvey & Campion, 1982; Imada & Hakel, 1977; Schlenker, 1980). For instance, facing a job applicant who claims to be highly stress resistant while at the same time nervously fidgeting in the chair might convey not such a good impression when applying for a job for which stress resistance is an important competence. Whereas the applicant's nonverbal behavior is used to form an accurate impression by the recruiter, the recruiter's nonverbal behavior can impact the applicant's decision whether to accept the job offer or not (Glueck, 1973). To illustrate, the more the recruiter shows warm nonverbal behavior (e.g., keeping a steady eye contact, smiling from time to time) the more the applicant intends to accept the job offer, compared to when facing a recruiter displaying cold nonverbal behavior (e.g., no eye contact and little smiling) (Kohn & Dipboye, 1998; Turban, Forret, & Hendrickson, 1998).

Based on a book chapter by Marianne Schmid Mast and I (see Section H), I focus in the next section on the role of the nonverbal behavior in the job interview. First, I summarize literature on the impact of the recruiter's nonverbal behavior on the applicant's perception.

Second, as the main focus of the present dissertation lies on the applicant's nonverbal behavior, I review in detail the literature on the link between the applicant's nonverbal behavior and the recruiter's hiring decision.

3. The role of nonverbal behavior in the job interview

Job interviews are often zero-acquaintanceship situations. Because the job applicant and the recruiter do not know each other before, visual nonverbal cues such as smiling, nodding, gazing, body posture and vocal nonverbal cues such as voice pitch, speaking rate, and speaking time reveal important additional information and enable the applicant and the recruiter to form a first impression. This first impression helps to infer relevant characteristics, such as personality, job related skills and competencies, and motivation.

Nonverbal behavior is defined as communication without words and can be divided in three categories: *visual nonverbal behavior* (e.g., smiling, nodding, gazing, gesture, body posture and position, facial expression), *vocal nonverbal behavior* (e.g., pitch, energy, speaking rate, speaking time), and *static nonverbal behavior* (e.g., appearance) (Knapp & Hall, 2010). The functions of nonverbal behavior are manifold, such as for instance expressing emotions (Ekman, 1993), delivering signs of attention, and coordinating conversational interactions in terms of turn-takings (Knapp & Hall, 2010). When investigating nonverbal behavior in personnel selection, often a composite of so-called *immediacy* or *positive nonverbal behavior* is used. Immediacy behavior contains visual and vocal nonverbal cues, such as a high amount of smiling, gazing, nodding, audio back-channeling (i.e, short utterances like “mmhh”, “ah”, or “yes”), tempo variation, and speech fluency (Guerrero, 2005). These behaviors facilitate social interactions by enhancing closeness and interactivity with others (Mehrabian, 1972). As a consequence, people showing immediate nonverbal behavior are perceived as being more friendly and likeable as compared to people using less immediate nonverbal behavior (Mehrabian, 1981).

3.1 The recruiter's nonverbal behavior and the applicant's perception

The applicant interprets the recruiter's nonverbal behavior constantly in order to obtain signs of how likely he or she is to obtain the job (Rynes & Miller, 1983). Applicants often have little information about the job offer and this is why they use additional information, such as the recruiter's nonverbal behavior to know more about the job characteristics. Indeed, research has shown that the recruiter's nonverbal behavior influences company attraction when the applicant is provided with little information about the job and the company (Rynes & Miller, 1983). Moreover, the recruiter's gazing and smiling had a positive impact on the applicant's first impression about the recruiter and the job (Gilmore & Ferris, 1989; Keenan & Wedderburn, 1975). The more the recruiter listened to the applicant – conveyed through smiling, nodding, and positive facial expression – the more the applicant was willing to accept the job offer (Harn & Thornton, 1985). However, the recruiter's interruption behavior was associated with poor listening skills (McComb & Jablin, 1984). Also, the less the recruiter maintained eye contact the less the recruiter was perceived as attractive and shorter were the applicant's replies (Kleinke, Staneski, & Berger, 1975). Recruiter nonverbal behavior also impacts how the applicant is perceived by strangers. For instance, the recruiter shaking the applicant's hand at the beginning of the job interview made an external observer perceive the applicant as liking the recruiter more, as compared to no recruiter hand shake (Staneski, Kleinke, & Meeker, 1977). Moreover, external observers rated applicants as being more comfortable and as having conveyed a better impression the more the recruiter showed nonverbal behavior, such as smiling, eye contact, and gesturing (Keenan, 1976; Keenan & Wedderburn, 1975; Washburn & Hakel, 1973).

Moderators, such as the applicant's self-esteem, influence the relation between recruiter nonverbal behavior and applicant job interview performance. Recruiter nonverbal behavior (cold vs. warm) had a stronger impact on applicants with low self-esteem than on applicants with high self-esteem (Liden, Martin, & Parsons, 1993). Applicants with low self-esteem performed significantly better when the recruiter showed warm nonverbal behavior as compared to the

recruiter showing cold nonverbal behavior. However, for applicants with a high self-esteem the recruiter's behavior (cold vs. warm) did not impact the applicant's performance.

3.2 The applicant's nonverbal behavior and the recruiter's hiring decision

The applicant's nonverbal behavior influences to a great extent the recruiter's impression formation of the applicant. It is not only *what* the applicant says but also *how* the applicant says it that makes an impression more or less good (Imada & Hakel, 1977). For instance, an applicant who smiles extensively and is very expressive in terms of hand gestures might give the impression of being an extraverted and sociable person. To the extent that extraversion might be a criterion for the selection, this first impression might affect the applicant evaluation.

It has been widely shown that the applicant's *nonverbal immediacy behavior* is positively related to the recruiter's evaluation. For instance, applicants who use more nonverbal immediacy behavior (i.e., eye contact, smiling, body orientation toward interviewer, less interpersonal distance) are perceived as being more suitable for the job, more competent, more motivated, and more successful than applicants using less immediacy behavior (Imada & Hakel, 1977). Applicants maintaining eye contact, showing a high amount of smiling, nodding, and facial expression were more likely to be accepted for the job than applicants who expressed less of these nonverbal behaviors (Forbes & Jackson, 1980). And, vocal nonverbal cues, such as articulation, voice intensity, and pauses predicted recruiter hiring decisions, above and beyond objective information (e.g., education and extracurricular activities) (Parsons & Liden, 1984). Finally, the applicant's authentic smiling was evaluated more favorably than the applicant's fake or neutral smiling (Krumhuber, Manstead, Cosker, Marshall, & Rosin, 2009).

3.2.1 Possible explanations for the link between the applicant's nonverbal behavior and the recruiter's hiring decision

In our book chapter on the role of nonverbal behavior in the job interview (see Section H), Marianne Schmid Mast and I review three different hypotheses that explain why the applicant's

nonverbal behavior has such a strong influence on the evaluation of the recruiter: the salience hypothesis, the reinforcement hypothesis, and the immediacy hypothesis.

The *salience hypothesis* (Forbes & Jackson, 1990) states that nonverbal behavior helps the recruiter to judge the applicant more correctly because the pre-screening of the applicants might not have delivered distinctive information between applicants with respect to competencies, education, or work experience. Due to differences in specific nonverbal behaviors, applicants become more salient, especially in homogenous (i.e., little distinguishing information) groups. This hypothesis has been confirmed in research investigating mentally retarded applicants who were homogenous in their ability to respond. Findings show that their nonverbal behavior explained a greater variance in the recruiter's hiring decision as compared to the group of mentally retarded applicants who were heterogeneous (i.e., ranging from people who could not answer questions to people who were responsive) (Sigelman & Davis, 1978; Sigelman, Elias, & Danker-Brown, 1980). In other words, if a recruiter faces a homogenous group of applicants the focus on nonverbal behavior might help to differentiate them (Edinger & Patterson, 1983).

The *reinforcement hypothesis* claims that recruiters reinforce their first impression during the job interview with their behavior (Webster, 1964). Thus, the applicant's nonverbal behavior might simply be a response to the recruiter's behavioral reinforcement. In other words, the recruiter's first impression can result in applicants behaving in a confirmative way with respect to the recruiter's impression (behavioral confirmation; Darley & Fazio, 1980; Snyder & Swann, 1978). The reinforcement hypothesis can go hand in hand with the salience hypothesis, because the recruiter's first impression might be based on the salient nonverbal behavior of the applicant at the beginning of the job interview (Forbes & Jackson, 1980).

The *immediacy hypothesis* claims that via nonverbal immediacy behavior applicants show intensified social engagement and closeness, which impacts the recruiter positively and therefore leads to a better evaluation (Imada & Hakel, 1977). Thus, liking the applicant might mediate the relation between the applicant's nonverbal behavior and the recruiter's hiring decision (Edinger

& Patterson, 1983). Also the immediacy hypothesis is in line with the reinforcement hypothesis meaning that the positive affect elicited in the recruiter can result in reinforcing behavior towards the applicant.

Whereas these three hypotheses try to answer the question as to *why* such a link between the applicant's nonverbal behavior and the recruiter's hiring decision exists, the question can be raised *under which conditions* this link exists. Is the strength of the relation between the applicant's nonverbal behavior and the recruiter's hiring decision the same across different situations or does the relation vary in its strength depending on different factors?

3.2.2 *Moderators influencing the applicant nonverbal behavior-hiring decision link*

A meta-analysis on the impact of applicant impression management strategies on hiring decisions reveals a correlation coefficient of $r_w = .30$ for the so-called applicant nonverbal behavior-hiring decision link (Barrick et al., 2009). Moreover, the authors found that this relation was more pronounced when the job interview structure is low and when the setting was experimental as compared to a field setting. However, the authors did not conduct further analyses investigating other, maybe more individual based, factors that influence the applicant nonverbal behavior-hiring decision link. We conducted a meta-analysis investigating – together with the correlation coefficient of the applicant nonverbal behavior-hiring decision link – different moderators that might influence the relation between the applicant's nonverbal behavior and the recruiter's hiring decision, such as the extent to which the nonverbal behavior is perceived as being immediate (immediacy hypothesis), the applicant's gender, and the experience of the rater (Frauendorfer et al., in prep.).

Overall, we found a coefficient effect ($r_w=.34$) between the applicant's nonverbal behavior and the hiring decision that is comparable to the overall effect size found in the meta-analysis of Barrick and colleagues (2009). Moreover, results show that the more the applicant's nonverbal behavior was perceived as being immediate the stronger the applicant nonverbal behavior-hiring

decision link. This is in line with the immediacy hypothesis, which claims that a high degree of applicant nonverbal immediacy behavior results in a higher likelihood of being hired.

We also found that the applicant nonverbal behavior-hiring decision link was significantly higher when the rater was a naïve judge as compared to a professional recruiter. These results suggest that naïve judges are more influenced by the applicant's nonverbal behavior than are professionals which might be due to lack of experience in employment selection. In other words, the applicant's nonverbal behavior might be more salient for naïve judges than for professionals because the former do not know how to process additional information available about the applicant, such as the applicant's verbal behavior, resume information, and competence scores (see Campion et al., 1997). In contrast, professionals might focus on different information simultaneously (because they are trained to do so) and the applicant's nonverbal behavior would therefore be only one informational cue among many.

Finally, the applicant nonverbal behavior-hiring decision link was stronger for female applicants than male applicants. This is in line with previous research showing that women are not only more nonverbally expressive (Knapp & Hall, 2010) but they are also expected to behave in a more expressive way (Riggio & Friedman, 1986). Our findings suggest that nonverbal immediacy behavior such as smiling, gazing, nodding, and hand gestures might be perceived as more favorable for women than for men. Research on gender stereotypes shows that in order to be perceived as more likeable women should reveal more communal attributes (e.g., socially oriented, caring) than agentic attributes (e.g., dominant, competitive), because these attributes are congruent with stereotypical beliefs about the social roles of men and women (Eagly, Johannesen-Schmidt, & van Engen, 2003). To illustrate, women in leadership position are perceived as more likeable when they behave in a more communal manner (e.g., nice and friendly) and men are more likeable when they reveal agentic attributes (e.g., dominant and serious) (Eagly & Wood, 1991). We suggest that communal attributes are more expressed through immediate nonverbal behavior, whereas agentic attributes are rather expressed through the lack of immediacy behavior (Hall, Coats, & LeBeau, 2005).

In sum, meta-analytical research reported situational moderators (i.e., job interview structure and the study setting; Barrick et al., 2009) and individual-level moderators such as the applicant's gender or the rater's experience (Frauendorfer et al., in prep.) that influence the applicant nonverbal behavior-hiring decision link.

Considering the number of studies included in the above-mentioned meta-analyses, one might notice that comparatively little research investigated the applicant's nonverbal behavior during the job interview. To illustrate, we included 29 effect sizes in total in our meta-analysis, which covers about forty years of research. One reason for this “lack” of behavioral research in personnel selection is that coding each and every single behavior is still very time and cost-intensive (Furnham, 2008; Reis & Charles, 2000). Even if today social interactions are recorded automatically with devices such as cameras and microphones the coding of the nonverbal behavior still has to be conducted by hand. However, the applicant's nonverbal behavior plays an important role in the job interview (as the present section shows) and should therefore not be neglected. If researchers had the mean to immediately obtain behavioral information after the social interaction (e.g., job interview), the field of behavioral research would be propelled forward in many different domains, such as personnel selection.

In the next section, I introduce a novel approach by presenting the so-called nonverbal social sensing method that allows researchers (and practitioners) to automatically sense and extract the applicant's nonverbal behavior. I show how nonverbal social sensing can be used in the job interview and to what extent automatically extracted applicant nonverbal behavior predicts objectively measured job performance.

4. Nonverbal social sensing (Article 1)

In this perspective article, Marianne Schmid Mast, Daniel Gatica-Perez, Laurent Nguyen, Tanzeem Choudhury, and I illustrate the importance of behavioral research and how far along we have come in the endeavor to replace human coders with machine learning processes, in order to

automatically extract nonverbal cues. This article aims at providing a new perspective on human behavioral research by introducing a so-called nonverbal social sensing approach. Nonverbal social sensing¹ conducts behavior coding in an automated manner - without the need of a human coder. Thus, this “intelligent machine” provides researchers with behavioral information (coding) directly, concerning the social interaction partners (e.g., how much the participant spoke during the interaction, who gazed at whom, and how frequently he or she nodded).

Nonverbal social sensing means that the nonverbal behavior of people engaged in social interaction is sensed, recorded, and extracted automatically. It is conducted in two steps: 1) the sensing and recording of the behavior with ubiquitous computing and 2) the extraction of the behavior via computational models and algorithms (Gatica-Perez, Guillaume, Odobez, & McCowan, 2007). Ubiquitous computing means that the computer fits the environment. Thus, the user does not have to enter the computer environment. The sensing and recording devices are integrated in the everyday environment of a person so that the behavior is sensed and recorded unobtrusively.

In the last years, computational analysis of interpersonal behavior became more pervasive (Gatica-Perez, 2009; Pentland, 2008). To illustrate, smartphones have contributed in a large way to the development of nonverbal social sensing as they contain multiple sensors such as a camera, a microphone, an accelerometer, a digital compass, a gyroscope, and a GPS, which all can sense and record the daily behavior of targets (Campbell & Choudhury, 2012). The smartphone is thus a *mobile (or wearable) social sensing platform* because it can sense and record the behavior both indoors and outdoors, wherever the target wearing the smartphone is located. People in the vicinity of the target are also recorded (Lu et al., 2012). *Stationary indoor located social sensing platforms* are rooms furnished with devices (e.g., cameras, microphones, Kinect motion sensor) that record the nonverbal behavior of the people interacting in the room. As such, the interaction partners do not have to wear any special gear or sensors. We built such a stationary social

¹ Note that throughout the present dissertation I refer to the term nonverbal social sensing; contrary to Article 1, which uses the term automatic social sensing

platform for a job interview situation. We equipped the room with a table, two chairs, two HD cameras, a microphone array, and two Kinect motion sensors on the table (see Figure 1).

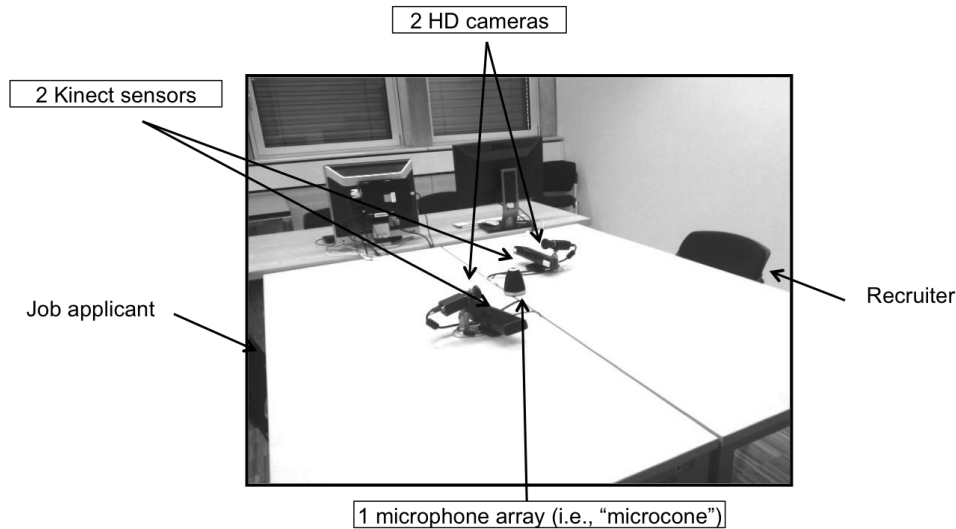


Figure 1. The stationary indoor sensing platform with two high definition cameras, two Kinect sensors, and the microphone array (“microcone”).

Extracting information from the sensing and recording of behavior has thus far been conducted manually. Together with computer scientists, computational models and algorithms were developed in order to train computers in extracting the nonverbal behavior of the interaction partners from sensed and recorded data. Although some of these extraction methods have been shown to be accurate (e.g., voice energy, pitch, speaking rate, visual motion or head pose extraction) (Biel, Aran, & Gatica-Perez, 2011), other extraction methods still need to be improved because they are more challenging to do. An example of such a method is the arm position recognition based on frontal camera views (Marcos-Ramiro, Pizarro-Perez, Marron-Romera, Nguyen, & Gatica-Perez, 2013). These challenging methods highlight the fact that the first step (i.e., sensing and recording) and the second step (i.e., automated extraction) are closely linked to each other. Automated extraction is only successful if the interaction has been sensed and recorded in a well-defined way (Vinciarelli, Pantic, & Bourlard, 2009). For instance, when extracting the arm positions of the interaction partners (Nguyen, Odobez, & Gatica-Perez, 2012),

lighting conditions, and the recording angle of the cameras must fulfill some requirements. Thus, sensing, recording, and extracting are interdependent in nonverbal social sensing.

4.1 Advantages and disadvantages of nonverbal social sensing

The fact that nonverbal social sensing works without human coders brings several advantages of this method. First, *several nonverbal cues of multiple social interaction partners* can be processed simultaneously. This means that a vast amount of data can be handled with devices such as the “microcone”, which identifies automatically each individual and does speaker segmentations for each of the interaction partners, for instance. In addition, co-occurring behavior can be treated simultaneously which is convenient when one is interested in a specific combination of nonverbal cues, such as the Visual Dominance Ratio (i.e., percentage of looking at the interaction partner while speaking divided by the percentage of looking while listening to the interaction partner) (Dovidio, Ellyson, Keating, Heltman, & Brown, 1988). Second, behavioral observations over *long periods of time* can be processed, due to vast storage capacities available. Third, behavioral data can be extracted very *quickly*. Once the algorithm is developed which the behavior is extracted, it can be run over large amounts of data (different interaction partners, long observation periods). Fourth, social sensing platforms (stationary and mobile) are ubiquitous and, thus, *unobtrusive* in that they do not interfere with natural course of everyday behavior. Finally, the *accuracy* of automated coding is higher than the accuracy of manual coding as algorithms always make the same decisions and are therefore less biased and less under stereotypical influence than are human coders. In other words, the automated coding of the behavioral data is more objective.

Automated social sensing also faces several drawbacks, however. For instance, even if nonverbal social sensing produces accurate behavior extractions, *accuracy* can still be challenged when the data do not match the data set up used for the development of the algorithm. That is, if the algorithm for extracting head positions is fed with video material showing the target laterally instead of frontally, as the algorithm was trained with, accuracy suffers. Moreover, data might

contain “*noise*” (e.g., traffic noise when using the mobile sensing device outdoors), which needs to be filtered out before processing the data. Detecting and filtering the noise might require an additional step before being able to extract behavioral cues. Another challenge is *privacy*. Before recording participants, they have to sign an informed consent form in order to accept their behavior is sensed and that the data is subsequently treated. Especially when working with mobile social sensing privacy is not only an issue for the people agreeing on being automatically sensed but also for people in the vicinity of the target. That is, if the target is interacting with a person on the street this person will be recorded as well. Two methods can solve this issue: either each potential interaction partner is informed beforehand about the fact that they are automatically sensed when talking to the target wearing the mobile device, or the recorded speech is directly filtered so that the person cannot be identified. A further disadvantage worth noting is the *high costs* of initial investment in the devices and for the development of the extraction algorithms. Working with nonverbal social sensing requires computational skills and research. If researchers intend to work with a social sensing platform (stationary or mobile) they should be aware of the fact that it requires computational skills and development. However, once the algorithms are established, they can be used by researchers and could even be made publicly available, which would lower the costs. Thus, in the near future algorithms for automated behavior extraction might be more easily accessible which would attenuate the significance of high costs.

In the next section, I illustrate how the stationary social sensing platform can be used in personnel selection research. More precisely, I show how and which applicant’s nonverbal cues can be automatically sensed and extracted during the job interview and to what extent the automatically extracted applicant nonverbal behavior predicts the recruiter’s hiring decision.

4.2 The implementation of nonverbal social sensing in the employment selection (Article 2)

In this article Marianne Schmid Mast, Laurent Nguyen, Daniel Gatica-Perez, and I illustrate that nonverbal cues can be automatically and validly sensed and extracted, using a stationary social sensing platform. We conducted a job interview study to investigate which automatically sensed applicant nonverbal behaviors influence the hiring decision. We were interested whether results similar to those mentioned in the meta-analyses (Barrick et al., 2009; Frauendorfer et al., 2013) could be achieved with nonverbal social sensing. Moreover, we investigated which *combination* of applicant nonverbal cues best predicts hiring decision. For instance, is it the applicant gazing combined with other visual cues such as smiling and nodding or is it rather the applicant's gazing with vocal nonverbal cues, such as audio back-channeling, speech fluency, and tempo variation?

In our study, 62 participants (mean age: 24 years) came into our lab and applied for a job as a research assistant. A structured job interview was conducted using three introductory questions, four past behavior questions (e.g., Campion et al., 1994; Janz, 1982; Motowidlo et al., 1992), and one final question about the applicant's strengths and weaknesses. Applicants were informed beforehand that the job interview will be audio and video recorded and they provided informed consent.

Because applicant immediacy behavior has been shown to be positively related to the recruiter's hiring decision, we selected immediate nonverbal cues such as smiling, gazing, and visual back-channeling (i.e., nodding while listening to the recruiter) for the visual nonverbal cues and audio back-channeling, speech fluency, and tempo variation for the vocal nonverbal cues. All these behaviors are suggested by Guerrero (2005) to be part of the immediacy behavior composite.

The applicant vocal nonverbal cues were all extracted based on speaking segments provided by the "microcone". For instance, the applicant's audio back-channeling, which is

defined as producing short utterances (e.g., “mmhh”, “aha”, or “yes”) while the recruiter is speaking, was extracted based on speaking segments shorter than one second. Speech fluency was measured based on the average time of speaking turns of the applicant. This was accomplished by computing the total amount of time the applicant was speaking and divided by the total number of speaking turns. Finally, for the tempo variation an open-source Matlab code was used to detect the voice segments. The speaking rate was then defined as the number of voiced segments (i.e., vowels) per second. The standard deviation of the number of voiced segments indicated the variation of the speaking rate. For the applicant visual nonverbal cues, so far only the visual back-channeling could be extracted automatically. Visual back-channeling is defined as a nodding event by the applicant while the recruiter is speaking. The head was automatically detected based on a method developed by Nguyen et al., (2012). This method tracked the location of the applicant’s face and estimates the visual motion in the face region. Both, the horizontal and vertical visual motion were then analyzed. To know whether the event is defined as nodding or not a binary decision between nod and non-nod was performed using a standard machine learning model. The method detects most head nods while minimizing false detections. Applicant smiling and gazing was extracted by human coders (with inter-rater reliability).

In order to know how accurate the nonverbal social sensing extracted the applicant’s nonverbal cues, we used two human coders who coded the applicant’s visual and audio back-channeling of a subsample of 20 job interviews. For both nonverbal cues the inter-rater reliability was high (visual back-channeling: $r = .90$; audio back-channeling: $r = .94$). The applicant average turn duration and tempo variation were not coded manually due to high technical complexity of the automated extraction of these cues. Moreover, research has shown that human coders have difficulties to code these nonverbal cues (e.g., Quené, 2007). However, they have shown to impact social judgments.

The recruiter hiring decision was assessed based on 5 professional recruiters, who all viewed the applicant’s competencies and the job interview video. Moreover, they were provided

with a detailed job description. Recruiters indicated to what extent they would hire the applicant (on a scale from 0% to 100%).

In terms of nonverbal behavior extraction accuracy, we found that automatically extracted applicant visual back-channeling and audio back-channeling revealed contingent validity as they highly correlate with manually coded applicant visual and audio back-channeling. Moreover, automatically sensed and extracted applicant nonverbal behavior resulted in similar results as compared to manually coded applicant nonverbal behavior (Anderson & Shackleton, 1990; Forbes & Jackson, 1980; Imada & Hakel, 1977; McGovern & Tinsley, 1978) which led us to conclude that our automatically extracted applicant nonverbal cues can be seen as being validly extracted.

Results showed that the more applicants gazed, the more fluent they spoke, and the more the speech tempo was varied the more likely applicants were to be hired. These findings confirmed previous research showing that applicant immediacy behavior enhances the likelihood of being hired (e.g., Imada & Hakel, 1977). Moreover, we were able to approach a novel research question in the field of nonverbal communication: Which combination of the applicant's nonverbal cues best predicts the recruiter's hiring decision? Even though this analysis could also have been calculated manually, in collaboration with computer scientists we were able to conduct a so-called sequential forward search (SFS; Pudil, Novovicova, & Kittler, 1994), which computed the best nonverbal behavior combination predicting hiring decision in a well-established and systematic way. The applicant's speech fluency, tempo variation, and gazing best predicted perceived hireability.

Speech quality is important when it comes to information delivery as it is positively related to perceived credibility and persuasiveness (Burgoon, Birk, & Pfau, 1990), which are important skills in sales, for instance (Leigh & Summers, 2002). Moreover, tempo variation is positively related to audience retention (Woolbert, 1920) and message delivery (Knapp & Hall, 2010). And, maintaining eye contact with the recruiter results in perceiving the applicant as more competent,

credible, and likeable (Kleinke, 1986). Thus, we assume that in our study the recruiter inferred high persuasiveness and credibility from the applicant who talked more fluently, varied their tempo, and maintained eye contact with the recruiter. This inference led to a higher likelihood of hiring the applicant.

Knowing that nonverbal social sensing produces similar results as compared to nonverbal behavior coded by “hand”, we went one step further and investigated which nonverbal behavior predicts not only recruiter hiring decision but also future job performance. If we can show that the applicant’s nonverbal behavior predicts objectively measured job performance, nonverbal social sensing could be used as a tool for applicant selection.

4.3 Using nonverbal social sensing for applicant selection (Article 3)

In this article, Marianne Schmid Mast, Laurent Nguyen, Daniel Gatica-Perez, and I set out to test whether automatically sensed and extracted applicant nonverbal behavior during the job interview predicted objectively measured job performance. Given that job holders’ nonverbal behavior is related to job performance (Leigh & Summers, 2002; Peterson, 2005; Taute, Heiser, & McArthur, 2011; Wood, 2006), we investigated whether the applicant’s nonverbal behavior shown in the job interview provides the recruiter with valuable information about future job performance. We assumed that if such a nonverbal behavior-job performance link exists, this information could be used for applicant selection. Moreover, we were interested whether the applicant’s nonverbal behavior predicts job performance above and beyond traditionally used applicant competence measures and recruiter evaluation.

To date, little research has investigated whether applicant nonverbal behavior expressed during the job interview could be used as predictors for future job performance. Motowidlo and Burnett (1995) showed that a composite of applicant nonverbal cues such as pitch, pitch variability, speech rate, and pauses during the job interview predicted supervisor ratings about applicant job performance (see also Burnett & Motowidlo, 1998). However, to the extent that supervisor ratings are subjective evaluations, we assumed that the above-mentioned relation

between applicant nonverbal behavior and job performance are not much different from the applicant nonverbal behavior-hiring decision link. Both outcome variables are subjective evaluations. This is why we were interested in objectively related job performance and how it might be predicted by applicant nonverbal behavior. Moreover, we investigated whether the applicant's nonverbal behavior is a better predictor for future job performance than is the recruiter's evaluation.

Required competencies for a certain job are typically derived from job analyses (Harvey, 1991). For sales, persuasion skills are one of the core competencies required (Weitz, 1978). However, assessing applicant's competencies can be problematic, because they are often assessed based on self-reports, which are prone to social desirability and thus decrease the validity of the competence assessment. To avoid social desirability, practitioners often use behavioral observations to eliminate biases inherent in self-report measures (Doverspike & Arthur, 2012). Given this, we assumed that the applicant's nonverbal behavior shown during the job interview might be a better predictor than the assessed competencies of the applicant based on self-reports.

The present study was based on the same data corpus described in the section above (see also Article 2). However, the sample of this study was slightly smaller as it consists of 54 participants only (compared to the reported 62 participants in the previous section). Eight participants abandoned the study after the job interview and were therefore not involved in the job. All 54 applicants were hired for the position, regardless of their performance during the job interview in order to avoid a restriction of range problem. Thus, our data contained a wide range of performance levels, including high and low performing applicants.

The job the applicants had to perform consisted of going out in the street and of recruiting as many community people as possible for one of our lab studies. Participants were informed that we were looking for research assistants who were willing to invest 4 hours in this job. To motivate applicants, they were told that they could gain between 120\$ and 200\$, depending on the number of people recruited. After the job every participant was paid 200\$ for 4 hours.

Applicants' job performance was defined as the mean number of community people who signed-up for the experiment per hour of recruitment. In order to measure the applicant's competencies, participants filled in the extraversion and agreeableness subscale of the NEO PI-R (Costa & McCrae, 1992), a 6-item questionnaire assessing persuasion skills (based on the Social Skills Inventory of Riggio, 1986) and the Wonderlic Personnel test (Wonderlic, 2001) measuring the applicant's general mental ability. Recruiter evaluation was equivalent to the recruiter's hiring decision mentioned in the section above (see Article 2). We automatically sensed and extracted the following applicant nonverbal cues (Guerrero, 2005): smiling, gazing, visual back-channeling, audio back-channeling, speech fluency (i.e., number of pauses during the job interview), and speaking time. We included applicant speaking time as an indicator of dominance (Schmid Mast, 2002), which has shown to be positively related to persuasiveness (Burgoon et al., 1990). Applicant speaking time was extracted based on speaker segmentation provided by the "microcone". The sum of all applicant speaking turn lengths was considered for the calculation of the applicant's speaking time.

Results showed that the applicant's visual and vocal nonverbal behavior shown during the job interview predicted job performance only marginally. However, when separating the visual and vocal nonverbal behavior, vocal nonverbal behavior significantly predicted future job performance, whereas visual applicant nonverbal behavior did not. Moreover, the applicant's vocal nonverbal behavior predicted job performance above and beyond the applicant's competencies and recruiter evaluation. Assessed competencies and recruiter evaluation were not predictive of future job performance.

With the present study, we were able to show that applicant nonverbal behavior is predictive of job performance not only when assessed subjectively (Burnett & Motowidlo, 1998; Motowidlo & Burnett, 1995) but also when measured objectively. We argue that jobs such as our door-to-door sales job require certain nonverbal skills in order to be successful. The extent to which the applicant is nonverbally expressive during the job interview might be therefore an indicator of how well the applicant performs in the future job. Moreover, our findings revealed

that the applicant's vocal nonverbal behavior is a better predictor of job performance than the applicant's self-reported competencies and recruiter evaluation. The fact that the applicant's mental ability, for instance, was unrelated to job performance might be counterintuitive when considering the findings of Schmidt and Hunter (1998). However, we assume that general mental ability might be less important for sales, as meta-analytic reviews found general mental ability to be unrelated to objectively measured sales job performance (Barrick, Mount, & Strauss, 1993; Vinchur, Schippmann, Switzer, & Roth, 1998; see also Section 6.1.2 of this dissertation).

In the first part of this dissertation, I have focused on the applicant's nonverbal behavior in the job interview, how it can be assessed automatically, and how it can be predictive of job performance. In the second part, I examine the recruiter's perception. Referring to the social perception approach by Anderson (1992), I illustrate the role of the recruiter by describing different biases recruiters can be inclined to have and how recruiters can overcome these biases. Last, I shed light on the recruiter's personality judgment and as to whether the resume photograph of an applicant influences assessment accuracy.

5. Recruiter perception

5.1 Recruiter stereotypical expectations

Anderson (1992) lists six main biases recruiters can harbor: a) stereotypical expectations, b) primacy-recency effect, c) contrast effect, d) similar-to-me effect, e) negative information bias, and f) personal liking bias (see also Anderson & Shackleton, 1990). Whereas all of these biases can occur beyond conscious awareness, stereotypical expectations are the most faceted ones. That is, recruiters can harbor all kind of stereotypes towards applicants. For instance, the gender, race, or age of the applicant might elicit certain stereotypical expectations in the recruiter which in turn lead to biased decisions, depending whether the applicant behaves according to the stereotypical expectations or not (Krings, Sczesny, & Kluge, 2010; Neckerman & Kirschman, 1991; Przygodzki-Lionet, Olivier, & Desrumaux, 2010).

In particular, applicant gender has drawn much attention in personnel selection research because it is strongly linked with stereotypes about competencies and skills in different occupations (Przygodzki-Lionet et al., 2010). In turn, many occupations are associated with gender stereotypical expectations. For instance, jobs such as accountant and security guard are perceived as typical male jobs, whereas jobs such as sales and assembly worker are perceived as typical female jobs (Athey & Hautaluoma, 1994; Buttner & McEnally, 1996). Because of these *gender-occupational stereotypes* women applying for a male-typical job and men applying for a female-typical job are less likely to be hired than applicants applying for gender congruent jobs (Cohen & Bunker, 1975; Desrumaux, De Bosscher, & Léoni, 2009; Przygodzki-Lionet et al., 2010). The phenomenon can be explained by the lack of fit model (Heilman, 1983) stating that the incongruity of applicant attributes and the perceived job requirements leads to unfavorable hiring decisions. Whereas women are more associated with characteristics such as caring and other-oriented (i.e., communal), men are more associated with attributes such as dominance and competitive (i.e., agentic). A female applicant applying for a job requiring agentic attributes will be less likely to be hired, because the gender-occupational incongruity leads to a back-lash effect (i.e., negative evaluation when being perceived as counter-stereotypically; Rudman & Glick, 1999, 2001). Thus, gender-occupational stereotypes have been shown to hamper objective employment selection of applicants belonging to a social minority.

Another characteristic of applicants which can lead to stereotypical expectations is the race or cultural background of the applicant. Various studies have shown that applicants coming from a racial minority (e.g., Blacks) are less likely to be hired than applicants belonging to a racial majority (e.g., Whites) (Hughes & Dodge, 1997; Kirschenmann & Neckerman, 1991). However, research so far has mainly focused on the applicant's cultural background and less on the recruiter's cultural background. Especially with the increasing number of internationally acquisitions of employees in the last decades, globalization has led to an enormous rise in international recruitment (from 24% in 1996 to 41% in 2000) which results in applicants and recruiters who no longer share the same cultural background (Javidan, Stahl, Brodbeck, &

Wilderom, 2005). As a consequence, one and the same applicant might be evaluated differently, depending on the cultural background of the recruiter.

Culture can be defined as a characteristic of a social group, including norms about behavioral expectations. These expectations are typically formed based on specific values (Brett, 2000). Countries are characterized by various values and the common beliefs they share. For instance, a study investigating different values and expectations all over the world ("GLOBE" study; Brodbeck et al., 2000; Chhokar, Brodbeck, & House, 2007) describes Anglo-Saxon countries such as Canada, Australia, United States, New Zealand, England, and Ireland as being proactive, wanting to make their voices heard, and being forceful. Conversely, the Swiss culture is characterized by diplomacy, modesty, and avoidance of confrontations. According to the social identity theory (Tajfel & Turner, 1979) group members of the same group value in-group members more than out-group members. Thus, if the behavior of the applicant is valued by the social group the recruiter is belonging to, the applicant might be evaluated more favorably as compared to an applicant whose behavior is not valued by the same social group.

In the next two sections, I present two articles, which focus on recruiter stereotypical expectations. In a first article, I illustrate the so far neglected relation between the cultural background of recruiters and the intended hiring decision. A second article shows first empirical evidence of how recruiter stereotypical expectations can be overcome.

5.1.1 Cultural differences in recruiter stereotypical expectations (Article 4)

In this study, Marianne Schmid Mast, Laurence Popovic, and I examined how the cultural background of either a Canadian or a Swiss recruiter influences the recruiter's perception of either a self-promoting or a modest applicant. More specifically, we were interested in whether recruiter stereotypical expectations related to their culture (Canada vs. Switzerland) influence the intended likelihood of hiring applicants behaving opposite to these expectations. In terms of applicant behavior, we investigated the applicant's impression management strategies shown during the job interview. Impression management strategies are widely used by applicants in

order to impress the recruiter and therefore to increase the likelihood of getting hired (Aronson, Wilson, & Akert, 2010). In the present study, we investigated two impression management strategies: self-promotion (i.e., emphasizing one's accomplishments, strengths, and talents; Stevens & Kristof, 1995) and modesty (i.e., "the underrepresentation of one's positive traits and accomplishments"; Wosinska, Dabul, Whetstone-Dion, & Cialdini, 1996, p.230). Given that the expected impression management in Switzerland would be modesty and in Canada the expected impression management would be self-promotion (Brodbeck et al., 2000; Chhokar et al., 2007), we hypothesized that Canadian recruiters would be more inclined to hire a self-promoting as opposed to a modest applicant. Moreover, we assumed that Canadian recruiters as compared to Swiss recruiters would be more inclined to hire a self-promoting applicant.

For this study, we used a sample of 44 native French speaking recruiters from Switzerland and 40 native French speaking recruiters from Canada ($n = 84$). We used a mock job interview, which was recorded with a male Swiss amateur actor (30 years old) who played either the role of the self-promoting or the modest applicant. Participants were presented based on random assignment with the mock job interview of either the self-promoting applicant or the modest applicant. After participants watched the video, they indicated how competent they perceived the applicant and how likely it would be that they hire the applicant.

Results confirmed our hypothesis. Canadian recruiters were more likely to hire the self-promoting applicant as compared to Swiss recruiters. Also, Canadian recruiters were more likely to hire the self-promoting applicant as compared to the modest applicant (see Figure 2). There was no significant difference between Canadian and Swiss recruiters in preference of the modest applicant. To understand the mechanism of why the self-promoting applicant was more likely to be hired, we conducted a mediation analysis, assuming perceived competence as a mediator. This was indeed the case: the self-promoting applicant was perceived as being more competent, and this is why recruiters intended to hire more likely the self-promoting applicant. Note that we conducted this mediation analysis including both Swiss and Canadian recruiters.

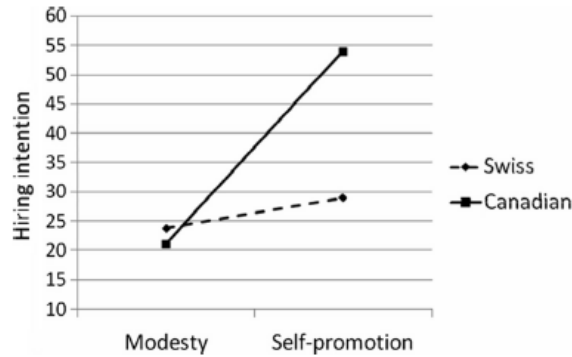


Figure 2. Probability of hiring the applicant according to recruiter culture (Swiss vs. Canadian) and applicant presentation style (self-promotion vs. modesty)

Our results suggest that recruiters behave according to the social identity theory (Tajfel & Turner, 1979), which claims that in-group members evaluate each other more positively than they evaluate out-group members. Put differently, if a person is behaving according to expectations of a specific group, this person will be evaluated more positively by this specific group than would be people who do not behave according to these expectations. Even if we did not measure the recruiter's expectations about applicants' behavior differences between Canadian and Swiss recruiter's expectations might explain our results. Canadian recruiters expected the applicant to behave in a self-promoting manner, whereas Swiss recruiters did not. If the applicant's behavior was in line with these expectations, the applicant was more likely to be hired. However, because we did not have a "neutral" condition, we are not able to tell whether it is the violation of the behavior that makes the modest applicant less hireable, or whether it is the confirmed expectations that make the self-promoting applicant being more likely to be hired.

Cross-cultural interactions in job interviews are increasing and might increase even more in the near future, due to globalization. Thus, it is crucial to know which impression management strategies are preferred in different cultures when applicants and recruiters with different cultural background meet. We found that the cultural background of the recruiters in combination with the applicant's behavior impacts the hiring intention. The finding that culture can influence hiring decisions has important consequences. If a recruiter misses a highly qualified applicant because

the applicant does not behave according to the recruiter's expectations, this might be very costly for the company. Since we assume that such expectations might be mainly happening unconsciously, a first step should be to make recruiters aware of these cultural differences (e.g., in recruiter training; see also Section 6.1.3 of this dissertation).

Whereas the question of how to overcome the negative effects of recruiters' stereotypical expectations was not central to this article, in the next article we focused more concretely on what exactly makes recruiters overcome their stereotypical expectations.

5.1.2 How to overcome recruiter stereotypical expectations (Article 5)

In this study, Marianne Schmid Mast and I investigated what recruiter characteristics make recruiters overcome stereotypical expectations. Astonishingly little research has been done to answer the question how stereotypical expectations in personnel selection can be reduced. In this study we were interested in the recruiter's interpersonal sensitivity and how individual differences in recruiters regarding this skill account for the tendency to stereotype when facing a gender-incongruent applicant.

Interpersonal sensitivity can be defined as an ability to infer other's traits and states correctly (Hall & Bernieri, 2001). Interpersonal sensitivity is shown to be related to less stereotyping, most likely because interpersonally sensitive people are characterized by more cognitive complexity (Davis & Kraus, 1997) and are thus more accurate in judging others. In other words, interpersonally sensitive recruiters are more likely to engage in deliberate information processing compared to automatic information processing. Thus, recruiters who are less interpersonally sensitive might invest less effort in correctly evaluating others (i.e., low need for cognition; Carter, Hall, Carney, & Rosip, 2006) and might therefore be more prone to stereotypical assessment (Fiske, Lin, & Neuberg, 1999). We hypothesized that recruiter interpersonal sensitivity works to protect against stereotyping and this is why a high interpersonally sensitive recruiter might evaluate applicants applying for a gender-incongruent job more favorably than recruiters low in interpersonal sensitivity. Conversely, we assumed that

for stereotype congruent applicants, recruiter interpersonal sensitivity would be less consequential, given that no stereotypes are violated. As such, interpersonal sensitivity would not affect the recruiter's hiring decision.

Seventy-three participants (42 female, 31 male, mean age 26 years, $SD = 9.88$) were recruited for this study. Most of the participants were students (77%). We used a sales job as a female-typical job and an accounting job for a male-typical job. To know whether these jobs are indeed perceived as being more female, more male respectively, we pretested them, asking 12 participants (6 female and 6 male) how they perceive these two jobs in terms of masculinity and femininity. Results of the pretest confirmed our predictions. Sales was perceived as being more feminine, whereas accounting was perceived as being more masculine. The study was conducted in a virtual reality (IVET; Blascovich et al., 2002), with applicants as human avatars. Before the participants entered a virtual world they performed an interpersonal sensitivity test (PONS; Rosenthal, Hall, DiMatteo, Rogers, & Archer, 1979). Afterwards, participants in the role of the recruiter interviewed either a female or a male applicant (human-avatar) for either a job in sales or in accounting (2 x 2 between subjects-design), in the virtual reality. Note that we collapsed the two incongruent conditions (female-accounting and male-sales) and the two congruent conditions (female-sales and male-accounting). After the job interview, the participants indicated to what extent they would hire the applicant. We also measured how attractive the participant perceived the applicant, in order to control for it later on.

Results confirmed our predictions. The more the recruiter was interpersonal sensitive the more favorably he or she evaluated stereotype incongruent applicants. Interpersonal sensitivity did not impact the hiring decision when the participant was facing a stereotype congruent applicant (see Figure 3). We controlled for perceived applicant attractiveness, because research consistently shows that attractiveness of the applicant influences the recruiter's hiring decision, in that the more the applicant is perceived as being attractive the more favorable he or she will be evaluated (Langlois et al., 2000).

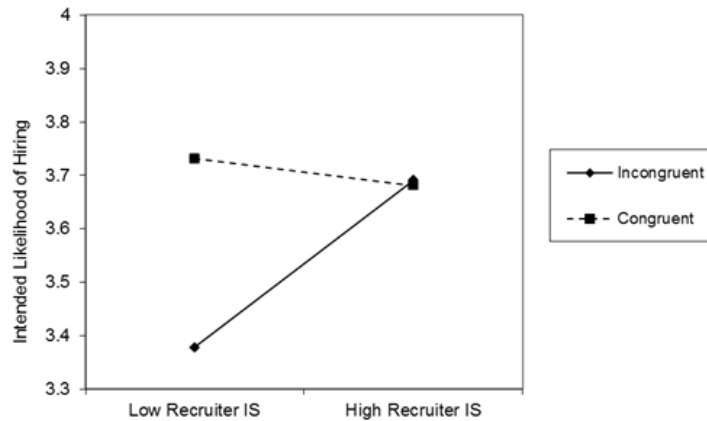


Figure 3. Intended Likelihood of Hiring by Level of Recruiter Interpersonal Sensitivity (Recruiter IS) and Gender-Occupational Congruency

In sum, even if gender-occupational stereotypes still exist, we showed that recruiters providing a high level of interpersonal sensitivity are able to overcome these stereotypes. Recruiter training programs are therefore of great importance and might want to focus in the future on social skills, such as the interpersonal sensitivity (Brief, 2008; see also Section 6.1.3 of this dissertation).

Recruiters' decisions, however, are not always biased. For instance, personality judgments of recruiters have shown to be quite accurate when assessing applicants. In the next section I examine the "positive" side of recruiters' evaluations.

5.2 Recruiter assessment accuracy

Characteristics that are inferred most frequently in job interviews are personality traits and cognitive ability (e.g., Van Vianen & Van Schie, 1995) because they have shown to predict future job performance (Barrick & Mount, 1991; Dunn, Mount, Barrick, & Ones, 1995; Nicholls & Visser, 2010; Schmidt & Hunter, 1998; Tews, Stafford, & Tracey, 2011). For instance, cognitive ability and conscientiousness are indicative of future job performance, regardless of the type of job (Schmitt & Hunter, 1998) and extraversion has shown to be predictive for jobs requiring social interactions, such as door-to-door sales, for instance (Barrick & Mount, 1991). Thus,

applicant personality traits are important constructs in personnel selection, because they are often assessed and they have been shown to predict future job performance. In others words, to select a high performing applicant, recruiters need to evaluate the applicant's personality correctly.

Research has shown that recruiters perform quite well when assessing applicants' personality traits based on job interviews. For instance, participants in the role of a recruiter were accurate in assessing the applicant's personality traits after having conducted a mock job interview (Barrick, Patton, & Haugland, 2000; Blackman, 2002). Also, when provided with a short excerpt of the applicant's behavior, judges were able to predict applicant personality traits based on 10-sec (Prickett, Gada-Jain, & Bernieri, 2000) and 2-min (Schmid Mast et al., 2011) slices of a mock job interview. Moreover, recruiters correctly inferred the applicant's future job performance after having watched a 40-sec thin-slice of an applicant answering two job interview questions (Frauendorfer & Schmid Mast, in prep.-a). Research shows that this first impression does not increase in accuracy when duration of the thin-slices is increased. No significant difference was reported between 30 s and 5 min excerpts (Ambady & Rosenthal, 1992, 1993; Murphy, 2005).

Before recruiters meet the applicant in person, however, they typically have already viewed the applicant's resume beforehand, in order to know whether to invite the applicant for a job interview or not. Thus, recruiters form a very first impression of the applicant based on the applicant's resume. In the following section, I highlight how accurate recruiters are in assessing applicants' personality based on resumes.

5.2.1 Personality assessment and assessment accuracy based on resumes

Resumes are a commonly used instrument in personnel selection, because they provide the recruiter with information about qualifications and they contain information about the applicant's knowledge, skills, abilities, and other characteristics (KSAOs), which are required for a job (Dipboye, 1992). Resumes are used for the pre-selection of the applicants, to know which applicant to invite for a job interview (Cable & Judge, 1997; Higgins & Judge, 2004). Besides the

above mentioned information, recruiters also infer characteristics, such as applicant's personality traits or cognitive ability (Ash, Johnson, Levine, & McDaniel, 1985; Brown & Campion, 1994; Knouse, 1989). For instance, recruiters use resume information such as academic achievement, work experience, extracurricular activities, or overall grade point average to infer personality traits (e.g., conscientiousness, extraversion, and agreeableness), and cognitive ability (Cole, Feild, & Giles, 2003a, 2003b; Cole, Rubin, Feild, & Giles, 2007). Moreover, these recruiter-inferred applicant's personality traits (i.e., extraversion, openness to experience, and conscientiousness) and cognitive ability are related to recruiter evaluation (Cole, Feild, Giles, & Harris, 2009; Raza & Carpenter, 1987).

Research investigating the accuracy of such personality judgments when only provided with the applicant resume showed that students were able to correctly assess applicants' openness to experience and conscientiousness based on the applicants' resumes (Cole, Feild, & Stafford, 2005). In another study, the same authors found that only extraversion could be assessed correctly by recruiters based on resumes (Cole et al., 2009). Thus, recruiters are able to correctly infer personality traits of applicants from the applicants' resumes.

Studies conducted by Cole and colleagues (2005, 2009), however, investigated resumes in the United States which normally do not contain photographs of the applicant (Watkins & Johnston, 2000). In Europe, and especially in Switzerland, it is a common standard to provide resumes with photographs (Doyle, 2011). So far, research has not shown how these photographs influence judgment accuracy. In the next section, I present a study in which we tested this research question.

5.2.2 *The resume photograph and its contribution to assessment accuracy (Article 6)*

In this article, Marianne Schmid Mast, Corinne Sutter, and I investigated whether adding a photograph on a resume, increases or decreases accuracy in personality judgment. Photographs might increase accuracy if the photograph provides the recruiter with valid information. For instance, personality traits are known to be expressed through physical attributes and appearance

(e.g., clothing). If the assessment is based on these valid cues, the photograph might facilitate the recruiter's judgment. However, it is also possible that the photograph might decrease judgment accuracy by distracting the recruiter from relevant information in the resume and therefore bias the judgment. Finally, it is also possible that the photograph does not impact judgment accuracy because either the photograph might be ignored or the personality assessment based on the photograph could be in line with the personality assessment on the resume. The goal of the present study was to uncover the impact of resume photographs on the assessment of the applicant's personality and intelligence. Moreover, we tested whether applicant personality and intelligence can be correctly assessed based on the photograph only.

In this study, 114 participants (75 female, 39 male, average age 27 years, ranging from 19 to 62 years) were recruited. Each participant assessed the personality traits and intelligence of eight applicants, based on resumes. Participants were randomly assigned to three different conditions: resume with photograph, resume only, and photograph only (resume content was held constant). In order to assess the applicant's personality, participants filled in an abbreviated form of the NEO Big Five Personality questionnaire (Schallberger & Venetz, 1999) after each resume. Participants also indicated how intelligent they perceived the applicant. Applicant's actual personality was measured with self-reports and peer reports (based on the same personality questionnaire used for the participants). The applicant's intelligence was measured using the Wonderlic Personnel Test (Wonderlic, 2001). To measure how accurate participants were in assessing applicant's personality traits and intelligence, we used a correlation approach commonly used in this field (Davis & Kraus, 1997; Schmid Mast et al., 2011). The higher the correlation between the perceived and the self-reported personality is, the higher the assessment accuracy.

Results showed that participants were able to assess above chance level all personality traits, intelligence, as well as the personality profile in all conditions (resume with photograph, resume only, and photograph only), except for agreeableness in the resume-only and the photograph-only condition. With respect to the applicant's personality profile, assessment

accuracy was significantly lower for the photograph-only condition as compared to the resume-with-photograph and resume-only condition. However, note that personality profile accuracy was still higher than chance. There were no condition main effects for personality traits and intelligence.

Our findings suggest that adding a photograph to the resume does not necessarily lead to biased judgments. So far research has shown that photographs rather negatively influence recruiters' evaluations due to the so-called halo effect, for instance (Marlowe, Schneider, & Nelson, 1996). Although photographs might lead to biased decisions, our findings showed that photographs did not specifically bias personality judgments. Thus, photographs seem to contain a wealth of nonverbal information based on which personality traits might be assessed. This is in line with previous research showing that healthy appearance was a valid indicator of extraversion and neuroticism and smiling for extraversion and agreeableness, when using photographs for personality assessment (Naumann, Vazire, Rentfrow, & Gosling, 2009). Moreover, our findings indicated that there might be some redundant information in the resume and the photograph. In other words, the photograph neither added information to the resume nor did it distract from it. This sheds completely new light on the role of the resume photograph in personnel selection.

6. General discussion

In the last decade, we have made great progress in the automated recording of social interactions. However, challenges remain when it comes to coding nonverbal behaviors, which is still a time and cost-intensive endeavor for most researchers, given that most of them use manual coding techniques. These circumstances call for new behavioral observation methods that enable researchers to automatically sense and extract nonverbal behavior.

In the present dissertation, I introduced such a novel and innovative method using a stationary social sensing platform (Article 1). By sensing and extracting the applicant's nonverbal behavior automatically, I showed that nonverbal social sensing can be used in the job interview to

measure the applicant's nonverbal behavior and to predict recruiter evaluation (Article 2). Results confirmed previous research reporting a link between the applicant's nonverbal behavior and the hiring decision. The more applicants maintained eye contact with the recruiter, spoke fluently, and varied in speech tempo, the more recruiters intended to hire the applicants. These findings and the fact that we found high contingent validity (i.e., correlation between the automated extraction and the manual coding) for some nonverbal cues show that nonverbal social sensing validly extracts applicant nonverbal behavior. In a further step, I illustrated that nonverbal social sensing can be considered for applicant selection. Findings revealed applicant nonverbal behavior to be predictive of future objectively measured job performance above and beyond subjective evaluations (Article 3).

The second part of this dissertation focused on the role of the recruiter (Anderson, 1992) by examining different factors that influence the recruiter's evaluation. In Article 4 and 5, we investigated recruiters' stereotypical expectations, their impact on the recruiter hiring decision, and how these stereotypical expectations can be overcome. More precisely, I illustrated that stereotypical expectations recruiters might harbor exist across different cultures. Comparing Canadian recruiters with Swiss recruiters, we found that Canadian recruiters prefer applicants who use self-promoting impression management as compared to Swiss recruiters and that Canadian recruiters are more likely to hire applicants with self-promotion impression management as compared to applicants with modest impression management (Article 4). Trying to answer the question how recruiter's stereotypical expectations can be overcome, I illustrate that the more recruiters are interpersonally sensitive the less likely they stereotype applicants who do not correspond to gender-occupational expectations (Article 5). However, recruiters do not always harbor cognitive biases. Recruiters have shown to be quite accurate in assessing applicants' personality traits (Cole et al., 2009; Cole et al., 2005; Schmid Mast et al., 2011). In a last article, we investigated whether the applicant's photograph contributes to assessment accuracy or not. Results show that individuals can accurately assess applicants' personality based

on the resume photograph alone (Article 6). In other words, the photograph does not necessarily lead to biased personality judgment of the recruiter.

In the following sections, I first illustrate the contribution of the present dissertation to research in personnel selection, by introducing a new theoretical framework and by discussing different aspects of my research. Second, I highlight the practical implications of nonverbal social sensing. Third, I uncover some limitations of the present studies and suggest several future research questions, which may help in overcoming these limitations.

6.1 Contribution to personnel selection research

6.1.1 Towards a combination of the psychometric and social perception perspective

Focusing on the applicant's behavior in personnel selection is nothing new. Selection tools such as assessment centers use simulation games, role plays, or group discussions to assess applicants' behavior during verbal performance tests (Gatewood et al., 2011; Kleinmann, 2003). These performance tests have the goal to measure work-related knowledge, skills, and abilities of the applicant (Kleinmann, 2003). Also, so-called work sample tests are used to measure the applicant's behavior on job relevant tasks. Assuming that the behavior is consistent throughout similar tasks and therefore indicative of future job performance, both assessment centers and work sample tests have revealed high predictive validity (Schmidt & Hunter, 1998).

In the job interview, the focus on the applicant's behavior has become apparent with the introduction of behavior questions, which assess the organizational behavior the applicant has shown in the past or will show in the future (Janz, 1982; Latham, Saari, Pursell, & Campion, 1980; Weekley & Gier, 1987). Using behavior questions aims at structuring the job interview to a high extent, in that the behavior of the applicant is assessed in a standardized and objective manner, which, in turn, increases predictive validity (Campion et al., 1997).

The examples of assessment centers, works sample tests, and behavioral interview questions illustrate that the applicant's behavior has been the focus of attention for quite a while

in personnel selection. Yet, with respect to the job interview, the difference between behavioral questions and nonverbal social sensing as a selection method is that the former refers to past or future applicant behavior without taking into account the actual behavior of the applicant while interacting with the recruiter. In other words, the information that can be gathered from simply observing the applicant's behavior (i.e., impression formation) during the job interview has rarely been used to evaluate applicants' competencies. One reason for this is that the information based on the applicant's behavior revealed, so far, low predictive validity (Barrick et al., 2009; Schmitt, 1976; Wiesner & Cronshaw, 1988).

However, with nonverbal social sensing, we show initial evidence that such behavior can be valid, since the applicant's vocal nonverbal behavior was predictive of future job performance. The present dissertation contributes therefore to a new theoretical framework combining the psychometric and the social perception perspective (Anderson, 1992). Whereas these two perspectives have been considered as entirely distinctive approaches (top of Figure 4), the automated assessment of the applicant's nonverbal behavior might be the tie that combines these two approaches (bottom of Figure 4). More precisely, the applicant's vocal nonverbal behavior shows predictive validity (based on initial evidence), which is the main goal of the psychometric approach and nonverbal social sensing captures the interaction behavior as it assesses the applicant's nonverbal behavior expressed during the interaction with the recruiter, which is the main focus of the social perception perspective (see top of Figure 4). Moreover, nonverbal social sensing measures the applicant's nonverbal behavior entirely objectively based on computational algorithms and is, therefore, avoiding subjective biases in evaluations. Thus, the present dissertation advances theory suggesting that the applicant's nonverbal behavior shown during the job interview does no longer have to be considered as belonging solely to the social perception perspective but it can also be seen as part of the psychometric perspective.

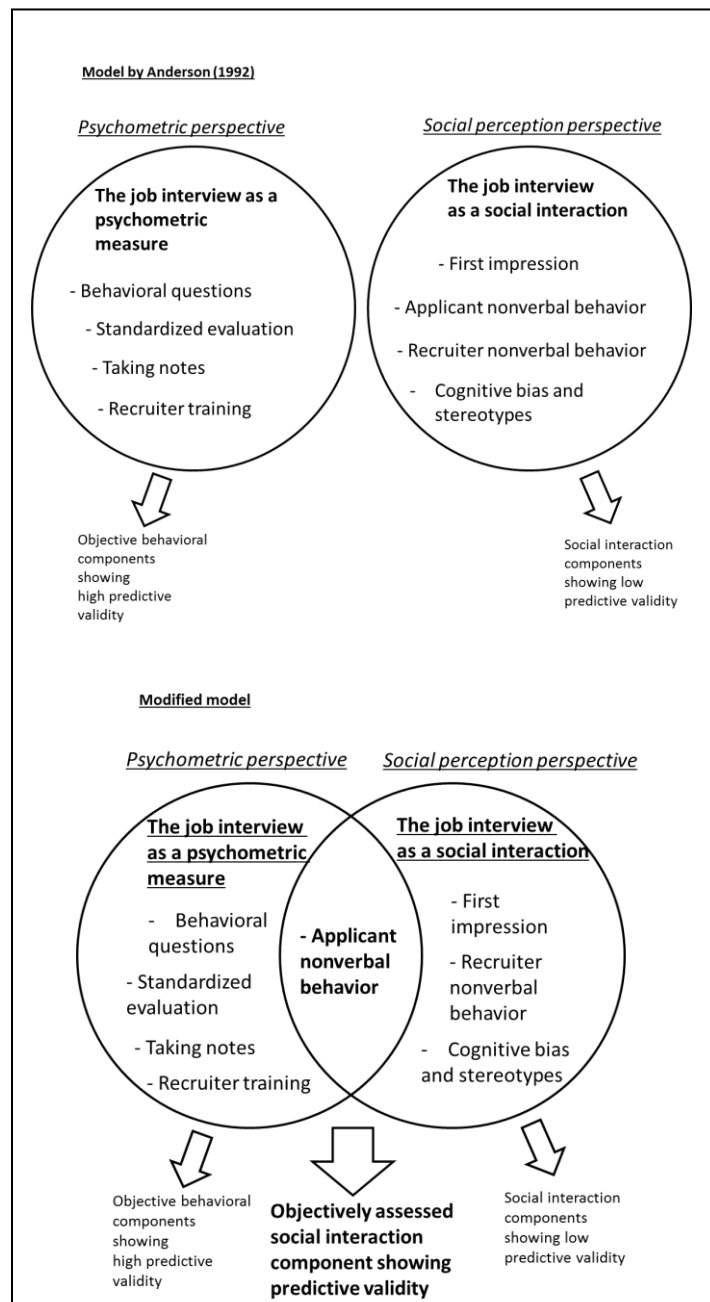


Figure 4. The psychometric and social perception model of Anderson (1992; top of Figure) modified: The objectively assessed applicant nonverbal behavior combining the psychometric and the social perception perspective (bottom of Figure)

6.1.2 Using objectively measured job performance as a criterion

To investigate the link between the applicant's nonverbal behavior and job performance, we used objectively measured job performance (Article 3). There are two facets of job

performance: subjective and objective job performance (Barrick & Mount, 1991; Barrick et al., 1993; Vinchur et al., 1998). Whereas subjective job performance is measured upon supervisor ratings or other subjective evaluations, objective job performance is assessed based on quantitative outcome, such as sales volume (e.g., Grant, 2013). Using objective performance as a criterion for predictive validity has always been strongly recommended, as objective performance directly measures job-related behavior resulting most likely in no systematic biases and random errors (Bommer, Johnson, Rich, Podsakoff, & MacKenzie, 1995). Moreover, meta-analytical research shows that subjective measures rarely correlate with objective measures, suggesting that they should not be used interchangeably (Heneman, 1986). Using objective job performance, the present dissertation contributes to a better understanding of how objective criteria can be used when investigating different predictors of job performance.

This contribution becomes even more prominent given that empirical studies have used twice as often subjective than objective job performance measures when assessing different predictors' validity (Barrick & Mount, 1991). This might have three explanations. First, in empirical research, objective performance measures are not always readily available. Depending on the type of job, objective performance measures may not even be available. For instance, in sales, job performance is mostly assessed based on sales volume or other objective measures, whereas in health care it is almost impossible to obtain objective performance measures because of the strong focus on patient satisfaction, which is obtained subjectively (AbuAlRub, 2004; Schwirian, 1978). Second, a higher number of psychological constructs seem to reveal predictive validity when using subjectively measured job performance as compared to objective job performance (Barrick & Mount, 1991; Barrick et al., 1993; Vinchur et al., 1998). For instance, Barrick and Mount (1991) reveal in their meta-analysis that personality traits significantly predict job performance. However, this was mostly the case for subjectively assessed job performance whereas the correlations for objective job performance (with exception of status change) were lower. Third, using objective job performance might lead to results, which are more difficult to explain. To illustrate, in our study presented in Article 3, we did not find applicant's cognitive

ability to be related to job performance. This is not in line with previous research showing a consistent positive link between cognitive ability and job performance (Schmidt & Hunter, 1998). Moreover, cognitive ability is predictive of supervisor ratings, a frequently used subjective job performance measure (Barrick & Mount, 1991; Barrick et al., 1993). However, the fact that we assessed job performance objectively might account for the difference between previous results and ours. Supporting this claim, Barrick and colleagues (1993) did not find cognitive ability to be related to sales volume. Thus, the applicant's cognitive ability might not be as relevant to objective sales output as it is to subjectively assessed job performance such as supervisor ratings. Or, the relation between predictor and objectively job performance is not linear but curvilinear, for example. To illustrate, predictors of sale performance (i.e., sales person extraversion) have shown to reveal a curvilinear rather than a linear relation (Grant, 2013). Too much and too less extraversion of sales people was detrimental for their sales performance (i.e., sales volume). Thus, future studies should implement objective job performance more frequently as a criterion, despite the risk of obtaining non-confirming results. Using objective job performance can instead inspire researchers to rethink the relation between predictors and criteria.

6.1.3 The importance of empirical research for recruiter training programs

The studies presented in Articles 4 and 5 provide an important contribution to recruiters' training programs. Whereas the goal of recruiters is to find the person who best fits the job, in order to assure the company's success, recruiters are sometimes at risk for missing highly qualified applicants who do not correspond to recruiters' stereotypical expectations. This can be costly for the company, as the success of the company stays and falls with the selection of high performing employees. Even if structured job interviews as a standardized procedure reduces this risk, recruiters' inclination to stereotypical expectations is still one of the most frequent reasons why good employment selection sometimes fails (e.g., Anderson, 1992; Anderson & Shackleton, 1990; Arvey & Campion, 1982; Cohen & Bunker, 1975; Desrumaux et al., 2009; Przygodzki-Lionet et al., 2010; Shaw, 1972). Thus, research, which investigates these stereotypical

expectations more profoundly remains enormously important for recruiter training programs, especially in the close future as the study presented in Article 4 shows.

Article 4 hints at the novel phenomenon of stereotypical expectations being more likely to be activated from the increasing globalization and merging acquisitions. Because of these changes in the business world, we see an increase in job interviews in which the applicant and the recruiter each have a different cultural background. Knowing about different self-presentation styles being preferred in different cultures, future training programs might want to focus on these differences. This can simply be achieved by providing the necessary information to future recruiters. Because stereotypical expectations are often unconscious, so-called diversity awareness training programs bring forward the importance of cultural differences between recruiters and applicants (Brief, 2008). However, there is little theoretical and empirical evidence that such trainings do indeed reduce stereotype application (Cavaleros, Van Vuuren, & Visser, 2002; Sanchez & Medkik, 2004). In contrast, diversity skill training has shown to be quite successful in reducing stereotype usage, since they focus less on the conveying knowledge of the cognitive process when stereotyping but rather on the refinement of self-observation skills in social interactions (Kulik & Roberson, 2008). Thus, training on the self might be an important asset in future training programs (Ambady, Bernieri, & Richeson, 2000), since it increases behavior change (Noe, 1999). Article 5 provides empirical evidence for this claim by showing that the individual level of recruiter's interpersonal sensitivity helps to overcome gender-occupational stereotypes. Assuming that the recruiter's interpersonal sensitivity also counteracts other stereotypical expectations, the present dissertation suggests that research investigating the improvement of such a social skill is highly important for future training programs.

6.1 Implications for practice

So far, research has shown that even if structured job interviews are known to be more predictive of future job performance than unstructured job interviews, unstructured job interviews are still more frequently used among practitioners (Lievens & DePaepe, 2004). Although the use

of structured job interviews varies across countries (e.g., higher adoption in the UK and in Canada than Italy and Sweden), it is still evident that many practitioners do not feel at ease using standardized questions when interviewing an applicant (Bangerter, Roulin, & König, 2012). However, if our results are replicated in future studies showing that automatically extracted applicant nonverbal behavior is indeed indicative of future job performance, the fact that recruiters rarely use structured job interviews might become less dramatic, as long as the applicant's nonverbal behavior during the job interview is objectively assessed. In other words, although job interviews should be structured whenever possible, if recruiters want to establish an informal contact and therefore decide to conduct a low-structured job interview (Lievens & DePaepe, 2004) they can still use nonverbal social sensing, in order to ensure predictive validity. For these recruiters, nonverbal social sensing captures exactly what recruiters in general highly value: the applicant's interaction behavior. Nevertheless, it goes without saying that using structured job interviews in combination with nonverbal social sensing is still highly recommended, because it most certainly increases predictive validity compared to using only nonverbal social sensing as a selection method (Schmidt & Hunter, 1998).

The fact that the applicant's nonverbal behavior expressed during the job interview can be indicative of future job performance opens a completely new avenue of selection procedures. It becomes possible to use nonverbal social sensing for applicant selection for jobs with a high level of social interactions and therefore with a remarkable importance of one's nonverbal behavior. Because we found vocal and not visual nonverbal behavior to be diagnostic for sales performance, automated assessment can become even easier: Future job applicants might not even need to be filmed during the job interview; recording the applicant's voice is enough. However, because meeting the applicant in person (i.e., in the framework of a face-to-face job interview) remains a highly desired aspect by recruiters (Dipboye, 1994) one might consider using nonverbal social sensing in the pre-selection phase which can consist of a telephone interview (Blackman, 2002). Including nonverbal social sensing in the telephone interview might increase predictive validity of the pre-selection phase and therefore restrict the selection for a

face-to-face job interview to a higher extent. This, in turn, can result in a greater likelihood of hiring high performing applicants. Moreover, it would save time and resources for both the applicant and the recruiter.

One might raise the question whether automated applicant selection really works. Is the applicant's nonverbal behavior really a better predictor of future job performance than using the traditional recruiter evaluations? The present dissertation shows that this is indeed the case. Results suggest that the objectively and automatically assessed nonverbal behavior during a job interview can be a valid predictor of future job performance and maybe even a better predictor than are human decision makers. However, it remains unclear to what extent the predictive applicant nonverbal behavior changes depending on the job at hand (see also Section 6.3.1). Moreover, the stationary social sensing platform might be only worth the investment when selecting a large number of applicants for a job in which performance can be objectively assessed. Nevertheless, the current research is starting to show that using nonverbal social sensing as a selection method is more than just throwing the dice.

6.3 Limitations and future research

In this section, I focus on some limitations the present dissertation faces. In order to provide ideas about how to overcome these limitations, I present potential veins of research.

6.3.1 *The validity of the applicant's nonverbal behavior*

Although our study presented in Article 3 shows that the applicant's nonverbal behavior predicted future job performance, the question about the validity of the applicant's nonverbal behavior during the job interview is not entirely answered. Too few studies have been conducted that investigated the link between the applicant's nonverbal behavior and job performance (Burnett & Motowidlo, 1998; Motowidlo & Burnett, 1995). Moreover, only supervisor ratings have been used as measure of job performance, so far. Thus, the study presented in Article 3 is the first one showing that such a link exists, also when using objective job performance as a criterion.

Given that our results are partially counterintuitive emphasizes the importance and also to a certain extent the validity of our data driven approach. Recruiters might harbor certain expectations about the kind of information revealed through the applicant's nonverbal behavior. These expectations might be wrong and result in biased hiring decisions. To illustrate, we found applicant vocal nonverbal behavior to be a better predictor of job performance than recruiter hiring decisions. Professional recruiters viewed all the job interviews and then indicated to what extent they would hire the applicant. Interestingly, the hiring decision and job performance were unrelated. As Article 2 shows, the recruiter used the applicant's gazing as an indicator of high job interview performance. And yet, applicant gazing did not predict actual job performance. Research shows that recruiters rely on the applicant's immediacy behavior (e.g., Anderson & Shackleton, 1990; McGovern & Tinsley, 1978) but these behaviors might not necessarily be indicative of future job performance. The fact that the recruiter's hiring decision and job performance are unrelated emphasizes the importance of extending research on the applicant nonverbal behavior-job performance link.

So far, we only tested the link between the applicant's nonverbal behavior and actual job performance with one sample of applicants and with one specific job. Only if we show, with a new sample of applicants, that the in a first step established nonverbal behaviors predict the same objective job performance, can we consider using applicant nonverbal behavior as a selection method in the future. Moreover, the extent to which our results can be generalized across different types of jobs is unclear. Our results might even differ between different types of sales jobs. Thus, in a future study, the nonverbal social sensing needs to be applied for different types of jobs. Finally, future research might want to consider testing our new method to compare jobs involving high levels of interpersonal contact with jobs involving low levels of interpersonal contact. Depending on the importance of the nonverbal behavior in a given job, relying on the applicant's nonverbal behavior might be more or less appropriate.

Note that the nonverbal behavior is dependent on different factors, such as the personality, gender, cultural background, and interaction partner of the nonverbal behavior sender. For

instance, highly agreeable applicants have been shown to be more nonverbally expressive than less agreeable applicants (Kristof-Brown, Barrick, & Franke, 2002; Peeters & Lievens, 2006). Moreover, it is widely shown that women are more nonverbally expressive than men (Dixon & Foster, 1998; Frauendorfer, Schmid Mast, Nguyen, & Gatica-Perez, in prep.; Hall, 1984; Hall & Carter, 2000; Van Vianen & Van Schie, 1995). Thus, even if the present study showed predictive validity of the applicant's nonverbal behavior, the above mentioned factors should be taken into account in future research in order to obtain a more insight into the link between the applicant's nonverbal behavior and their job performance.

6.3.2 *Faking nonverbal behavior*

Considering the large number of job interview counseling books providing advices to applicants about how to behave in job interviews, one might quickly notice that applicants can easily train and therefore also fake their behavior (DePaulo, 1992). Given this, applicants might have a greater awareness of their own nonverbal behavior resulting in them being highly motivated to show nonverbal cues, which are favorable for the recruiter's hiring decision. Knowing which nonverbal behavior is desired by recruiters, applicants can train themselves (e.g., in workshops) in order to show perfectly adequate nonverbal behavior during the job interview.

Even if the objective assessment of the applicant's nonverbal behavior with nonverbal social sensing is not fight against applicant's faking of nonverbal behavior, it might be still less affected because we use a data-driven approach. Applicant nonverbal behavior is used as an estimation of whether the applicant performs better or worse on the future job. If the applicant's nonverbal behavior expresses sometimes true characteristics and sometimes not (in case of faking) no relation will be found between the applicant's nonverbal behavior and future job performance. Thus, when identifying the applicant's nonverbal behavior that predicts future job performance, the only risk is to find no link but not to find a non-existing link. Put differently, faking leads to find no nonverbal cues being indicative of future job performance but not to find wrong nonverbal cues. However, faking can be problematic if the applicant is aware of the

nonverbal behavior that is being looked for. In this case, the applicant might be likely to be faking the nonverbal cues (i.e., applicant's characteristics are not related to his or her nonverbal behavior anymore) which in turn would decrease the predictive validity.

Further consequences of this phenomenon can be that organizations will eventually know about the potential of applicants' faking and might adapt their selection criteria in order to counteract applicant's dishonest behavior (Bangerter et al., 2012). In turn, assuming that applicants will sooner or later know about these adapted criteria, they might re-adapt their behavior leading to a vicious circle of selection criteria adaptation (Bangerter et al., 2012). However, assuming that some predictive applicant nonverbal behavior might be counter intuitive (as is shown in Article 3), the likelihood that the applicant will be aware of the desirable nonverbal behavior and therefore be able to fake the nonverbal behavior, is rather low.

Moreover, the likelihood of applicant faking is described as being a function of the three situational and dispositional variables capacity, willingness, and opportunity (Levashina & Campion, 2006). If the applicant provides the capacity and the willingness to fake and if there is the opportunity to fake, only then will faking occur. Thus, simply knowing about which nonverbal behavior to fake might not be reason enough to do so. Also, nonverbal behavior is considered as being hard to fake because it is often beyond conscious awareness (DePaulo, 1992; Ekman & Friesen, 1969). Vocal nonverbal cues are known to be especially hard to fake and these are exactly the cues we found to predict future job performance.

Maybe the question about faking nonverbal behavior is not that relevant, however. If the faked nonverbal behavior predicts job performance, the ability to fake the right nonverbal behaviors might not be such a bad thing. In this case the "faking" applicant knows which nonverbal behavior to use and not to use during the job interview and this might lead the applicant to use the appropriate nonverbal behavior in the job as well. To verify this argument, future research might be to investigate the extent to which the applicant is actually using the same valid nonverbal behavior during the job.

6.3.3 *The job interview as a dynamic interaction between applicant and recruiter*

One limitation of our results presented in Articles 2 and 3 is that the applicant's nonverbal behavior might have been influenced by the recruiter's behavior during the job interview. In our study, we did not take into account the dynamic of the interaction between the applicant and the recruiter. The interpersonal behavior between the applicant and recruiter remains a subjective and dynamic matter which means that the recruiter might adapt his or her behavior during the job interview depending on which applicant he or she is facing (Anderson, 1992). We are, thus, not able to rule out that applicants showing a high amount of positive nonverbal cues might have been reinforced by the recruiter's (nonverbal) behavior. Even if we can preclude a systematic bias with respect to the applicant's behavior (i.e., we only used one recruiter), we are not able to assure that the recruiter did not adapt the behavior according the applicant he or she is facing.

One way to remedy this issue in future research is to use different recruiters so that every applicant is interviewed from at least two recruiters at different times. If the applicant behaves in a similar way in both job interviews, the recruiter's behavior most likely does not influence the applicant's nonverbal behavior (Campion et al., 1997). Another way to reduce the dynamic component of the job interview would be to consider the approach of maximally standardizing the recruiter's behavior. To do so, the immersive virtual environmental technology (IVET; Blascovich et al., 2002) could be used, in which a human avatar acting as the recruiter conducts the job interview. Because the human avatar is pre-programmed, the virtual recruiter would behave in a standardized way, independent of the applicant's behavior. Thus, the dynamic impact of the recruiter's behavior could be reduced, as the recruiter would not be able to adapt his or her behavior during the job interview, according to different applicants. A commonly raised concern with respect to this method is that the applicant might elicit less interpersonal and especially less nonverbal behavior when facing a non-human. Maybe the applicant's behavior would more rigid and not as expressive when facing a non-human compared to when interacting with a real person. If this is the case, this would fail the goal of reducing only the dynamic component of the job interview but it would rather result in little variance with respect to applicant nonverbal

expressiveness. Reducing the significance of this claim, research using IVET has shown that participants in an interaction with a human-avatar behave similarly, as if in the “real” world (Bailenson, Blascovich, Beall, & Loomin, 2003; Blascovich et al., 2002). Thus, using IVET to reduce a possible reinforcement by the recruiter could be considered as a liable method for future research.

However, because the dynamic between the recruiter and applicant is an essential factor in the job interview (Anderson, 1992), future research might want to focus on this dynamic by using so-called sequential analyses of interactional behavior (e.g., Bakeman, Adamson, & Strisik, 1988; Gottman & Roy, 1990; Hewes, 1979). This type of analysis captures the dynamic component of social interactions and provides information about which recruiter nonverbal behavior follows a specific applicant nonverbal behavior at rates that are significantly different from chance (O'Connor, 1999). For instance, does one specific recruiter nonverbal behavior, such as nodding, elicit a specific nonverbal behavior of the applicant? Sequential analysis helps to obtain a clearer picture of the extent to which the recruiter's nonverbal behavior reinforces the applicant's nonverbal behavior. Before starting with sequential analyses, one might be interested to know whether there is a relation between the recruiter's nonverbal behavior and the applicant's nonverbal behavior during the job interview. In terms of the data presented in Article 2 and 3, preliminary results indicate that the recruiter's nodding behavior is related to the applicant's audio back-channeling (negatively) and the applicant's speech fluency (i.e., average speaking turn duration). The more the recruiter nodded during the job interview the more fluently the applicant spoke and the less audio back-channeling he or she used while the recruiter was speaking. Moreover, the higher the recruiter's speech fluency was, the more the applicant nodded while the recruiter was speaking. Thus, there is preliminary evidence that the recruiter's nonverbal behavior is related to the applicant's nonverbal behavior. However, sequential analysis would provide more detail about the dynamic between the applicant and the recruiter in future analyses.

6.3.4 *Using thin-slices of the applicant's nonverbal behavior*

In Articles 2 and 3, we investigated the role of the applicant's nonverbal behavior throughout the entire length of the job interview. In personnel selection it is a given that every applicant is provided with the opportunity to assert him or herself within a predefined length of time. It is therefore not common for recruiters to dismiss applicants after the first minute, only because the applicant revealed an unfavorable first impression in the first minutes of the job interview. However, a vast amount of research has shown that the very first impression we obtain from a person predicts outcomes such as job performance. To illustrate, students evaluating a 30-sec thin-slice of different college teachers during class predicted the end-of-semester evaluations of the teacher's respective students (Ambady & Rosenthal, 1993). Also surgeons' and sales people's performances were highly predictable based on a 20-sec audiotape thin-slice (Ambady, Krabbenhoft, & Hogan, 2006; Ambady et al., 2002). And, because thin-slices of the applicant's behavior have shown to be sufficient for external observers or professional recruiters to accurately assess the applicant's characteristics and future job performance (Frauendorfer & Schmid Mast, in prep.-a; Schmid Mast et al., 2011) it would be interesting to know whether dismissing an applicant after the first minute is hypothetically justified or not. Given this, one might want to investigate what predicts more accurately the recruiter's hiring decision or future job performance, the first or final minute of the job interview. Or, which behavioral thin-slice predicts hiring decision the best? Is it the first minute or rather the last minute, which is crucial for the recruiter's evaluation? Also, to what extent does the predictive validity of the thin-slices depend on the type of nonverbal behavior?

In a first attempt to answer these questions, we investigated, in collaboration with Murphy and colleagues (Murphy et al., 2013), the predictive validity of applicant's nonverbal behavior thin-slices based on the study presented in Articles 2 and 3. We used the first 6 minutes of the job interview by dividing the job interview in six one minute thin-slices. Results show that the second minute of the job interview with respect to applicant's gazing and speaking time was the most predictive for recruiter's hiring decision. Interestingly, the second minute revealed a higher

correlation than did the total length of six minutes. For predicting job performance, the last thin-slice was the most predictive with respect to the applicant's speaking time. The prediction based on the 6th min was also higher than the 6-min total of the job interview. Thus, the predictive validity of behavioral thin-slices has shown to depend not only on the applicant's nonverbal behavior but also on the outcome to be predicted. More precisely, the applicant's speaking time in the second minute of the job interview was highly predictive for the hiring decision, whereas it was rather the last thin-slice that best predicted future job performance (Murphy et al., 2013).

These first results illustrate that different phases in the job interview can be used to investigate which applicant nonverbal behavior provides the most valid information about the recruiter's likelihood of hiring the applicant or even about the applicant's future job performance. Although in practice this approach might not be used in the near future to select applicants, it might be worth thinking about the possible advantages this approach provides. Focusing, for instance, on the second minute of the applicant's gazing and speaking time behavior already provides the recruiter with enough information to make a hiring decision which in turn could save time that is precious for both the recruiter and the applicant.

6.3.5 The role of the applicant's verbal behavior

When investigating the applicant's nonverbal behavior during the job interview the question concerning the applicant's verbal behavior and its impact on the recruiter's evaluation raises almost intuitively. Even if the applicant's nonverbal behavior plays an important role in the job interview, the applicant's verbal behavior has shown to explain a remarkable amount of variance in the recruiter's hiring decision (Schmidt & Hunger, 1998; Campion et al., 1997). A wide array of research has focused on the applicant's verbal behavior and how it is used in different impression management strategies, such as self-promotion, ingratiation, or lying (Gilmore & Ferris, 1989; Higgins & Judge, 2004; Levashina & Campion, 2006; Roulin, Bangerter, & Levashina, in press.; Stevens & Kristof, 1995). Other research has investigated the different communication styles of an applicant during a job interview, such as assertive, non-

assertive, aggressive, powerful, and less powerful (Gallois, Callan, & Mcalmer, 1992; Parton, Siltanen, Hosman, & Langenderfer, 2002). Applicants' impression management implies that applicants use impression management strategies consciously in order to impress the recruiter and therefore to increase the likelihood of obtaining the job offer (Steven & Kristof, 1995). However, applicants use words not only in a conscious but also in a spontaneous way, beyond consciousness (Pennebaker, Mehl, & Niederhoffer, 2003). In collaboration with Mehl and colleagues, we investigated the spontaneous word use of applicants during the job interview and its impact on the recruiter's hiring decision. More precisely, we focused on the so-called verbal immediacy behavior and the cognitive mechanism applicants express while interacting with the recruiter (Pennebaker & King, 1999). Verbal immediacy (similar to nonverbal immediacy) can be defined as speaking in a highly engaged manner, using experiential and concrete language, and focusing on the here and now. In contrast, applicants scoring low on verbal immediacy tend to use a rather abstract, impersonal, detached, and rational language style (Mehrabian, 1972; Wiener & Mehrabian, 1968). Cognitive mechanism indicates the extent to which the applicant conveys his or her own thoughts during the job interview (Pennebaker & King, 1999).

In order to investigate the applicant's spontaneous word use, we used the text analysis program Linguistic Inquiry and Word Count (LIWC; Pennebaker & King, 1999). LIWC detects words from text files (i.e., transcriptions of the job interview), compares it with a dictionary, and assigns each word to different categories, which are either of a linguistic (e.g., first person singular pronouns, present tense verbs, words longer than six letters) or a psychological (e.g., cognitive mechanism, positive and negative emotions words) nature. Verbal immediacy is a composite of categories and Pennebaker and King (1999) found the following five categories loading on one, typically the first, factor, which they call verbal immediacy: a frequent use of first person singular pronouns, present tense verbs, discrepancy words (i.e., "could", "should", "would"), and an infrequent use of articles and words longer than six letters. In contrast, cognitive mechanism is a predefined category of the text analysis program, containing insight

words (e.g., “think”, “consider”, “know”), exclusive (e.g., “but”, “without”, “exclude”), inclusive (e.g., “and”, “with”, “include”), and tentative words (e.g., “maybe”, “perhaps”, “guess”).

We were interested in whether verbal immediacy was positively or negatively related to the recruiter’s hiring decision. As it is widely known that nonverbal immediacy behavior has a positive impact on the applicant’s evaluation (e.g., Imada & Hakel, 1977), we were wondering whether this was also the case for verbal immediacy. Moreover, we were interested in how cognitive mechanism was related to the job interview outcome. There is literature showing that reflecting thoughts during the job interview (i.e., starting sentences with “I feel”, “I guess”, “I think”) relates to powerless speech and that this in turn has a negative impact on the applicant’s hireability (Parton et al., 2002). Based on this, we assumed that the applicant cognitive mechanism negatively predicts recruiter hiring decisions.

Results show that independent of the applicant’s nonverbal immediacy behavior, verbal immediacy was highly negatively correlated with the job interview outcome. In other words, the recruiter prefers an applicant who talks in a detached, abstract, impersonal, and rational way. We also found that the applicant’s cognitive mechanism during the job interview was negatively correlated with the recruiter’s hiring decision. The more the applicant reflected his or her own thoughts during the job interview, the less likely the applicant was to be hired (Frauendorfer, Mehl, Schmid Mast, Nguyen, & Gatica-Perez, in prep.).

These first findings show that spontaneous word use impacts the applicant’s evaluation to a remarkable extent. Moreover, nonverbal and verbal immediacy – even if based on the same construct of immediacy – do not have equal impact on the recruiter’s perception. Nonverbal immediacy behavior of the applicant is appreciated by the recruiter, whereas verbal immediacy is not. In order to obtain a more systematic picture of which language style to use and not use when being interviewed for a job, future research might want to focus more extensively on the applicant’s spontaneous word use and its impact on recruiter hiring decision.

6.3.6 *The role of the target in personality judgment*

One question that still remains unanswered with respect to the recruiter's assessment accuracy (study presented in Article 6) is to what extent our results are influenced by the judgeability of our targets' photographs. Judgable people are defined as being sociable and open individuals who express themselves in a way that enables others to accurately assess their states, traits, and intentions (Colvin, 1993a, 1993b). This description goes hand in hand with the term of a "good target" (Funder, 1995). Most research – including our study presented in Article 6 – has focused on the individual differences in judges' performance, whereas there is astonishingly little research on individual differences in judgeability (see for a review: Human & Biesanz, 2013). Yet, a study investigating the distribution of individual differences in judges and targets shows a much wider distribution for targets than for judges (Biesanz, 2010). The higher level of individual differences in targets hints at the importance of judgeability when investigating first impression formation.

There might be different reasons why certain targets are easier to judge correctly than other targets. Human and Biesanz (2013) found in their review that good targets are psychologically well-adjusted (i.e., satisfied with their life, have positive interpersonal relationships), have higher status, and are socialized to express themselves more accurately. Moreover, psychological adjustment is related to higher nonverbal encoding skills and to having a more judgable personality (e.g., Colvin, 1993a, 1993b). And, higher status is related to better nonverbal behavior encoding skills (Hall, Murphy, & Schmid Mast, 2006). Finally, Human and Biesanz (2013) argue that socialization factors such as gender roles and family environment are related to judgeability.

With regards to the study presented in Article 6, it would be interesting to investigate the extent to which our eight targets in the photographs differed regarding these three dimensions. Assuming that all of these dimensions were highly present in our targets, this might explain why their personality traits could be assessed accurately, to such an extent. On the contrary, if some of

our targets revealed higher and some lower scores on these dimensions, our results might be even more pronounced when keeping these dimensions constant on a high level. Thus, future research investigating assessment accuracy might not only want to increasingly focus on the target and its judgeability but might also want to systematically uncover the effect of the judges' psychological adjustment, status, and socialization.

7. Conclusion

The investment in new methods, which enables researchers to advance behavioral research in psychology and more precisely in personnel selection, is of great importance. The present dissertation advances the field of personnel selection by showing how nonverbal social sensing can be applied in the job interview and that automatically extracted applicant nonverbal behavior predicts future job performance above and beyond subjective evaluations. To what extent practitioners will apply nonverbal social sensing remains an open question. However, as the second part of the present dissertation illustrates, recruiter's biases – based on cultural differences and gender-occupational stereotypes – are still widely present in personnel selection. Given this, automated methods, such as nonverbal social sensing, should be considered in the future in order to assess the applicant's behavior objectively. Finally, I illustrated that interdisciplinary collaborations, especially on novel and innovative technologies, can open new and promising avenues for research in personnel selection.

8. References

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B. Article 1

With Automatic Social Sensing Towards the Interpersonal Behavior Revolution in
Psychology

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Abstract

This paper provides an overview of how far along we have come in the endeavor to automatically assess social interaction behavior of individuals and groups via automatic social sensing. Automatic social sensing means the automatic extraction of behavioral cues from people engaged in social interactions via ubiquitous computing platforms for sensing and recording interactions and via computational models and algorithms for extracting the cues. Ubiquitous computing means that the computer fits the human environment and does not require the user to enter the computer environment. With the help of automatic social sensing it becomes possible to investigate social interaction behavior as it occurs in everyday life, over long periods of time, among many social interaction partners, and without the need of human coders. Concrete research examples of portable (e.g., mobile phone) and of stationary social sensing platforms are presented to show how these platforms can be used for automatic extraction of verbal and nonverbal interaction behavior. The implications for research and practice, as well as the advantages and challenges of automatic social sensing are discussed.

Keywords: social interaction, interpersonal behavior, nonverbal behavior, ubiquitous computing, social sensing, honest signals

With Automatic Social Sensing Towards the Interpersonal Behavior Revolution in Psychology

A core goal of psychological research is to understand and predict human behavior and because most human behavior occurs in a social context, understanding interpersonal behavior is a key for the advancement of our understanding of the psychology of the human. Researchers dedicated to the study of social interaction behavior face, however, different challenges that have so far prevented behavioral observation research to play the central role in psychological research we claim it deserves. For one thing, coding of behavior as it occurs in social interactions is very time and resource intensive. Moreover, registering interpersonal behavior in everyday life is hard to accomplish because the assessment typically goes hand in hand with interfering in the everyday life course and thus if not altering behavior then at least seriously disturbing it. And, the behavioral observation over long periods in time is challenging not only in the registration phase because of location changes but also in the extraction phase because the behavior coding of large amounts of data can become a task surpassing the lifetime of a researcher. Automatic social sensing heralds a new area of behavioral observation research with the potential to position the study of interpersonal behavior to center stage in psychology.

Automatic social sensing means the sensing and recording of verbal and nonverbal cues from people engaged in social interactions via ubiquitous computing platforms and computational models and algorithms for extracting those cues. Ubiquitous computing means that the computers are integrated in the environment of the humans and that the human behavior can be observed in an unobtrusive manner without the person having to interact with the computer. With the help of automatic social sensing, it becomes possible

to investigate social interaction behavior as it occurs in everyday life, over long periods of time, and without the need of human coders. Hand in hand with the “fourth generation” of computing and information technology, characterized by smart environments and ubiquitous computing (Pentland, 2000), we advocate in this article that this “fourth generation” information technology is the means by which we can achieve the Interpersonal Behavior Revolution in Psychology.

The Study of Interpersonal Behavior in Psychology

The APA defines psychology as “the study of the mind and behavior. The discipline embraces all aspects of the human experience — from the functions of the brain to the actions of nations, from child development to care for the aged. In every conceivable setting from scientific research centers to mental health care services, "the understanding of behavior" is the enterprise of psychologists”

(<http://www.apa.org/support/about/apa/psychology.aspx#answer>). From this definition it becomes evident how central behavior is in the study of psychology. We posit that much research has been concerned with antecedents and consequences of human behavior and less with the behavior in and of itself, its observation and measure and that this is especially the case when it comes to interpersonal behavior.

APA defines behavior as “The actions by which an organism adjusts to its environment.” Based on this definition, we understand behavior as any act a person executes that is potentially observable by others

(<http://www.apa.org/research/action/glossary.aspx#b>).

This emphasizes that behavior is intimately linked to our body and that muscular activity is necessary to perform an act. Assessment of human behavior is essential for all

domains of psychology. How much a person eats or what he/she eats, how much cigarettes an individual smokes etc. are typical questions about individual behavior in health psychology research. Personality research is interested in the behavioral expressions of a person's traits, whether an extravert is more likely to dance at a party than an introvert, for instance. In developmental psychology, cognitive advancement is usually assessed with behavioral tests. As an example, to determine whether an 18 months-old child has a self-concept and recognizes him- or herself in the mirror, a mark is unobtrusively put on the child's forehead and when looking at him- or herself in the mirror, children who touch their mark (the behavior) signal that they have understood that the mirror image has a correspondence in the real world which is themselves (Rouge Test, Amsterdam, 1972). Behavioral measures in cognitive psychology, for instance, encompass choosing among different answer alternatives in psychology experiments or reaction time measures (i.e., the time it takes to make this choice).

We focus on *social or interpersonal behavior* defined as any behavior directed towards or elicited by one or many actual or imagined interaction partners. Humans have been described as social animals, recognizing the importance of interpersonal interaction behavior (Argyle, 1991). We will discuss in particular verbal and nonverbal behavior.

Understanding interpersonal behavior is important because it can help prevent or solve conflicts at the workplace, in relationships, and at the level of the society at large. Interpersonal behavior is essential when trying to bring about change in individual behavior and development. Sometimes we even infer our own attitudes or feelings based on the observation of our interpersonal behavior (Self-Perception Theory, Bem, 1972). A person's interaction behavior (verbal and nonverbal as well as appearance) is the basis of a first

impression we form about this person and we use it to infer a person's personality, motives, emotions, and thoughts (Hall & Bernieri, 2001). Especially in situations in which we do not know the social interaction partner (so-called zero acquaintance situations, Nalini Ambady & Robert Rosenthal, 1992) his or her verbal and nonverbal behavior is the only information available to make inferences about him or her. For instance, job applicants who smile more are more likely to be hired, all other things being equal (Levine & Feldman, 2002; Woodzicka, 2008). Or, dominance hierarchies that form around differences in interpersonal behavior among group members can affect the group's performance (Frauendorfer, Schmid Mast, Sanchez-Cortes, & Gatica-Perez, 2013). Thus, how we perceive others based on their nonverbal behavior can even have an impact on team performance. Especially the nonverbal channel is a valuable source of information about a social interaction partner. Compared to verbal behavior, nonverbal behavior seems less under conscious control (N. Ambady & R. Rosenthal, 1992); it is therefore also more difficult to fake (DePaulo, 1992).

Given the importance of behavior for understanding humans and for bringing about change for individuals and society, it is surprising that not more research in psychology focuses on interpersonal behavior. The reasons why behavioral observation research has played a relatively marginal role within the field of psychological research is, we claim, practical: The coding of verbal and nonverbal behavior of people engaged in a social interaction is very time- and cost-intensive (Furnham, 2008; Reis & Charles, 2000). A human coder has to watch each interaction partner and code each behavior of each partner separately. Even if the coding is assisted by coding software (e.g., Noldus Observer, Noldus, 1991), it still needs a human coder who takes the decision of whether - say - a smile has occurred, yes or no. Also, behavioral coding often takes several viewings of the

same videotaped segment in order to be able to take a coding decision. Coding errors necessitate rewinding the tape and redoing the coding, subtle interaction behaviors might need to be looked at frame by frame, and some behavior coding needs extra training (e.g., the detection of subtle emotional expression in the face, called micro expressions) (Ekman, 2001).

If the human behavior coding could be done by some sort of “intelligent machine” instead of human coders, this would be immensely beneficial for the study of human interaction behavior. Imagine that after a social interaction is over, the “intelligent machine” would provide the researcher directly with the coded behavior of each of the social interaction partners (e.g., how much each participant gazed at the other, who interrupted whom how many times, who spoke the most, or how long two interaction partners were engaged in mutual gazing). The vision of the “intelligent machine” has become reality by what is called *automatic social sensing*. By using tools and expertise of computer science the role interpersonal behavior plays in psychology research can be revolutionized.

Automatic Social Sensing

Automatic social sensing means the sensing, recording, and extraction of verbal and nonverbal behavior from people engaged in social interactions. It encompasses two steps: 1) the sensing and recording of the social interaction behavior via ubiquitous computing and 2) the extraction of the verbal and nonverbal behavior with computational models and algorithms (Gatica-Perez, Guillaume, Odoñez, & McCowan, 2007). Ubiquitous computing means that the user does not need to enter the computer environment but that the computer fits the human environment so that the sensing and recording devices are incorporated in

the everyday environment of a person and record and sense the interaction behavior in an unobtrusive manner¹.

The last years have witnessed a surge of work in computational analysis of conversational behavior (Gatica-Perez, 2009; Pentland, 2008). A major driver for this trend is sensing, where devices like Kinect have significantly facilitated visual processing of natural behavior (Shotton et al., 2011) and smartphone-based sensing allows to develop platforms that record multiple sensors without the need for dedicated hardware (Campbell & Choudhury, 2012) and that potentially scale-up to large studies. A smartphone is a wearable social sensing platform. It possesses one (or in the new models even two) cameras, a microphone, an accelerometer, a digital compass, gyroscope, and a GPS which can all be used as sensing devices to record the verbal and nonverbal behavior of the person wearing the device and of people being in the vicinity of the wearable social sensing platform (Lu et al., 2012).

Stationary ubiquitous social sensing platforms are smart rooms equipped with sensors (e.g., cameras, microphones, Kinect motion sensor) that record the verbal and nonverbal behavior of the social interaction partners in the room without them wearing any special gear or sensors. An example of such a stationary platform can be seen in *Figure 1* (Frauendorfer, Schmid Mast, Nguyen, & Gatica-Perez, 2013a) showing a table with two opposing chairs for an interview or discussion situation with two HD cameras recording the interaction partners, a microphone array recording their speech, and two Kinect motion sensors on the table.

Once the data is sensed and recorded, a second step is needed, the extraction of the interaction behavior. This is the part where psychology research typically uses human

coders. We suggest using computer science competence. Through the development of algorithms and machine learning technologies, computers are trained to extract the verbal and nonverbal behavior of the social interaction partners from the sensed and recorded data. Some of these extraction methods have proven to be accurate and are publicly available, such as voice energy, pitch, and speaking rate (Basu, 2002), visual motion (Biel, Aran, & Gatica-Perez, 2011), or head pose extraction (Ba & Odobez, 2011). Other cue extractions are more challenging to realize and are still in development to date like, for instance, the automatic recognition of arm position based on frontal video recordings (Marcos-Ramiro, Pizarro-Perez, Marron-Romera, Nguyen, & Gatica-Perez, 2013).

The extraction process is intimately linked to the sensing and recording process of the behavior meaning that the extraction algorithm only works (or works best) if the data has been sensed and recorded in a specific way (Vinciarelli, Pantic, & Bourlard, 2009). For instance, an algorithm that extracts head position (Nguyen, Odobez, & Gatica-Perez, 2012) or gazing (Funes & Odobez, 2012) of the social interaction partners can only do so if minimal requirements of lighting and registration angle of the camera are observed. This is the reason why the sensing, registering, and extraction processes go hand in hand in automatic social sensing. As technology advances, these steps become even more interwoven. A prime example of an automatic social sensing device is the “microcone”. The “microcone” (<http://www.dev-audio.com/products/microcone/>) is a microphone array that can register up to six people at the same time by performing speaker segmentation of distant speakers automatically, based on spatial discrimination. The resulting segmentations are stored in a file containing the identifier (speaker) and the relative time in seconds (starting and ending time of the speaking segment). Based on these segmentation files,

speaking time duration of each interaction partner, turn taking, and who interrupts whom is, for instance, information that then can be extracted with the corresponding algorithms automatically.

Another example showing that sensing and extracting need to be calibrated is the case of facial expressions recognizers. They have matured to real-time performance (Littlewort et al., 2011) but the quality of the features that can be extracted are still highly dependent on viewpoint and image size. As an example, the face reader (Den Uyl & Van Kuilenburg, 2005) is a program that automatically extracts the basic emotions from videotaped faces. However, if the face is not frontal to the camera, if the lighting conditions are unfavorable, or if the filmed target person speaks, the emotion extraction becomes inaccurate or downright impossible.

We will now present research that has used wearable and stationary social sensing platforms and will later detail the advantages and challenges inherent in automatic social sensing.

Research Examples with Social Sensing Platforms

Wearable social sensing platforms allow for mobile sensing directly in the field which is a key development towards ecological validity of assessing social interaction behavior. Mobile sensing was pioneered by Pentland and his group (Choudhury & Pentland, 2003; Waber et al., 2007). Before smartphones became widely available, they used badges or sociometers. The first wearable sensor badge was developed in 1999 (Farrington, Moore, Tilbury, Church, & Biemond, 1999) that was capable of sensing whether a person was sitting, standing, lying, walking, or running with the aid of an accelerometer. Wearable sensors with microphones and accelerometers were used to automatically and unobtrusively

assess the social network structures of groups by assessing proximity and conversations in face-to-face interactions (Lane et al., 2010). Other examples of this work are the use of audio cues in the context of speed dating and salary negotiations (Curhan & Pentland, 2007). More recently, the work in automatically aggregated measures of face-to-face interaction and e-mail communication patterns was used to inform high-level management about everyday communication at the team or division levels, without focusing on specific individuals but on group estimates (Olguin et al., 2009). This information could potentially be used to integrate changes at the organizational level. Although smartphones are a very practical social sensing devices (many people possess them and use them throughout the day and carry them close by), the sensing is restricted to what comes with the specific smartphone model and data storage needs to be solved (e.g., via remote storage to a server). This is why for some research; the sociometers are still used instead of the smartphone.

Automatic sensing research that has used smartphones is called mobile phone sensing (Lane et al., 2010; Miluzzo et al., 2010). It has been used for activity or safety monitoring in healthcare and for research to determine the proximity of social groups at work and their network structure (Eagle & Pentland, 2006). This research shows, for instance, that individuals who are less sociable (assessed via mobile sensing) report poorer mood and the more sociable participants were during the day, the more optimal was their sleep duration (7 or 8 hours) (Moturu, Khayal, Aharony, Wei, & Pentland, 2011). Another example is that health behaviors of participants with respect to nutrition and physical activity are correlated with the behaviors of peers (Madan, Moturu, Lazer, & Pentland, 2010).

We used mobile phone sensing to develop StressSense, an application that can be downloaded on a person's Android phone and when activated, it provides the user with

feedback about his/her current level of stress based on the voice registration of the user (Lu et al., 2012). Automatic social sensing was used to develop the App. We had participants wearing the platform in a relaxed situation reading a passage from a book. The voice registration of this recoding served as the baseline measure (no stress) to which the voice registration of the same individual involved in a stressful situation was compared. This comparison made it possible to identify on the group and on the individual user level, the voice quality changes associated with increased stress. One such voice-related indicator of stress was faster speech. The StressSense App senses the user's voice characteristics via the microphone in the smartphone and then compares this voice profile to the user's baseline no stress voice profile and provides the user with individualized stress feedback.

EmotionSense is another example of a social sensing platform running as an application on mobile phones that is capable of sensing emotions, verbal activity, and proximity of members of a defined group (e.g., work team) and to feed this information back to the individual user (Rachuri et al., 2010).

Stationary social sensing platforms are rooms equipped with unobtrusive sensing devices that allow the automatic recording of social interactions and the subsequent automatic extraction of the behavioral cues. We set up such a stationary social sensing platform in order to simulate a job interview situation with two interaction partners: the recruiter and an applicant (Frauendorfer, Schmid Mast, et al., 2013a; Frauendorfer, Schmid Mast, Nguyen, & Gatica-Perez, 2013b). Two HD cameras and the "microcone" recorded the applicant and the recruiters' visual nonverbal behavior (e.g., visual back-channeling, body gestures) (Marcos-Ramiro et al., 2013; Nguyen et al., 2012) and vocal nonverbal behavior (e.g., speaking time, audio back-channeling, and speech fluency). Recruiter hiring

decision could be predicted by the applicant's extended eye contact with the recruiter, more speech fluency, and more speech tempo variation. Moreover, applicant vocal nonverbal behavior predicted later job performance.

The disadvantage of the stationary platform is that the participants need to be brought into the sensing environment. There exist also solutions in between the stationary and mobile sensing. We used a portable sensing setup to record small group meetings taking place at different locations (Dairazalia Sanchez-Cortes, Aran, Mast, & Gatica-Perez, 2010; D. Sanchez-Cortes, Aran, Mast, & Gatica-Perez, 2012). We essentially used cameras and synchronized microphones to sense the interaction behavior and then extracted a series of speech-related (e.g., speaking turns, interruptions) and visual cues (e.g., attention given and received), as well as combined audio-visual cues (e.g., looking while listening) to predict emergent leaders in small groups. We showed that speech-related cues were better predictors of emergent leadership than were visual cues and that interruptions were particularly predictive of an emergent leader.

Examples of Automatic Cue Extraction

Mobile phone sensing has focused so far mostly on capturing human motion activity (via accelerometer and GPS) and in terms of the interest in the present article, interaction behavior such as person-to-person proximity and cues extracted from vocalization (e.g., speech duration, pitch, number of pauses) (Pentland, 2007). Stationary sensing platforms allow for a wider array of interpersonal behavior extraction, such as gesturing, nodding, smiling, eye contact, and self-touch. While voice recognition from registered speech can be transcribed already automatically (Pennebaker, Francis, & Booth, 2001), we will focus on nonverbal behavior in the present article. Nonverbal behavior is defined as communication

behavior without linguistic content (Knapp & Hall, 2010). Nonverbal behavior can be related to speech or not. Speech-related nonverbal behavior encompasses loudness of voice, pitch (low vs. high), monotony (vs. variations), speech rate, and speech duration. It is sometimes called *vocal nonverbal behavior*. Speech-unrelated nonverbal behavior, or *visual nonverbal behavior*, spans over different body parts: the *face* with nonverbal behaviors including smiling, gazing, frowning, eyebrow raising, or, on a more general level, facial expressivity, (b) the body with nonverbal behaviors indicative of *posture*, like arm and leg positions (crossed vs. uncrossed), head tilt, body orientation (toward the interaction partner or not), interpersonal distance, *gestures*, such as emblematic gestures (e.g., thumb up) or head gestures such as nodding, illustrative gestures (e.g., indicate the size of an object), regulating gestures that coordinate the verbal exchange (e.g., to slightly open one's mouth and lean forward to manifest one's intention to speak), adaptive gestures that satisfy a personal need (e.g., scratching oneself to relieve a sensation of itching), or gestures that express emotions (e.g., to clench one's fist when expressing hostility) (Knapp & Hall, 2010).

Nodding. The automatic nod detection method tracks first the location of the target's face and estimates then the visual (horizontal and vertical) motion in the face region. (Nguyen, Odobez, and Gatica-Perez (2012). The frequency of these visual motions is analyzed by using a windowed Fourier transform. Moreover a binary decision is performed between nods and non-nods with a standard machine learning model. In case nodding is defined as visual back-channeling while the interaction partner of the target is speaking, head gesture movements can be conditioned by the speaking status of the target (silent vs. speaking). To increase the detection accuracy, we use two support vector machine

classifiers; one for speaking and one for silence. In terms of the objective evaluation of the nodding extraction method by Nguyen, Odobez, and Gatica-Perez (2012) the F1-score (harmonic mean between precision and recall) was 63% at the frame level. Even if this level of accuracy is not at a 100%, the detection is still satisfactory because the number of false detection is kept low. And because the detected head nods are aggregated over a longer period of time, the errors tend to cancel out. The nodding extraction can be repeated several times without changing the number of detected head nods.

Advantages of Automatic Social Sensing for Psychological Research

The main advantages of using automatic social sensing for psychological research are that interpersonal behavior can be extracted without human coders. Once the extraction algorithm is in place and tested, the *rapidity* with which the behavioral data can be extracted and the high *accuracy* of behavioral data extraction make automatic social sensing a revolutionary approach in behavioral science. Moreover, large amounts of data can be handled meaning that the behavior of *many social interaction partners* over *long observation periods* can be managed. Also, the behavior *observation is unobtrusive* and does not interfere or interrupt social interaction behavior which makes for high ecological validity. When using wearable sensing platforms, the behavior can be sampled in a *real world environment* during the natural course of social interactions.

Rapidity of data extraction. Once the algorithm for data extraction is developed, large amounts of data (different individuals, long observation periods) can quickly be processed. In psychology research, interpersonal verbal and nonverbal behavior is coded by human raters who are either naïve or trained. Training requires time and naïve judges require a large number of them in order to obtain sufficient coding reliability. Typically, the

time needed to code one nonverbal behavior for one interaction partner is about equal to the real video viewing time. If the number of observed individuals, the number of observed and coded nonverbal behavior cues, or the observation time increases, manual behavior coding becomes a burden and even an obstacle for researchers.

Accuracy of data extraction. To the extent that the computer algorithm uses always the same decision rules, there should be less influence of bias and stereotypes while coding, meaning that the data coding is more objective. Research shows that human coders are not always unbiased. For instance, the same nonverbal expression, a smile, was judged as less authentic when a women displayed it than when a man displayed it (Krumhuber, Manstead, & Kappas, 2007). Automatic coding done by a computer algorithm would not be influenced by such accidental characteristics and thus less biased. However, accuracy of automatic coding suffers if the recording of the data does not correspond to the data recording of the data set used to develop the extraction algorithm. To illustrate, if the algorithm that extracts head position was developed and trained on video material showing the target looking directly into the camera, the algorithm will work less accurately on video material featuring targets looking at the camera at a 45 degree angle.

Observation of many social interaction partners. The observation of large numbers of individuals at the same time and especially several individuals interacting with each other and detect and extract their interpersonal behavior is not only a challenge in terms of the sheer amount of data generated that needs to be handled (and coded) but it is also a challenge in terms of separating the co-occurring verbal and nonverbal behavior. For the first issue, the advantage of using automated registration and extraction – thus automatic social sensing – is obvious. For the second issue, it is possible, for instance, to use a

recording device for each observed individual (e.g., mobile phone) and then to synchronize the separate recordings. Another approach can be to use a device that does the target segmentation automatically. The microcone mentioned before is an example of such a device that can separate up to 6 different speakers and identify them individually.

Automatic social sensing facilitates the analysis of more complex vocal and nonverbal interaction behavior because it provides solutions to register all interaction partners in an individualized manner. One example is the automatic coding of interruptions. When dyadic interruptions in a group of say 5 people need to be coded manually, each dyad needs to be coded separately. With automatic social sensing, such coding becomes easy and fast. Moreover, researchers are more and more interested in specific combinations of nonverbal cues that often are more informative than single cues. As an example, Visual Dominance Ratio is the percentage of gazing at an interaction partner while speaking to him/her divided by the percentage of gazing while listening to this interaction partner (Dovidio, Ellyson, Keating, Heltman, & Brown, 1988) and has been shown to be indicative of power, dominance, or status.

Observation during long time periods. Behavior observation over long periods of time is not problematic anymore because large amounts of data storage capacities are needed and as detailed under the advantage in terms of rapidity of extraction of the behavior, once developed algorithms can be run over large amount of data as is the case in longterm behavioral data capturing.

Research on thin slices of behavior observation (shorter than 5 min excerpts of a social interaction) (Ambady, Bernieri, & Richeson, 2000; Nalini Ambady & Robert Rosenthal, 1992) has offered a solution to the long observation period problem. This research shows

that for many aspects, the coding of a thin slice is sufficient. For instance, watching a 2-min thin-slice of a job interview, openness, extraversion, and conscientiousness as well as the personality profile of the applicant could be correctly assessed (Schmid Mast, Bangerter, Bulliard, & Aerni, 2011). Moreover, judges who watched a 10-sec slice of a mock job interview were able to predict the evaluation of personality traits (Prickett, Gada-Jain, & Bernieri, 2000).

It is, however, not clear to what extent a thin slice either predicts the whole behavior during the entire interaction or predicts interaction outcomes to the same degree as the whole behavior during the interaction. Research shows that 1-min slices of nodding, gazing, gesturing, smiling, and self-touch showed moderate to high correlations with the total amount of those behaviors across a 15-min interaction (Murphy, 2005). So even if the thin slice method shows to possess some predictive validity, there will always be instances in which the researcher needs a full account of all the behavior as it occurred during a social interaction.

Unobtrusive observation in real world environments. Wearable social sensing platforms can be used to assess everyday interaction behavior in naturally-occurring environments. The use of event sampling methods is widespread in psychological research. However, most event sampling procedures require the participant to report behavior or experiences either at preset moments during the day (e.g., by a peep on a watch) or near the occurrence of the event. The disadvantage of these methods is that they interrupt – and sometimes even interfere with – the natural course of behavior. Automatic social sensing does not require the targets to interact with the sensing and recording device; it is ubiquitous. Such passive capturing should not affect a person's behavior (ideally, the

person is not aware of being sensed) (Vinciarelli et al., 2009). Technically, more invasive capturing is typically easier to process (in the phase of the behavioral extraction) but it comes at the cost of changing the behavior of the recorded individuals. It thus becomes possible to record a person's verbal and nonverbal behavior parallel to the person going on about his or her everyday life. A predecessor of automatic social sensing in the vocal domain is the electronically activated recorder (EAR; Mehl & Robbins, 2012) which is a modified portable audio-device that registers thin slices of daily social interactions, randomly throughout the day. Participants can wear the EAR on the belt or in a bag and it is, thus, low obtrusive. The audio thin-slices registered by the EAR can be used for psychological or behavioral ratings. In both cases, trained coders listen to all thin-slices and evaluate them in terms of psychological constructs being present (e.g., personality, emotions) or behavioral ratings captured during the day (e.g., type of activity, location, use of language). Investigating how people's personality is manifested in their everyday life behavior (captured by the EAR), Mehl and colleagues (2006) showed that highly extraverted individuals, for instance, spend less time alone and less time talking to themselves during the day than low extraverted individuals, and highly conscientious individuals spend less time at home, more time in public spaces (others than restaurants, bars, and coffee shops), and in class and they use less negative emotions and swear words. Moreover, Mehl (2006) found that judging other's level of depression is based on the daily behavior the person to judge reveals, such as spending time alone, talking, entertaining, socializing, and laughing (besides the first behavior all other behaviors are negatively correlated with the degree to which a person is judged as being depressive). Finally, research investigating cultural differences in personality self-perception and daily behavior

reveals that even if Mexicans describe themselves as being less extraverted than Americans they behave more sociable; they just do it in a different way. Mexicans socialize more in public environment and with immediate present people, whereas Americans socialize more in private environment and with remote people (Ramirez-Esparza, Mehl, Alvarez Bermudez, & Pennebaker, 2009).

Even if the EAR is able to automatically record snippets of people's daily behavior, the coding still has to be conducted manually. In other words, the advantage of automatic social sensing is that it does both, automatic sensing and automatic coding of the behavior, whereas the EAR is only automatic in behavior sensing. Moreover, compared to the EAR, automatic social sensing has the advantage of including not only vocal behavior but also visual behavior (Lathia, Rachuri, Mascolo, & Rentfrow, 2013).

Challenges of Automatic Social Sensing for Psychological Research

There are challenges inherent to the computer science part of the here advocated approach. Especially for mobile sensing, data storage issues, and low battery life time of the mobile phones together with energy intensive sensing performance are issues on the technical side that await advancement. Of more direct concern for psychology research are privacy issues and the relatively high costs involved in the initial development of extraction algorithms for specific research use.

With respect to the *privacy issues*, researchers in psychology are maybe particularly well-placed to handle these given that we routinely have participants sign informed consent forms prior to conducting research. This policy needs to apply also for mobile sensing so that the user understands exactly what behavioral data is sensed and how this information is used for research. A remaining tricky issue is the fact that when one individual agrees to

being automatically sensed, people in the vicinity of this person are also sensed (e.g., if the microphone is turned on and some of the speech of the social interaction partner is sensed). One way to handle the issue is to either get the explicit consent from each interaction partner to be registered which can hamper the smoothness of the social interaction and go opposite the great advantage of not disturbing the social interaction while being sensed. Another way is to directly filter the recorded speech so that the content of it cannot be accessed once registered.

There are relatively high *costs for developing the extraction algorithms*. This development requires computations skills and research, but once it is established it can be used by researchers and it can be made publically available. It is thus merely a question of time until more and more off-the shelf extraction algorithms will be available to the researchers and to the greater public. Here again, it becomes important to stress that the extraction algorithm works best if the data corresponds to the data on the basis of which the algorithm was initially developed.

An important question to address in behavioral observation and coding is the level of abstraction on which the data extraction takes place. Interestingly, this is not an issue related to applying the new method of automatic social sensing; it is an issue that is relevant for behavioral research irrespective of the sensing and extracting method used. By *level of abstraction of the behavioral extraction* we mean that researchers can either code nonverbal behavior so that the coding reflects the occurrence of each nonverbal behavior during the interaction (e.g., frequency of smiling, duration of eye gaze, erectness of posture) or code more abstract concepts such as how dominant, friendly, or trustworthy a social interaction partner appeared during a social interaction. The more we move from a micro to a macro

level of coding, the more the single behavior cues are subject to interpretation. Such coding still is useful because in some research questions, the interest is not in documenting exactly how the targets behaved verbally and nonverbally but in knowing what impression the targets conveyed to others without necessarily knowing on which cues or combination of cues such an impression is based on. As a matter of fact, much research shows that some verbal and nonverbal cues are valid indicators of say power or dominance but that observers not necessarily use the diagnostic cues of dominance to infer dominance of their social interaction partner (Gifford, 1994). As an example, smiling is unrelated to dominance but observer use low levels of smiling to infer high power of the interaction partner (Hall, Coats, & Smith LeBeau, 2005). Even though observers use (at least partly) the wrong cues for their inferences, those inferences are still correct, meaning that a person can accurately judge another's level of power or dominance. This paradox might find an explanation in the fact that in existing research, the number of verbal and nonverbal cues was relatively limited. Moreover, very few have used combinations or temporal sequences of cues to see whether this is what observers use to form correct impressions about others. Automatic social sensing offers the possibility of tackling this paradox in a new way, by assessing a much larger number of verbal and nonverbal behaviors and testing different cue combinations and temporal patterns.

Interpreting one's nonverbal behavior is quite challenging as nonverbal cues, such as smiling, for instance, does not always have a unique meaning, but it rather depends on the behavior morphology (e.g., sociable vs. a Duchenne smile), the situation (e.g., formal vs. informal), observer characteristics (e.g., gender, age), and other behavioral cues (verbal and nonverbal) that are revealed on the same time. In sum, single nonverbal cues do not provide

unambiguous meanings (Schmid Mast, Klöckner, & Hall, 2010). This is why we have to be careful when interpreting them.

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Figure Captions

Figure 1. The indoor sensing platform with two high definition cameras and the microphone array (“microcone”).



¹ We do not discuss wearable cloth sensors because we do not consider them as ubiquitous given that the user needs to wear them during social interaction.

C. Article 2

Nonverbal Social Sensing in Action:
Unobtrusive Recording and Extracting of Nonverbal Behavior in Social Interactions
Illustrated with a Research Example

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Abstract

Nonverbal behavior coding is typically conducted by “hand”. To remedy this time and resource intensive undertaking, we illustrate how nonverbal social sensing, defined as the automated recording and extracting of nonverbal behavior via ubiquitous social sensing platforms, can be achieved. More precisely, we show how and what kind of nonverbal cues can be extracted and to what extent automated extracted nonverbal cues can be validly obtained with an illustrative research example. In a job interview, the applicant’s vocal and visual nonverbal immediacy behavior was automatically sensed and extracted. Results show that applicant’s nonverbal behavior can be validly extracted. Moreover, both visual and vocal applicant nonverbal behavior predict recruiter hiring decision, which is in line with previous findings on manually coded applicant nonverbal behavior. Finally, applicant average turn duration, tempo variation, and gazing best predict recruiter hiring decision. Results and implications of such a nonverbal social sensing for future research are discussed.

Keywords: Ubiquitous social sensing platform, automated extraction, applicant nonverbal behavior, hiring decision, job interview

Nonverbal Social Sensing in Action:

Unobtrusive Recording and Extracting of Nonverbal Behavior in Social Interactions

Illustrated with a Research Example

Observing and coding of nonverbal behavior in social interactions is time and resource intensive. Although technical advances in recording devices make it relatively easy to record nonverbal behavior during social interactions with regular video cameras and microphones, the extraction of nonverbal cues from the recordings still typically needs to be done by humans who manually code each and every behavior of the interaction partners (Reis & Charles, 2000).

One way to circumvent the tedious coding is to use wearable sensing devices that measure the nonverbal behavior as it occurs from the point of view of the social interaction partner. An example of this would be eye tracking devices mounted on the head of the study participant or body-worn sensors to detect gestures (Junker, Amft, Lukowicz, & Tröster, 2008). These wearable sensing devices have the disadvantage that they interfere - at least to some extent - with the social interaction per se and sometimes with the very nonverbal behavior that is measured (e.g., a worn eye tracking device can affect a person's gazing or how an interaction partner gazes at the person). If social interaction behavior could be observed without having to put on cumbersome sensing devices on participants and, if researchers (and practitioners) had an account of the social interaction partners' nonverbal behavior available right at the end of a social interaction, without having human coders invest many hours to code these behaviors, this could immensely propel the nonverbal behavior field.

In the present article, we will show how far along we have come in this endeavor through collaboration between psychologists and computer scientists with what we call **nonverbal social sensing** (described in more detail below). Nonverbal social sensing can be used to unobtrusively record and extract nonverbal cues in social interactions. We will present a nonverbal social sensing platform, a smart room that we created for the study of nonverbal (vocal and visual) conversation behavior in dyadic interactions.

The goal of the present paper is to show how nonverbal social sensing can be used for research in psychology by providing a concrete research example from the field of personnel psychology (i.e., the link between applicant nonverbal behavior in the job interview and the recruiter's hiring decision). We set out to test whether visual and vocal nonverbal cues obtained via nonverbal social sensing can be used to replicate findings in the psychological literature.

Nonverbal Social Sensing

Nonverbal social sensing means the sensing and recording of nonverbal cues from people engaged in social interactions via ubiquitous computing platforms and computational models and algorithms for extracting those cues. Ubiquitous computing means that the user does not need to enter the computer environment but that the computer fits the human environment. Social sensing and recording devices are incorporated in the everyday environment of a person; the environment becomes "smart". There are stationary sensing and recording platforms (e.g., "smart rooms") and wearable sensing and recording platforms (e.g., smartphones). In this paper, we focus on stationary social sensing platforms, which are smart rooms equipped with sensors (e.g., cameras, microphones, Kinect motion sensor) that record the nonverbal behavior of the social interaction partners

in the room without them wearing any special gear or sensors. We focus on the sensing and the extraction of nonverbal cues and include visual nonverbal cues (e.g., smiling, gazing, and nodding) as well as vocal nonverbal cues (e.g., audio back-channeling, average turn duration, and tempo variation).

Nonverbal social sensing is based on two steps. First, the social interaction behavior is sensed and recorded in an unobtrusive way, via the ubiquitous sensing platform. Second, the nonverbal behavior is extracted based on the recordings with computational models and algorithms (Gatica-Perez, Guillaume, Odobez, & McCowan, 2007; Vinciarelli, Pantic, Bourlard, & Pentland, 2008). Once those models and algorithms are stable and accurate, the nonverbal cue extraction becomes automated.

Unobtrusive sensing. Due to the non-invasive nature of ubiquitous computing, there is no interference of the recording with the social interaction and the sensing devices do not restrict the social interaction partners in any way during the conversation. Especially when studying nonverbal behavior, the unobtrusiveness of the sensing and recording device is important. As an example, if a researcher is interested in measuring gesturing and the social interaction partners are equipped with body-worn sensors, this can impede spontaneous gesturing because the placement of the sensors might make certain movements harder to do, or because the sensors feel heavy, or because the person wearing the sensors is conscious about the fact that his/her gesturing behavior is surveyed.

An example of a stationary social sensing platform, a smart room, can be seen in *Figure 1*. This is the nonverbal social sensing platform with which we have recorded the data presented in this article. The platform is set up to record two interaction partners (in our case, the job applicant and the recruiter) with two HD cameras and a microphone array

(i.e., “microcone”) recording the interaction partners’ voices separately (i.e., direct speaker segmentation). The “microcone” (<http://www.dev-audio.com/products/microcone/>) consists of a microphone array able to register up to six people at the same time and each person is recognized individually and his/her speech registered separately from the others. This so-called direct speaker segmentation is a key advantage for the automated extraction of the vocal nonverbal cues. The cues are directly available for each interaction partner separately while at the same time they remain synchronized among the different interaction partners to, for instance, easily extract interruptions or other turn taking behavior. When putting one microphone in the room to register different interaction partners, the speaker segmentation has to be conducted as an additional step (Lathoud & McCowan, 2003). When clipping an individual microphone on each interaction partner, the synchronization of the different recordings need an additional step in order to be able to extract turn taking behavior. Moreover, individual microphones clipped to the social interaction partners make the behavioral observation salient and less unobtrusive. Using ubiquitous computing like in the form of the “microcone” makes it possible to take the sensors, the microphones, off the individual interaction partners and put them in the environment to make the room smart.

Our nonverbal social sensing platform has been created to sense and register nonverbal communication behavior in dyadic interactions between two social interaction partners that sit at a table facing each other. This is a common setting in the real world (e.g., job interview, physician-patient communication). It goes without saying that there are challenges inherent in using a smart room like ours for nonverbal social sensing. The smart-room environment needs to fulfill certain criteria in terms of camera resolution, lighting conditions, and camera angles for the accurate automated extraction of nonverbal cues. For

camera resolution we used 1280x960 cameras, which allowed the recording of detailed images; however, lower resolution (e.g. 640x480) video cameras can also be used as some automated visual nonverbal cue extraction method do not require very high video resolution. The lighting conditions of the room are critical for the proper recording of interactions and can be overcome by using blinds or curtains in front of the windows (to prevent reflections and ensure constant lighting conditions) and using artificial lighting. In terms of camera angles, the devices should be placed in a manner such that the views are quasi-frontal, while avoiding attracting the participants' attention; pilot-studies are necessary to fine-tune the sensor setting. The sensing platform also has requirement in terms of storage. Typically, a 10-minute interaction requires 2GB of storage while recorded at full resolution. This relatively large data size can be reduced by adjusting the resolution of the video cameras. Furthermore, with the dramatic increase of storage capabilities, the dataset storage size becomes less and less a problem.

Automated extraction. The automated extraction of the sensed and recorded interaction behavior requires the development of algorithms and machine learning technologies by computer scientists. They train computers to extract the nonverbal cues from the sensed and recorded data. The automated extraction of nonverbal cues circumvents the hand coding by humans and offers therefore a tremendous advantage for nonverbal behavior researchers. Once the algorithms are in place and validated, the coding can be done in an automated way by computers. This means that the researcher can investigate nonverbal behavior in social interactions with many social interaction partners present at the same time and over long recording periods. Because the coding is automated, the amount of data processed does not make a difference any more.

In the domain of nonverbal cue extraction, some of these automated methods have been demonstrated to be accurate and have the advantage of being publicly available, such as voice energy, pitch, and speaking rate (Basu, 2002), visual motion (Biel, Aran, & Gatica-Perez, 2011), or head pose extraction (Ba & Odobez, 2011). Other cues can be directly extracted from the recorded data of specific ubiquitous sensing devices such as, for instance the “microcone”, for which pauses, total speaking time, or interruptions can easily be extracted. Some nonverbal cues are more challenging to extract from videotaped material. Cues like arm (Marcos-Ramiro, Pizarro-Perez, Marron-Romera, Nguyen, & Gatica-Perez, 2013) and head gestures (Nguyen, Odobez, & Gatica-Perez, 2012), or gaze direction (Funes & Odobez, 2012) are still subject of ongoing perceptual computing research with promising preliminary results.

It has to be noted that the ubiquitous sensing and the automated extraction processes go hand in hand. This means that the algorithms developed based on a specific social sensing platform work best for data that has been collected in this environment. As an example, if the recording angle changes, the algorithm that has learned to detect gazing from videos showing the social interaction partners at a specific angle, will not work as well or not at all. If the algorithm has learned to accurately detect gazing when social interaction partners have been filmed front view, the same algorithm will not be able to detect gaze if the social interaction partner is filmed profile view.

At least for the extraction of visual cues such as nodding, stationary social sensing platforms are an advantage because the sensing devices remain at the same place. It becomes, however, also clear that there are some constraints on the social interaction partners necessary to optimize automated nonverbal cue extraction. In the case of our smart

room, social interaction partners need to sit at a table facing each other. Given that such a scenario is very common in our everyday lives (e.g., job interview), the constraints become minor.

We have argued that using nonverbal social sensing brings about two distinct advantages for nonverbal behavior researchers. First, the unobtrusiveness of the recording of the social interaction makes it possible to obtain nonverbal behavior information as it occurs in social interactions without in any way interfering or disrupting the interaction. Second, the automated extraction of the nonverbal cues makes it possible to study the nonverbal behavior of many social interaction partners over long periods of time without this necessitating costly and time consuming human coders. In principle, once the nonverbal social sensing is in place, the researcher has the nonverbal behavior data of each of the social interaction partners at hand right away.

Nonverbal Social Sensing in Action

We used nonverbal social sensing to investigate how nonverbal job applicant behavior is related to the recruiter's hiring decision. Research shows that nonverbal behavior of an applicant during the job interview indeed influences the hiring decision of the recruiter. For instance, applicants who use a high amount of eye contact, smiling, body orientation toward the interviewer, and less interpersonal distance are perceived as being more hireable, more competent, more motivated, and more successful than applicants who do not express such immediacy behavior (Imada & Hakel, 1977). Applicants with extended eye contact, a loud and modulated voice, fluent speech, and an expressive face (expression of affects) during the job interview were more likely invited for a second job interview than applicants who did not show these behaviors (McGovern & Tinsley, 1978). Forbes and Jackson (1980)

showed that employed applicants looked more at the recruiter, smiled more, and nodded more during the job interview than applicants who were not employed after the job interview. Also, Anderson and Shackleton (1990) report that selected applicants showed more gazing and more facial expressiveness than rejected applicants. In sum, research shows that the more an applicant shows immediacy behavior the better his or her chances of being hired. The immediacy behavior hypothesis claims that immediacy nonverbal behavior of the target (e.g., applicant) is perceived as closeness and involvement in the interaction (Mehrabian, 1972), which in turn is perceived by the observer (e.g., recruiter) in a positive way affecting his or her evaluation of the target. We investigate whether similar results can be achieved with unobtrusive sensing and automated extraction of the applicant's nonverbal behavior during a job interview.

Some of the research on job applicant nonverbal behavior and hiring decision relies on the investigation of single cues (does more smiling increase the likelihood of being hired?) (Anderson & Shackleton, 1990; Forbes & Jackson, 1980) and other research has looked at a behavioral composite, typically lumping together many different cues and investigating their joint effect on the hiring decision (does more smiling, more gazing, and more nodding increase the chances of being hired?) (Imada & Hakel, 1977; McGovern & Tinsley, 1978). What is not clear is whether different cues together, how many of them, and which combination of those cues best predict hiring success. This is the reason why we investigated which *combination* of applicant nonverbal cues predicts the hiring decision best. For instance, is it more the applicant's gazing in combination with other visual nonverbal cues such as smiling and nodding, or is it the applicant's gazing in combination with vocal nonverbal cues, such as audio back-channeling (e.g., "mmhh", "yes"), average

turn duration (i.e., average length of turns), and tempo variation (i.e., the extent to which the applicant varies in his or her speech tempo) that predict hiring decision?

To decide which nonverbal behaviors to extract and focus on, we selected applicant nonverbal immediacy cues shown in previous research as being related to the hiring decision (e.g., Anderson & Shackleton, 1990; Forbes & Jackson, 1980; Hollandsworth, Kazelskis, Stevens, & Dressel, 1979; Imada & Hakel, 1977; McGovern & Tinsley, 1978). For the visual nonverbal behavior we selected three cues being indicative of immediacy behavior: smiling, gazing, and visual back-channeling (i.e. nodding while listening to the interaction partner). For applicant vocal nonverbal behavior, we selected the following three immediacy cues: audio back-channeling (i.e., short utterances like “mmhh”, “ah”, or “yes” while listening to the recruiter), average turn duration (as an indicator of speech fluency, Fillmore, 1979), and tempo variation. So far, tempo variation has been neglected in the nonverbal immediacy behavior research. However, it has been clearly defined by Guerrero (2005) as being an important indicator of immediacy, as have been the other above mentioned visual and vocal nonverbal cues. Thus, we expect applicant tempo variation to be positively related to hiring decision.

In sum, the research questions we pursue in the present work are: (a) Can applicant visual and vocal nonverbal immediacy behaviors validly be obtained via nonverbal social sensing? (b) Are the so obtained applicant nonverbal behaviors linked to better hireability judgments of recruiters? (c) Which combination of the applicant’s nonverbal behaviors best predicts hiring? By answering these research questions we can demonstrate the validity of the nonverbal social sensing approach in two ways: First, by showing the validity of the automated extraction process when compared to hand coding by humans, and second, by

replicating findings established in the literature when using the cues that have been extracted by nonverbal social sensing. We hope to provide evidence showing that nonverbal social sensing is a powerful tool that can be used by nonverbal behavior researchers.

Method

Participants

Sixty-two participants (45 female and 17 male) with a mean age of 24 years (one missing; range from 19 to 40 years) applied for a sales job. Participants were Bachelor and Master students majoring in different domains (90%), PhD students (4.8%), and employed (3.2%; one missing). We posted a job advertisement at different places, such as online forums and information boards at different universities.

Procedure

The job advertisement said that we are looking for research assistants who help us recruit community people on the street as participants for studies conducted at the local university. The advertisement specified the competences required for the job (communication and persuasion skills, extraversion, and agreeableness). We also included the exact application procedure and the e-mail address of the first author, so that participants could get in contact. People interested in the job were invited for an assessment including a structured job interview.

Participants coming to our lab were welcomed by the recruiter (first author) and given an informed consent form to sign. Participants gave their written consent to being video and audio taped during the job interview in order to use this data for scientific purposes. They underwent a structured job interview (average interview duration: 11 min). The job

interview contained introductory questions (e.g., “could you say a few words about yourself?”, “what is your motivation to apply for this job?”) and behaviorally based questions (e.g., Campion, Cheraskin, & Stevens, 1994; Janz, 1982; Motowidlo et al., 1992) concerning the competences required (e.g., for communication skills: “Could you tell me about a situation in which you succeeded in communicating in a clear and well-structured way?” and for persuasion: “Could you tell me about a situation in which you succeeded in persuading another person of something?”). As a last question of the interview, applicants were asked to tell the recruiter about their strengths and weaknesses. At the end of the interview, participants were informed that they would be hired for the job. All applicants received the same information without them knowing that we told everybody that he/she was hired. Based on the video and audio recordings, we extracted and coded the applicants’ nonverbal behavior and we had professional recruiters watching the videotapes (with sound) and provide us with a hiring decision for each applicant.

Material and Measures

Hiring decision. We contacted professional recruiters via e-mail asking them to evaluate the videotapes showing applicants during the job interview. Recruiters were offered a salary of an equivalent of 100\$/hour. Five recruiters (2 male, 3 female, mean age: 26 years, $SD = 7.67$, mean experience: 5.7 years) agreed to do the evaluation. All applicants were evaluated by three recruiters (see inter-rater correlation below). That is, one recruiter evaluated all applicants and four recruiters each viewed half of the job interviews. We provided recruiters with a detailed job description. Recruiters evaluated applicants with respect to hireability on a scale from 0% to 100% (“to what extent would you think that this

applicant should be hired for the job”), $M = 59.73$, $SD = 19.15$, $ICC[1] = .50$, $ICC[2] = .75$, $F = 4.45$, $p < .05$.

Applicant nonverbal behavior. Our smart room (*Figure 1*) is equipped with two high definition cameras recording video at 26.6 frames per second and a commercial microphone array device (“microcone”). The “microcone” (<http://www.dev-audio.com/products/microcone/>) is a microphone array that registers up to six people at the same time. The software coming with this device provides automatic speaker segmentation based on spatial discrimination. The resulting segmentations are stored in a file containing the identifier (recruiter or job applicant) and the relative time in seconds (starting and ending time of the speaking segment). We used the segmentation files to extract on the one hand the vocal audio signals for each interaction partner (i.e., the applicant’s tempo variation) and on the other hand the speaking turn-based nonverbal cues: the average time of applicant’s turns and the number of short utterances like “mmhh”, “ah”, or “yes” while listening to the recruiter as (audio back-channeling). The three vocal nonverbal cues were thus obtained by automated extraction. For the visual nonverbal cues, we gained applicant visual back-channeling via automated extraction (described in more detail below) while we hand coded gaze and smiling. The work on automated extraction of gaze and smiling is still in progress which is why the applicant’s smiling and gazing behavior were coded manually.

Applicant audio back-channeling. Applicant audio back-channeling was defined as events when the applicant produces a short utterance (such as “mmhh” or “yes”) while the recruiter is speaking. Concretely, short utterances were defined as speaking segments of duration shorter than 1 s, and we recorded the number of such events. This number was then normalized by the job interview duration, $M = 6.95$, $SD = 5.86$.

We had two human raters do hand coding of the applicant's audio back-channeling ("count the number of times an applicant says "yes" or "mmhh" or another short – shorter than 1 s – vocalization of approval or agreement while the applicant is listening to the recruiter") based on the videotapes for 20 job applicants. Inter-rater reliability of the two coders was $r = .94$. We averaged the raters' codings.

Applicant average turn duration. The average time of speaking turns of the applicant was assessed using the speaking segmentations. We aggregated the total speaking time, and divided this number by the total number of speaking turns (without taking into account the utterances shorter than 1 s), $M = 30.77$, $SD = 13.94$.

The computation of the average turn duration relies on the speaker segmentations (when is the applicant speaking). Speaking turns are characterized by their starting and ending time and are assessed based on two pre-defined conditions. First, short utterances (speaking turns shorter than 1 s) are discarded. Second, if the non-speaking segment between two turns is shorter than 1 s, the two turns are merged, being considered as one turn. In contrast, the turns are considered as two separate turns, when the non-speaking segment between the turns is longer than 1 s. Given this highly technical assessment, we assume the average turn duration to be a technical rather than a psychological measure. The assessment of the average turn duration is based therefore solely on the automated extraction. Notwithstanding that average turn duration can affect observer judgments without observers being able to explicitly extract such a "technical" cue. It can affect judgment on an implicit level, maybe in combination with other cues.

The average time of speaking is defined as being part of speech fluency. A person who talks fluently succeeds in talking at length (Fillmore, 1979). In other words, the longer the average time of the speaker's turn is, the more he or she talks fluently.

Applicant tempo variation. To assess the applicant's tempo variation, we used a hidden Markov model (HMM) and Mel-frequency cepstrum coefficients (MFCC), using the method presented in Basu (2002). To detect the voice segments we used open-source matlab code provided by the MIT Media Lab (<http://groupmedia.media.mit.edu/data.php>). The tempo (or speaking rate) was defined as the number of voiced segments (i.e. vowels) per second. We computed the standard deviation of the number of vowels per second across the speaking time, $M = 1.25$, $SD = 0.09$.

Research shows that the just noticeable difference in speaking rate is 5% deviated from the baseline (Quené, 2007). Given this, we assume this nonverbal cue to be a technical rather than a psychological measure. This is why the assessment of this nonverbal cue was based solely on the automated extraction.

Applicant visual back-channeling. Applicant visual back-channeling was defined as an applicant's head nod while the recruiter was speaking. We used the method presented in Nguyen, Odobez, and Gatica-Perez (2012) to automatically detect head nods from the videos, providing the relative timings of nodding events (starting and ending time). This method starts by tracking the location the applicant's face and estimates the visual motion in the face region. The horizontal and vertical visual motions are then analyzed in terms of their frequency, using a windowed Fourier transform, and the binary decision between a nod and a non-nod is performed using a standard machine learning model. As head gesture dynamics are conditioned by the speaking status of the person under analysis, we used two

support vector machine classifiers (one for speaking and one for silent, provided by the “microcone” segmentations) to improve the accuracy of the detection. The objective evaluation of the nodding extraction method was presented in Nguyen, Odobez, and Gatica-Perez (2012) where the F1-score (harmonic mean between precision and recall) was 63% at the frame level. Even if the method is not 100% percent accurate, the detection is satisfactory for detecting most head nods (even subtle ones), while keeping the number of false detections low. Moreover, as the detected nods are aggregated over the whole job interview, the errors tend to cancel out. The nodding extraction method is completely repeatable, meaning that if a same video is processed several times the detected nods will always be the same at each run. The head nod detection outputs the number of nodding events. The number of head nods was normalized by the job interview duration, $M = 21.37$, $SD = 14.15$.

We had two human raters do hand coding of the applicant’s nodding while listening (visual back-channeling: count the number of times an applicant nods while the applicant is listening to the recruiter) based on the videotapes for 20 job applicants. Inter-rater reliability of the two coders was $r = .90$. We averaged the raters’ codings.

Applicant smiling. A trained rater coded the degree to which an applicant smiled during the job interview as a general impression every minute of the job interview on a scale from 1 (*not at all*) to 5 (*very much*). Applicant’s smiling was defined as the edges of the lips moving upwards compared to the person’s baseline lip expression. Raters viewed a couple of min of the applicant in the job interview to get an idea about that particular applicant’s baseline lip expression. The general impression score was computed based on the average

across all 1-min thin slices, $M = 2.51$, $SD = 0.90$. A second rater coded five applicants to obtain an inter-rater reliability measure ($r = .95$).

Applicant gazing. Gazing was defined and coded as the applicant looking at the recruiter. The duration of applicant gazing was divided by the job interview duration to obtain the applicant gazing measure, $M = 0.51$, $SD = 0.14$. A second rater coded five applicants to obtain an inter-rater reliability measure ($r = .95$).

Results

To know whether the applicant's visual and audio back-channeling can be obtained validly via nonverbal social sensing, we compared this nonverbal behavioral data retrieved from the automated extraction with the manual coding conducted on a subsample of 20 job interviews. Automatically extracted visual back-channeling and audio back-channeling correlate significantly with the manual coding of these nonverbal cues, $r = .88$ for visual back-channeling, $r = .78$ for audio back-channeling, respectively.

To test whether the job applicant's nonverbal behavior during the job interview is linked to better hireability judgments of recruiters, we conducted a multiple regression analysis in which we regressed hiring decision on the applicant's nonverbal behavior (i.e., visual nonverbal behavior: smiling, gazing, visual back-channeling and vocal nonverbal behavior: audio back-channeling, average turn duration, and tempo variation), controlled for applicant gender and age.

The regression model was significant, showing that applicant nonverbal behavior significantly predicts hiring decision (Table 1). Job applicants were more likely to be hired when *gazing more* at the recruiter, having *longer average speaking time turns*, and when *varying their tempo more* during the job interview. When calculating separate regression

models for vocal and visual nonverbal cues, results show that both regression models are significant meaning that visual cues alone (Table 2) and vocal cues alone (Table 3) both predict hiring decision significantly.

To investigate which combination of the applicant nonverbal behavior cues best predicts hiring, we performed a sequential forward search (SFS) (Pudil, Novovicova, & Kittler, 1994) on the six selected cues, which is a standard feature selection technique in machine learning to find the best combination of cues with respect to a merit function (i.e., the function we want to maximize). To this end, we used the R-square value as the merit function in a multiple linear regression framework. SFS searches the feature space (in this case, we have six nonverbal cues, therefore it is a six-dimensional space) for the best combination of features using a greedy approach which a) starts by selecting the best (with respect to the merit function) feature alone b) then tries all combinations between the selected feature and the remaining ones and adds the best one to the selected set. The process is repeated until the maximum number of features (a parameter set by the user) is reached or until the merit function decreases. In the present study, the maximum number of features allowed was set to 6, meaning that if necessary, all features could be used to predict the hiring decision, if that would increase the merit function.

With this method, the best combination of cues is the *average turn duration* combined with the *tempo variation*, and *gazing*, yielding a R^2 of .38. Taken individually, the *average turn duration* is the most predictive nonverbal cue ($R^2 = .16$), followed by *gazing* ($R^2 = .11$) and *tempo variation* ($R^2 = .02$). Adding more nonverbal cues decreases the prediction performance.

Discussion

The aim of the current article was to introduce nonverbal social sensing as a powerful research tool for nonverbal behavior researchers. We tested whether applicant visual and vocal nonverbal immediacy cues obtained via nonverbal social sensing are valid predictors of being hired. We also asked which combination of the applicant nonverbal behaviors best predicts hiring.

We validated the nonverbal social sensing method by correlating some of the automatically extracted nonverbal behavior data with nonverbal behavior data coming from human coders. Results indicate that social sensing for the applicant's visual and audio back-channeling is highly valid, which is promising news. In other words, nonverbal social sensing extracting the applicant's visual and audio back-channeling can therefore be used to replace human coders in the future, which in turn lowers costs and time investment. Moreover, the present study shows that the applicant's average turn duration and tempo variation predicts recruiter hiring decision. In other words, the applicant's average turn duration, an indicator of speech fluency (Fillmore, 1979), can be seen as being validly extracted to the extent that it replicates previous research, which coded speech fluency manually (Hollandsworth, et al., 1979). In terms of the applicant's tempo variation, research has not yet investigated how it is related to hiring decision. However, because Guerrero (2005) claims that tempo variation is an indicator of immediacy nonverbal behavior, which in turn is known to predict hiring decision, our results show first evidence confirming Guerrero's argument based upon one might consider tempo variation as being validly extracted.

With a study in the field of work and organizational psychology we showed that automatically extracted applicant nonverbal immediacy behavior predicts outcomes such as

hiring decision. Results indicate that applicant nonverbal behavior during the job interview significantly affects the hiring decision such that applicants who had longer average turn duration, varied their speech tempo more during the job interview, and gazed longer at the recruiter, were more likely to be hired than applicants using those nonverbal cues to a lesser extent. These findings confirm previous research and with that the immediacy hypothesis (Mehrabian, 1972), stating that the more the applicant shows immediacy nonverbal behavior the more likely the applicant is hired. The novelty of these results lies in the fact that the computational nonverbal behavior analysis leads to similar results compared to previous research based on manually coded nonverbal behavior (Anderson & Shackleton, 1990; Forbes & Jackson, 1980; Imada & Hakel, 1977; McGovern & Tinsley, 1978). This adds evidence to the validity of the nonverbal social sensing method.

Moreover, we were interested in a rather novel research question in the field of nonverbal communication: Which *combination* of the applicant's nonverbal behavior cues *best* predicts the hiring decision. In other words, how many and which applicant nonverbal behaviors best predict the recruiter's hiring decision? Results reveal that the combination of the applicant's average turn duration, his or her increased tempo variation, and maintenance of eye contact best predict hiring decision. Among the three cues, applicant average turn duration is the more predictive one.

Fillmore (1979) defined speech fluency among other things as talking at length with making few pauses. Research shows that speech fluency has a remarkable impact on persuasion and related constructs in sales. For instance, Burgoon, Birk, and Pfau (1990) found that speech fluency is the strongest predictor for perceived competence and credibility and it is one of the strongest predictors for persuasiveness. Moreover, speech

fluency is associated with trustworthiness, dynamism, and attitude change in the context of sales (Leathers, 1992; Leigh & Summers, 2002). Leigh and Summers (2002) argue that through speech fluency, assertiveness, and control is communicated (Burgoon, 1994; Wardhaugh, 1985) and thus, a higher likelihood of persuading the client is achieved.

In terms of tempo variation, Woolbert (1920) showed that the higher the tempo variation, the higher the audience retention is. Moreover, Knapp and Hall (2010) argue that the higher the variability in speech tempo, the better the message delivery, compared to speakers holding the speech tempo constant. Maintaining eye contact with the social interaction partner results in perceiving the communicator as more sincere, honest, competent, credible, self-confident, dominant, and likeable (Kleinke, 1986). Moreover, sales people's gazing at the client has shown to predict how they are perceived in terms of warmth and trustworthiness, which are two key aspects in sales (Leigh et al., 2002; Wood, 2006). Thus, in the present study, we suspect that the recruiters inferred high persuasiveness, credibility, and a high ability to deliver information efficiently and recognized these as important aspects for the job which is why they recommended hiring those applicants. The job for which the applicants were recruited was a job necessitating those competencies (convince people on the street to participate in studies at the local university). Alternatively, the recruiters might themselves have been persuaded to hire the applicants by the applicant's immediacy behavior without necessarily thinking about the job competencies.

Although the literature shows that immediacy behavior of the applicant is a plus for applicant evaluation for many different jobs, the here reported results might differ for different types of jobs. For jobs requiring less social interaction, the nonverbal behavior of

the job applicant might influence the hiring decision less because research shows that nonverbal behavior of the job holder is important, especially for jobs with extended client contact (Leigh & Summers, 2002; Peterson, 2005; Taute, Heiser, & McArthur, 2011; Wood, 2006). In the present study, applicants applied for a job similar to sales. Thus, for evaluators, the ability to speak fluently and to vary in tempo variation to keep the attention of potential clients while talking to them seems an important factor as detailed above. However, as job profiles differ across domains the applicant's nonverbal behavior profile related to better chances of being hired might also differ. Depending on the type of job applicants are applying for, different nonverbal cues and different combinations of nonverbal behaviors might predict hiring decision.

We always used the same trained recruiter who interviewed all applicants and behaved in a standardized way. It is therefore unlikely that the applicant's behavior was just an expression of the recruiter's behavior (i.e., mimicking the recruiter's immediacy behavior; Tiedens & Fragale, 2003). In order to rule out this possibility, we also coded some of the same vocal and visual behaviors of the recruiter and for each of the behaviors we correlated the recruiter's with the applicant's behavior. Correlations were small and non-significant (ranging from $r = -.14$ to $r = .16$, all p 's $> .20$). Although we cannot completely rule out that some of the applicant's behavior was a reaction to the recruiter's behavior, the non-existence of mimicry with respect to the behaviors we tested, provides some support for the claim that the behavior we measured in the applicant originates in the applicant.

We showed that nonverbal social sensing worked: we validated some of the automated cue extraction with hand coding and we validated the entire method with replicating research findings in the literature. Moreover, we also foreshadow that the collaboration

with computer scientist can open up new and promising future avenues of research when testing which cue combinations best predict hiring. Nonverbal social sensing can be the basis of further interesting analyses: the extraction of nonverbal composites. Much research on nonverbal behavior relies on single nonverbal cues. However, nonverbal composites – a specific combination of cues – might be a more promising indicator of interaction outcomes. As an example, one of the strongest and most stable predictors of dominance and status in a dyadic interaction is visual dominance. The Visual Dominance Ratio (VDR) (Dovidio, Brown, Heltman, Ellyson, & Keating, 1988) is defined as the percentage of gazing at an interaction partner while speaking divided by the percentage of gazing while listening. A human coder cannot code this indicator in one coding because there are too many cues to pay attention to. So several rounds of coding are necessary. With nonverbal social sensing, the coding of behavioral composites becomes easy. The same is true for the question that we pursued in the current paper, namely which combination of nonverbal cues best predicts an outcome.

We have focused on a stationary ubiquitous computing platform in the current paper. Ubiquitous mobile social sensing (with smartphones) is another interesting research avenue for nonverbal social sensing. While the extraction of visual cues in ubiquitous mobile sensing is difficult, the vocal nonverbal cues can be sensed and extracted with relative ease. As an example, we have developed a program that infers felt stress by the smartphone user based on nonverbal social sensing of the user (Lu et al., 2012).

The setup of the stationary nonverbal social sensing platform we used requires costs, time, and knowledge to deal with different factors, such as light conditions (i.e., artificial light vs. day light), possible reflections coming from the window, resolution of the cameras,

and high capacity of the computer so that registering the video while recording is enabled. Moreover, the distance of the cameras to the person being registered and the camera angles are important because the registered person has to appear in the picture frame all the time with no body parts cut-off when moving too extensively. Once the sensing platform is in place, it can be used repeatedly, of course. Note that algorithms are mostly calibrated to the sensing devices. Only few algorithms are commercially available, such as the “microcone” which is a more consumer-oriented device in our setting. This device has a standard way of use and can therefore be easily installed and used.

Nonverbal social sensing is not only an interesting research tool. It can also be interesting for practitioners, for instance, in the realm of personnel selection as we have shown with our data. If the computer can approximate the hiring decision of the recruiter, maybe the recruiter can be assisted in his or her decision by nonverbal social sensing. Given that research shows that recruiters often are biased in their decision making by applicant characteristics that are not central to the job at hand (e.g., gender, appearance, stereotypes) (e.g., Anderson, 1992; Barrick, Shaffer, & DeGrassi, 2009), automated nonverbal sensing has the potential to help overcome such biases.

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Figure Captions

Figure 1. The stationary indoor sensing platform with two high definition cameras, two Kinect sensors, and the microphone array (“microcone”).

Table 1

Multiple Regression Analyses with Applicant Nonverbal Behavior Predicting Hiring Decision (Controlled for Applicant Gender and Age)

Applicant variable	B (SE B)	β
Gender	-3.37 (5.41)	-.08
Age	-0.78 (0.56)	-.15
Smiling	-1.93 (2.51)	-.09
Gazing	56.08 (16.00)	.40**
Visual back-channeling	0.05 (0.16)	.03
Audio back-channeling	-0.09 (0.39)	-.03
Average turn duration	0.66 (0.14)	.48***
Tempo variation	61.79 (23.67)	.28*

Note. $R^2 = .53$ ($p < .0001$); * $p < .05$, ** $p \leq .001$, *** $p < .0001$.

Table 2

Multiple Regression Analyses with Applicant Visual Nonverbal Behavior Predicting Hiring Decision (Controlled for Applicant Gender and Age)

Applicant variable	B (SE B)	β
Gender	-10.08 (5.95)	-.24+
Age	-0.60 (0.62)	-.12
Smiling	-4.32 (3.00)	-.20
Gazing	65.05 (18.01)	.46*
Visual back-channeling	0.08 (0.18)	.06

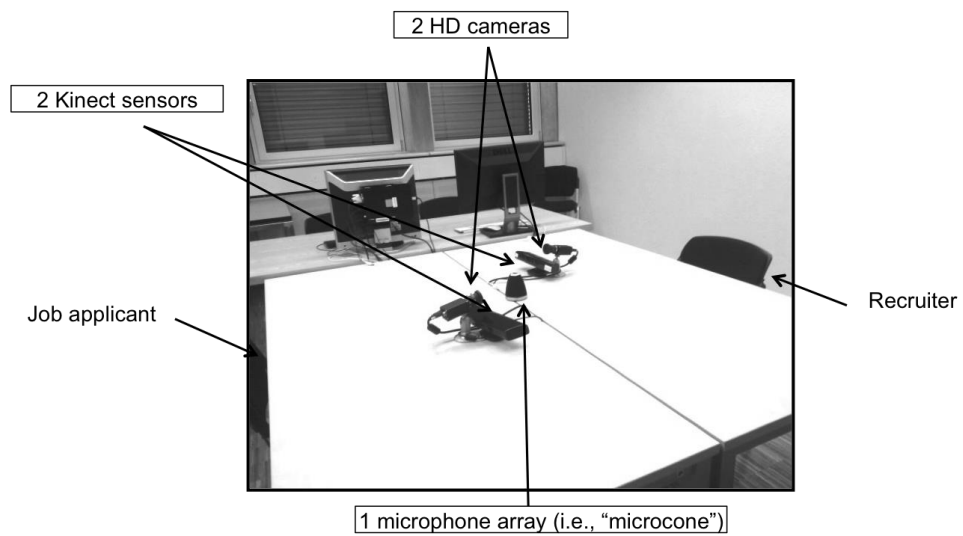
Note. $R^2 = .27$ ($p = .003$); + $p < .10$, * $p \leq .001$.

Table 3

Multiple Regression Analyses with Applicant Vocal Nonverbal Behavior Predicting Hiring Decision (Controlled for Applicant Gender and Age)

Applicant variable	B (SE B)	β
Gender	-5.16 (4.72)	-.12
Age	-0.92 (0.58)	-.18
Audio back-channeling	0.46 (0.36)	.14
Average turn duration	0.74 (0.15)	.54**
Tempo variation	57.82 (25.45)	.26*

Note. $R^2 = .41$ ($p < .0001$); * $p < .05$ ** $p < .0001$.



D. Article 3

Predicting Job Performance Based on Automatically Sensed and Extracted Applicant
Nonverbal Interview Behavior

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Abstract

Purpose - The goal of the present study was to test whether applicant nonverbal behavior during the job interview predicts actual job performance. Moreover, we were interested whether the applicant's nonverbal behavior predicts job performance above and beyond traditionally used applicant self-reports, test scores, and recruiter evaluation.

Design/Methodology/Approach - Job applicants ($N = 54$) were audio- and videotaped during the job interview and unbeknownst to them we hired all applicants for a sales-like job. We then measured their job performance objectively, for the job for which they were hired. The applicants' nonverbal behavior was automatically sensed via a ubiquitous computing platform and the nonverbal cues were automatically extracted via the development of specific algorithms. This is what we call nonverbal social sensing.

Findings - Applicant vocal nonverbal behavior, but not visual nonverbal behavior, significantly predicted later job performance; above and beyond applicant self-reports, test scores, and recruiter evaluation.

Implications - Showing that an applicant nonverbal interview behavior-job performance link exist, this information can be used for the selection of new applicants for the same job.

Originality/value – This is one of the first studies to investigate the link between the applicant's nonverbal behavior shown during the job interview and objectively measured job performance. Moreover, we use a novel and innovative method to automatically sense and extract the applicant's nonverbal behavior (i.e., nonverbal social sensing), which provides an objective and therefore unbiased assessment of the applicant's behavior during the job interview.

Keywords: Job performance, applicant nonverbal behavior, self-report, general mental ability score, hiring decision, job interview, social sensing, sales

Predicting Job Performance Based on Automatically Sensed and Extracted Applicant Nonverbal Interview Behavior

Applicant nonverbal behavior during a job interview affects the recruiter's hiring decisions and research shows that especially applicant nonverbal immediacy behavior such as smiling, gazing, and nodding, to name just a few, leads to more favorable job interview outcomes (e.g., Anderson & Shackleton, 1990; Forbes & Jackson, 1980; Imada & Hakel, 1977; McGovern & Tinsley, 1978). Research also shows that the job holder's nonverbal behavior is linked to job performance and nonverbal behavior seems especially important for performance in jobs with extended contact with clients (Leigh & Summers, 2002; Peterson, 2005; Taute, Heiser, & McArthur, 2011; Wood, 2006). So, if nonverbal behavior of the job-holder is important for job success, maybe the nonverbal behavior an applicant shows in a job interview already contains valuable information about the applicant's future job performance. The goal of the present article is to show that job performance can be predicted by how the applicant behaves nonverbally in a job interview and that the applicant's nonverbal job interview behavior explains later job performance above and beyond self-reports (i.e., self-reported extraversion, agreeableness, and persuasion skills), test scores (i.e., general mental ability), and recruiter evaluation.

Focusing on Nonverbal Behavior in Applicant Selection

The assessment of applicants' competencies is typically conducted via self-report measures (e.g., personality questionnaires), behavioral observation during a simulation task (e.g., work sample), or during the job interview (Arthur, Woehr, & Graziano, 2001; Burroughs & White, 1996). A disadvantage of the self-report method is that it is potentially biased by social desirability and impression management strategies (Edwards, 1957;

Stevens & Kristof, 1995). To remedy this problem, many selection procedures involve behavioral observation of job applicants in simulation situations (Doverspike & Arthur, 2012). Using behavioral observation eliminates most of the biases inherent in self-report measures. Behavioral observation encompasses verbal and nonverbal behavior. In terms of applicant behavior, the focus was for a long time on the applicant's verbal behavior (Motowidlo et al., 1992). However, there is evidence that the applicant's *nonverbal* behavior is also important in the selection process (e.g., Anderson & Shackleton, 1990; Forbes & Jackson, 1980; Krumhuber, Manstead, Cosker, Marshall, & Rosin, 2009).

Nonverbal behavior means any behavior other than speech content. Typically, nonverbal behavior related to speech production is called *vocal* nonverbal behavior (e.g., speaking time, audio back-channel) whereas nonverbal behavior unrelated to speech production is called *visual* nonverbal behavior (e.g., gazing, smiling, nodding) (Knapp & Hall, 2010). Nonverbal behavior is more difficult to consciously control than verbal behavior (Ambady & Rosenthal, 1992) and is therefore also more difficult to fake (DePaulo, 1992), especially in a socially stressful situation as is the job interview. Although, deliberately manipulating one's nonverbal behavior during a job interview (e.g., by appearing warm and friendly) is an impression management strategy used by applicants (Stevens & Kristof, 1995), it is still less under conscious control than verbal behavior on which most of the impression management strategies (e.g., self-promotion, ingratiation) relay.

So far, it has been shown that a composite of applicant vocal nonverbal cues (i.e., pitch, pitch variability, speech rate, pauses, and amplitude variability) during the job interview (for a manager position) was positively related to supervisor job performance

ratings. Also, a composite of visual cues (i.e., physical attractiveness, smiling, gaze, hand movement, and body orientation) in an interview was positively related to supervisor performance ratings and to better interviewer judgments (Burnett & Motowidlo, 1998; DeGroot & Motowidlo, 1999; Motowidlo & Burnett, 1995). In all of these studies, job performance was measured *subjectively* being operationalized as supervisor ratings. Research has shown that applicant nonverbal immediacy behavior is positively related to recruiter assessed hiring potential. Superior ratings are very similar to recruiter assessments in that both are subjective ratings, most likely influenced by likability cues. In the present study, we are interested in whether applicant nonverbal behavior during the job interview also predicts *objectively* measured job performance. To the extent that the interaction qualities shown during a job interview are also important for the future job, applicant nonverbal behavior during the interview might be informative of later job performance. Nonverbal behavior during the job interview might be particularly predictive of later job performance in jobs that require face-to-face social interactions (e.g., with clients). Nonverbal behavior is an important component for sales jobs in which the employee typically has extended contact with clients (Leigh & Summers, 2002; Peterson, 2005; Taute et al., 2011; Wood, 2006).

Nonverbal Social Sensing in the Job Interview

Although the registration of nonverbal behavior is not a technical challenge anymore the extraction or the coding of the nonverbal behavior based on video and audio recordings still needs to be done manually by a human coder which makes it a time- and resource-intensive endeavor (Reis & Charles, 2000). The use of nonverbal social sensing alleviates this problem and makes nonverbal cue extraction comparatively easy.

Social sensing means automatically extracting verbal and nonverbal cues from people engaged in social interactions via (1) ubiquitous computing platforms for sensing and recording interaction behavior and (2) computational models and algorithms for extracting the behavioral cues (Gatica-Perez, Guillaume, Odobez, & McCowan, 2007). Ubiquitous computing means that the computer fits the human environment and does not require the user to enter the computer environment; the computer and its sensing devices are incorporated in everyday environments or things; the surroundings become “smart”. In the present research, we used ubiquitous computing in the form of an indoor social sensing platform equipped with two HD cameras, two Kinect sensors, and a microphone array (i.e., Microcone) (Figure 1). Nonverbal social sensing enables us to automatically sense and extract the applicant’s nonverbal behavior during the job interview without the applicant having to wear specific sensing devices. Moreover, nonverbal social sensing assesses the applicant’s nonverbal behavior in an objective and therefore unbiased way. The automated extraction is based on publically available algorithms (developed by computer scientists) for extracting vocal features (i.e., voice energy, pitch, speaking rate) or for visual motion and head pose extraction (Ba & Odobez, 2011; Basu, 2002; Biel, Aran, & Gatica-Perez, 2011).

The Present Study

In the present study, we used a job that is similar to a sales job because, as discussed above, nonverbal behavior might be particularly relevant for sales (Leigh & Summers, 2002; Peterson, 2005; Taute et al., 2011; Wood, 2006). This is why in the present study, the job holder needed to go out on the street in a city and recruit community people as participants for psychology studies. The job holder needed to go up and talk to strangers

and convince them to sign up their name and contact information so that they could be invited to participate in a one-hour study at the local university (no remuneration).

According to O*Net by Peterson and Sager (2010), the skills for “door-to-door sales workers, news and street vendors, and related workers” (<http://www.onetonline.org/link/summary/41-9091.00>) include *persuasion skills* (“persuading others to change their minds or behavior”). Moreover, to cover the interpersonal orientation and interest in the contact with other people (“being aware of others' reactions and understanding why they react as they do”, “actively looking for ways to help people”, “adjusting actions in relation to others' actions”, “bringing others together and trying to reconcile differences”, and “giving full attention to what other people are saying”) we included *agreeableness* and *extraversion* as competencies. We also included *general mental ability* because it has shown positive associations with different kinds of job performance measures for different job domains and qualification levels (Schmidt & Hunter, 1998). Thus, general mental ability is a rather job-unspecific indicator of job success in the sense that more intelligent people will do better on any given job.

In order to decide which nonverbal behaviors to focus on, we selected nonverbal behavior cues that connote immediacy behavior, indicative of conveying a positive impression. Immediacy behavior is behavior that facilitates social interaction by creating closeness and interactivity with others (Mehrabian, 1972). It is typically perceived as friendly and likeable (Mehrabian, 1981) and thus a prerequisite for being successful in approaching strangers, a skill needed in the sales-type job we investigated. We selected three *visual* nonverbal cues indicative of immediacy behavior: smiling, gazing, and visual back-channeling, defined as nodding while listening to the social interaction partner. For

vocal nonverbal behavior, we selected indicators of immediacy (e.g., audio back-channeling, meaning short utterances while the social interaction partner spoke, like “mhm” or “yes”, and speech fluency) (Guerrero, 2005) but also indicators of dominance such as speaking time (Schmid Mast, 2002).

This enables us to test which nonverbal behavior of the job applicant during the job interview predicts later job performance. To what extent the nonverbal behavior-job performance relations are specific to the kind of sales job our participants were confronted with or whether these links would generalize to other sales jobs is an empirical question. The goal of this research was not to provide a list of nonverbal behaviors that are indicative of job success for all jobs or all sales jobs, but to show that job applicant nonverbal behavior can be used as a predictor of future job success and to test whether it significantly adds predictive validity to the traditional self-report competencies measures, test scores, and recruiter assessment.

Method

Participants

Fifty-four participants (39 female and 15 male) from the French speaking part of Switzerland applied for the sales job with a mean age of 23 years (one missing; range from 19 to 40 years). Participants were mostly bachelor and master students of different study domains (91%), two PhD students, and two participants who were employed. To recruit participants we posted a job announcement on online forums and in different university buildings.

Procedure

In the job announcement we advertised a research assistant job that consisted of recruiting community people for participating in one of our studies. The job announcement said that we are looking for workers who are willing to invest 4 h for this job. We also included information about the job holder's competencies required for the job, the exact application procedure, and the e-mail address of the first author, so that participants could get in contact in case they were interested. Additionally, we included information about how much workers will be paid. The salary was high (between 120\$ and 200\$ for the 4 h) in order to attract both better and worse suited applicants for the job and therefore obtain a wide range of actual job performance. Interested people were invited for an assessment consisting of a structured job interview (video and audiotaped).

When participants came for the assessment, they were welcomed by the recruiter (first author) and signed an informed consent form. They were informed that besides being considered for the job position, they were participants in a study and gave their written consent. Participants then filled in different questionnaires (see in more detail below) and underwent a structured job interview with introduction questions (e.g., "Could you tell me a few words about yourself?", "What is your motivation to apply for this job?") and behaviorally based questions (Campion, Cheraskin, & Stevens, 1994; Janz, 1982; Motowidlo et al., 1992) based on the competences required for the job (e.g., "Could you tell me about a situation in which you succeeded in persuading another person of something?"). The average interview duration was 11 min. After the job interview, the recruiter informed the participant about the hiring decision. Unbeknownst to the participants, all applicants were hired, regardless of their performance during the job interview. This ensured a broader

spectrum of skills of our participants and therefore more variance in the job performance measure, avoiding a restriction of range issue.

Participants were informed that their job will be to go out on the street at a specific public square twice for 1 hour and go to different university buildings twice for 1 hour and to recruit as many people as possible for our research. They thus had to convince people to invest 1 hour of their time to come to the local university to participate in a study without being remunerated. We fixed the days and the hours of the day when participants had to recruit in order to create comparable conditions for all participants. Participants always recruited at the same place at the same time (1 hour in the morning and 1 hour in the afternoon). Participants were informed that they would be paid 120\$ for the 4 hours of work but that they could be paid up to 200\$ depending on how many passers-by they would recruit. Participants thus had to sell the purpose of psychological research to ordinary people on the street and to convince them to sign in their names so that we could contact them later. We provided sign-up sheets to the participants and recruited passers-by signed in their name and their e-mail address or telephone number. At the end of the study, participants were debriefed and thanked. Every participant was paid 200\$.

Material and Measures

Applicant competences. In order to assess the applicant's competences we used self-report questionnaires (for extraversion, agreeableness, and persuasion skills) and a standardized general mental ability test.

Applicant extraversion. We assessed applicant extraversion with the extraversion 12-item subscale of the NEO PI-R (Costa & McCrae, 1992). Sample items are: "I like to have a lot of people around me", "I laugh easily", and "I don't consider myself especially "light-

hearted” (reversed). Items were assessed on a scale from 1(*not at all*) to 5 (*very much*), Cronbach’s alpha = .72, $M = 4.01$, $SD = 0.48$.

Applicant agreeableness. Applicants filled in the 12-item agreeableness subscale of the NEO PI-R (Costa & McCrae, 1992). Sample items are: “I try to be courteous to everyone I meet”, “I often get into arguments with my family and co-workers” (reversed), and “I would rather cooperate with others than compete with them”. Items were measured on a scale from 1(*not at all*) to 5 (*very much*), Cronbach’s alpha = .67, $M = 4.14$, $SD = 0.45$.

Applicant persuasion skills. To measure applicant persuasion skills we generated six items based on the Social Skills Inventory (Riggio, 1986). Items were for example “I often succeed in selling my point of view” and “I do not easily succeed in changing somebody’s opinion” (reversed). The items were answered on a scale from 1 (*not at all*) to 5 (*very much*), Cronbach’s alpha = .78, $M = 3.94$, $SD = 0.55$.

Applicant general mental ability. We assessed the applicant general mental ability with the Wonderlic Personnel Test (Wonderlic, 2001) which is a validated measure of cognitive ability (Dodrill, 1983; McKelvie, 1989). In this paper-pencil test the applicant answers 50 questions testing vocabulary, arithmetic reasoning, and spatial ability. The goal is to answer as many questions correctly as possible in 12 min. The general mental ability scores are the total number of correctly answered items, $M = 23.48$, $SD = 6.36$.

Recruiter evaluation of applicant. Professional recruiters were contacted via e-mail asking them whether they were interested in evaluating job applicants during a job interview, based on videotapes. They were offered a salary of an equivalent of 100\$/hour. In total, five recruiters (2 male, 3 female, mean age: 26 years, $SD = 7.67$, mean experience: 5.7 years) agreed on assessing the job applicants. While one recruiter rated all applicants,

four recruiters rated half of the applicants. Thus, all applicants were evaluated by three recruiters (see inter-rater correlation below). Recruiters were provided with a detailed job description of what the job encompassed as well as the applicant self-reports (i.e., extraversion, agreeableness, and persuasion skills), general mental ability test score (i.e., Wonderlic Personnel Test) and they watched the video of the job interview. Recruiters indicated to what extent he or she was convinced about hiring the applicant, on a scale from 0% to 100%, $M = 60.12$, $SD = 19.09$, $ICC[1] = .47$, $ICC[2] = .72$, $F = 4.20$, $p < .05$.

Applicant nonverbal behavior. The applicant vocal and visual nonverbal behavior were assessed objectively via an automated sensing platform. This platform contains a high definition camera and a microphone array, able to perform accurately segment and register different speakers (described in more detail below). With the exception of the applicant smiling and gazing which were coded manually (including inter-rater reliability), all nonverbal cues were extracted automatically using computational methods.

Applicant speaking time. To register and extract the applicant's speaking time, we used the Microcone (<http://www.dev-audio.com/products/microcone/>) which is a microphone array capable of doing speaker segmentation. That is, it registers up to six individual speakers at the same time but separate from each other. The speaker segmentations are stored in a file containing the identifier (applicant or recruiter) and the relative time (starting and ending time of the speaking segment for each identifier). With the corresponding software, we were able to extract turn taking data for each of the recorded speakers. The Microcone was placed in the middle of the table between the applicant and the recruiter. To assess the applicant's speaking time, the sum of all speaking turn lengths

(in seconds) was calculated and then divided by the interview duration (in seconds) and multiplied by the average interview duration (in seconds), $M = 391.92$, $SD = 66.53$.

Applicant audio back-channeling. We defined audio back-channeling events as short utterances of the applicant (such as “mmhh” or “yes”) while the recruiter was speaking. Short utterances are speaking segments shorter than one second. We developed an algorithm that counted the number of applicant short utterances during recruiter speech segments (speech segment data stemming from the Microcone); the number was then normalized by the job interview duration, by dividing the number of events by the interview duration (in seconds) and multiplying by the average interview duration (in seconds), $M = 7.00$, $SD = 6.00$.

Applicant speech fluency. Speech fluency was defined by the number of pauses which were non-speaking segments shorter than one second. Based on the data registered by the Microcone, the number of such events was counted and the number was then normalized over the job interview duration by dividing it by the interview duration (in seconds) and multiplying by the average interview duration (in seconds). We reversed the scores so that higher values indicate higher speech fluency $M = -10.57$, $SD = 6.29$.

Applicant visual back-channeling. Applicant visual back-channeling was defined as the applicant producing a head nod while the recruiter was speaking. We used the method presented in Nguyen, Odobez, and Gaticaz-Perez (2012) to automatically detect head nods, providing the relative timings of nodding events (starting and ending time). Based on this method the location of the applicant’s face is tracked and visual motions in the face region are estimated. Accuracy for these estimates is high because most head nods (also subtle ones) are detected while keeping number of false positive low. We developed an algorithm

which combines the nodding events from the nodding detector (Nguyen et al., 2012) with the Microcone segmentations and which counts the number of such events. The number was then divided by the interview duration and multiplied by the average interview duration (in seconds), $M = 21.90$, $SD = 14.46$.

Applicant smiling. To measure how much the applicant smiled during the job interview, the applicant smiling behavior was coded each minute of the job interview on a scale from 1 (*not at all*) to 5 (*very much*). Two raters coded five applicants. Inter-rater reliability was $r = .95$. One rater then coded all applicants. Per applicant, the smiling scores of each of the 1-min slice were averaged, $M = 2.46$, $SD = 0.90$.

Applicant gazing. Applicant gazing was defined as the applicant looking at the recruiter. We assessed the time each applicant gazed at the recruiter during the interview relative to the entire job interview duration ($M = 0.52$, $SD = 0.13$). Two raters coded five applicants. Inter-rater reliability was $r = .95$. One rater then coded all applicants.

Objective applicant job performance. The applicant's job performance was the average number of people who signed up their name and contact information in the sign-up sheet per hour of recruitment work, $M = 9.28$, $SD = 4.63$.

Results

Table 1 illustrates the correlation matrix with all variables included in the study. To test whether applicant nonverbal behavior during the job interview can predict later job performance, we conducted a multiple regression analysis and regressed job performance on the applicant's nonverbal behavior during the job interview (i.e., smiling, gazing, visual back-channeling, speaking time, speech fluency, and audio back-channeling). Results show that applicant nonverbal behavior marginally significantly predicted job performance

(Table 2). When separately testing the effects of applicant vocal and visual nonverbal behavior, results show that applicant visual nonverbal behavior (i.e., smiling, gazing, and visual back-channeling) did not predict job performance (Table 3) whereas applicant vocal nonverbal behavior (i.e., speaking time, pauses, and audio back-channeling) did (Table 4). Therefore, vocal nonverbal job interview behavior (but not visual nonverbal behavior) significantly predicted job performance.

In order to know whether applicant vocal nonverbal behavior also predicts job performance above and beyond applicant competence measures and recruiter evaluation, we conducted a hierarchical multiple regression analysis. In a first model, we regressed job performance on the applicant's competence measures (i.e., self-reported level of extraversion, agreeableness, persuasion skills, and intelligence test score) as predictors and compared this to a second model in which we added the recruiter evaluation. In a third step, we included the applicant's vocal nonverbal behavior (i.e., speaking time, audio back-channeling, and speech fluency). Results show that applicant vocal nonverbal behavior predicts job performance above and beyond applicant competence measures and recruiter evaluation (see Table 5).

Discussion

We set out to test whether applicant nonverbal behavior during the job interview is predictive of the job applicant's later job performance. Results show that applicant vocal nonverbal behavior significantly predicts job performance whereas applicant visual nonverbal behavior does not. This is the first study that shows a link between applicant (vocal) nonverbal behavior during a job interview and later objectively measured job performance.

Applicant nonverbal behavior affects hiring decisions (e.g., Anderson & Shackleton, 1990; McGovern & Tinsley, 1978). Also, applicant nonverbal behavior is related to job performance when job performance is assessed by observer ratings, meaning that the nonverbal behavior of the job holder might have affected the performance assessment, as is the case, for instance, in job performance ratings by superiors (Burnett & Motowidlo, 1998; DeGroot & Motowidlo, 1999; Motowidlo & Burnett, 1995). This means that such performance measures are not objective. In the present study, we tested whether applicant nonverbal behavior during the job interview predicts later, *objectively measured* job performance. Our results show that even for objectively measured job performance, nonverbal behavior can be used as an indicator of performance. We believe that this is the case because the job required certain nonverbal skills that then affected performance. This is commonly the case in sales-type jobs: the job holder's nonverbal expressive skills affect how successful as a salesperson he/she is. The nonverbal expression during the job interview most likely is an indicator of the nonverbal skill level necessary for performing well on the job and therefore becomes a predictor of later job performance. This is what our results show with respect to vocal nonverbal behavior. We focused on a sales-type job. In sales, the nonverbal behavior of the applicant during the job interview might be indicative for his or her performance, whereas in jobs that require less social interactions (e.g., accounting) the applicant nonverbal behavior might not play the same role. Thus, future research might want to test how the degree of social interaction (e.g., client contact) in a given job affects the interview-based nonverbal behavior profile predicting high job performance.

The goal of our research was not to investigate how each behavioral cue was related to job performance, because, as argued before, we assume that this might vary quite a bit from one job to the next. Nevertheless, when looking at our results, one observes that job applicants who talk *less* when conversing with the recruiter during the structured job interview do better on the job. One explanation of this link could be that it is important for the job at hand to have active listening skills, to know how to dose the information and communication with the passers-by, whom to address and whom to let go. This argument can be strengthened by a study of Grant (2013) showing that the relationship between extraversion and sales performance is not linear but curvilinear, indicating that too much extraversion is detrimental to sales performance. This skill might manifest itself during the job interview by an applicant listening attentively to the recruiter and the applicant him- or herself not talking as much. Another explanation could be that applicants who are at ease interpersonally are less stressed in social interaction situations in general and thus maybe are more concise in their responses to the recruiter's questions during the interview which would make for less speaking time. This interpersonal skill would then also benefit them in the job context in which they have to approach and talk to strangers. One might have expected that speaking time relates positively to the job performance. That our results are contrary to common expectations with respect to speaking time goes to show how useful and valid our data-driven approach is: our expectations can be wrong and if hiring decisions are based on them, hiring is biased. This is also demonstrated in our finding that applicant vocal nonverbal behavior is a better predictor of job performance than is recruiter hiring decision.

Applicant vocal nonverbal behavior predicted job performance above and beyond applicant test scores and recruiter evaluation. Moreover, applicant test scores (i.e., personality traits, persuasion skills, and general mental ability) as well as recruiter evaluations did not predict job performance (see also Table 1). Interestingly, neither applicant self-reports nor applicant general ability were related to job performance. This is not in line with existing research showing that general mental ability increases job performance for basically all jobs (Schmidt & Hunter, 1998). Based on a study of Barrick et al. (1993), one explanation for the lack of this relation could be that for sales, general mental ability is less important; Barrick and colleagues found general mental ability to be unrelated to sales volume. Alternatively, the fact that we measured job performance objectively might explain the difference to the results in the literature. If intelligent people have better interpersonal skills which is suggested by the literature (Hall, Andrzejewski, & Yopchick, 2009; Lippa & Dietz, 2000), they might be more successful in conveying a competent impression to others including the people who evaluate them. This is strengthened by findings showing that general mental ability indeed correlates with supervisor performance ratings in sales (Barrick et al., 1993). However, if the performance is assessed objectively, as was the case in our study, general mental ability might not be related to performance so tightly any more. This same reasoning might explain why recruiter hiring decision was unrelated to actual job performance: Recruiters used high amounts of applicant gazing and speaking time as indicators of applicant performance. However, applicant gazing was not predictive of later job performance. As documented in the literature, recruiters rely on applicant immediacy behavior for their hiring decisions (e.g., Anderson & Shackleton, 1990; McGovern & Tinsley, 1978) but these behaviors

might not always be indicative of actual job performance. The lack of a relation between recruiter hiring decision and job performance hints to the importance of extending existing research to more objective job performance measures.

Nonverbal behavior is not always encoded unconsciously (Lakin, 2006). Thus, one might argue that the applicant's nonverbal behavior during the job interview can be faked and therefore be used as an impression management strategy (Stevens & Kristof, 1995). Especially nowadays numerous counseling books about how to behave in job interviews make future applicants more and more aware of the impact of nonverbal behavior in the job interview. Moreover, there are training programs provided for future applicants where they attend job interview simulations, in which the use of certain nonverbal behaviors can be practiced. As a consequence, the role of the nonverbal behavior in the job interview is not only put to a higher awareness, but future applicants become also more motivated to influence their nonverbal behavior during the job interview, and thus faking might become more prominent.

The question of whether the applicant nonverbal behavior is faked or not might be less of a concern for the data-driven approach we suggest here. Applicant nonverbal behavior is most likely a proxy for the applicant's characteristics, which in turn are the reason for better or worse job performance. If the nonverbal behavior is a true expression of the underlying characteristics for some applicants (those who do not fake) but not for others (those who fake), this will result in not finding a relation between that specific nonverbal behavior and performance. For identifying the nonverbal behavior profile that predicts high job performance, this will result in missing existing nonverbal behavior-performance links but

not in identifying links that are not there. Thus faking works against finding nonverbal cues indicative of high performance but it does not result in finding the wrong cues.

The fact that applicant nonverbal behavior can be indicative of future job performance opens a completely new avenue of research and of selection procedures. The use of nonverbal social sensing for the selection of applicants for specific jobs becomes possible. The fact that we found vocal nonverbal behavior to be diagnostic for job performance makes automated assessment and analysis even easier: Future job applicants might not even have to be observed or filmed during the job interview; it is enough to register their voice which can easily be done via telephone or computer because we showed that the vocal and not the visual nonverbal cues were decisive.

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Figure Captions

Figure 1. Indoor social sensing platform, including cameras and microphones.

Table 1

Correlation Matrix With Variables Included in the Study

Applicant variable	1	2	3	4	5	6	7	8	9	10	11
1. Job performance	-										
2. Recruiter hiring decision	-.02	-									
3. Applicant extraversion	-.04	.36**	-								
4. Applicant agreeableness	.04	.08	.37**	-							
5. Applicant persuasion skills	.10	.31*	.37**	.30*	-						
6. Applicant general mental ability	.03	-.01	.03	-.04	-.13	-					
7. Smiling	.15	-.01	.09	.11	-.18	.06	-				
8. Gazing	.09	.36**	.12	.16	.27+	-.13	.31*	-			
9. Nodding	.21	.22	.04	-.05	-.10	.28*	.19	.22	-		
10. Speaking time	-.26+	.47**	.27*	-.16	.18	-.24+	-.25+	.11	-.21	-	
11. Audio back-channeling	-.16	.09	.03	.29*	.05	-.19	.16	.41**	.27*	-.02	
12. Speech fluency	.20	.17	.19	-.05	.02	.06	.12	.19	.08	.01	.10

+ $p < .10$, * $p \leq .05$, ** $p < .01$.

Table 2

Multiple Regression Analyses with Applicant Nonverbal Behavior Predicting Job Performance

Applicant variable	B (SE B)	β
Smiling	0.17 (0.74)	.03
Gazing	5.45 (5.51)	.15
Visual back-channeling	0.06 (0.05)	.18
Speaking time	-0.02 (0.01)	-.24+
Audio back-channeling	-0.23 (0.11)	-.30*
Speech fluency	0.13 (0.10)	.18

Note. $R^2 = .20$ ($p = .089$). + $p < .10$, * $p < .05$.

Table 3

Multiple Regression Analyses with Applicant Visual Nonverbal Behavior Predicting Job Performance

Applicant variable	B (SE B)	β
Smiling	0.57 (0.75)	.11
Gazing	0.56 (5.22)	.02
Visual back-channeling	0.06 (0.05)	.18

Note. $R^2 = .06$ ($p = .410$).

Table 4

Multiple Regression Analyses with Applicant Vocal Nonverbal Behavior Predicting Job Performance

Applicant variable	B (SE B)	β
Speaking time	-0.02 (0.01)	-.27*
Audio back-channeling	-0.14 (0.10)	-.18
Speech fluency	0.16 (0.10)	.22

Note. $R^2 = .14$ ($p = .052$). * $p < .05$.

Table 5

Hierarchical Multiple Regression Analyses with Applicant Self-Reports and Test Scores, Recruiter Evaluation, and Applicant Vocal Nonverbal Behavior Predicting Job Performance

Variable	Step 1		Step 2		Step 3	
	B (SE B)	β	B (SE B)	β	B (SE B)	β
Applicant extraversion	-1.00 (1.54)	-.10	-0.90 (1.64)	-.09	-0.89 (1.63)	-.09
Applicant agreeableness	0.40 (1.61)	.04	0.30 (1.66)	.03	0.47 (1.73)	.05
Applicant persuasion skills	1.14 (1.31)	.14	1.20 (1.36)	.14	1.22 (1.29)	.15
Applicant general mental ability	0.04 (0.10)	.05	0.04 (0.11)	.05	-0.06 (0.11)	-.08
Recruiter hiring decision			-0.01 (0.04)	-.03	0.03 (0.04)	.11
Applicant speaking time					-0.02 (0.01)	-.34*
Applicant audio back-channeling					-0.18 (0.11)	-.23
Applicant speech fluency					0.17 (0.10)	.22

Note. $R^2 = .02$ for Step 1; $\Delta R^2 = .01$ for Step 2 ($p = .854$); $\Delta R^2 = .16$ for Step 3 ($p = .042$)

* $p = .05$



E. Article 4

Self-Promoting and Modest Job Applicants in Different Cultures

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Abstract. The goal of this study was to investigate the influence of the recruiter's cultural background on the evaluation of a job applicant's presentation style (self-promoting or modest) in an interview situation. We expected that recruiters from cultures that value self-promotion (e.g., Canada) will be more inclined to hire self-promoting as compared to modest applicants and that recruiters from cultures that value modesty (e.g., Switzerland) will be less inclined to hire self-promoting applicants than recruiters from cultures that value self-promotion. We therefore investigated 44 native French speaking recruiters from Switzerland and 40 native French speaking recruiters from Canada who judged either a self-promoting or a modest videotaped applicant in terms of hireability. Results confirmed that Canadian recruiters were more inclined to hire self-promoting compared to modest applicants and that Canadian recruiters were more inclined than Swiss recruiters to hire self-promoting applicants. Also, we showed that self-promotion was related to a higher intention to hire because self-promoting applicants are perceived as being competent.

Keywords: presentation style, cultural differences, job interview, impression management, self-promotion

A study by the global auditing and professional services network KPMG showed that 41% of all mergers and acquisitions in 2000 were transacted internationally, compared to 24% in 1996 (Javidan, Stahl, Brodbeck, & Wilderom, 2005). Moreover, the globalization and liberalization of the business market entail an increase of international recruitment, characterized by the job applicant and the recruiter not sharing the same cultural background. One implication of international recruitment might be that one and the same job applicant is perceived and evaluated differently by recruiters stemming from different cultures and that a job applicant is using different impression management strategies depending on his or her cultural background or on the cultural background of the recruiter. Although there is some research addressing how culture affects human resource management practices (Aycan et al., 2000), research on the impact of culture in job interviews is scarce. In the present study, we investigate how Swiss and Canadian recruiters perceive and evaluate job applicants who either present themselves in a self-promoting or in a modest manner.

Job applicants often use impression management strategies in order to "... get others to see them as they want to be seen." (Aronson, Wilson, & Akert, 2010, p. 174). One of these impression management strategies is self-promotion (Jones & Pittman, 1982; Stevens & Kristof, 1995), defined as describing one's accomplishments, emphasizing one's strengths, and talents, and attributing success rather internally than externally (Rudman, 1998; Stevens & Kristof, 1995). Research has shown that self-promotion is widely used by applicants in job interview situations (Baron, 1989; Delery & Kacmar, 1998; Ellis, West, Ryan, & DeShon, 2002; Giacalone & Rosenfeld, 1989, 1991; Harris

& Kacmar, 2007; Liden & Parsons, 1989; Stevens & Kristof, 1995) and it seems to be an effective and successful strategy because it is positively related to hiring decisions (Gilmore & Ferris, 1989; Kacmar & Carlson, 1994; Rosenfeld, 1997; Stevens & Kristof, 1995; Wiley & Eskilson, 1985). Recruiters might see self-promotion in an applicant as an indicator for the applicant's competence, confidence, and ambition, all desired qualities in a new hire (Stevens & Kristof, 1995; Wiley & Eskilson, 1985). Self-promotion of applicants might also be valued highly by recruiters because they assume that this is the way the applicant will present him- or herself and the organization in future interactions (Griffith, Peterson, Isaacson, Quist, & Gammon, 2009). On the flip side, when an applicant does not self-promote, it might be seen as a sign of disinterest in the job (Bozeman & Kacmar, 1997).

However, self-promotion does not only have positive outcomes. Depending on who is showing the self-promoting behavior, the evaluation of it can be different. For instance, when women self-promote in a job interview situation, they are rated as less competent and recruiters are less willing to hire them than men showing the same self-promoting behavior (Baron, 1989; Kacmar & Carlson, 1994; Wosinska, Dabul, Whetstone-Dion, & Cialdini, 1996). Moreover, the cultural context in which a job interview takes place might play a role. Lievens and Peeters (2008) showed in a study conducted in Europe (Belgium) that impression management strategies – and self-promotion in particular – were not very strongly linked to interview outcomes. In the present study, we set out to test whether the cultural background of the recruiter (Swiss vs. Canadian) influences how a self-promoting or a modest applicant is evaluated.

Culture is considered as a unique characteristic of a social group including norms that define what kind of behavior is appropriate and what is not (Brett, 2000). These norms affect social behavior (Chhokar, Brodbeck, & House, 2007; Fink, Neyer, & Kölling, 2007; House, Javidan, & Dorfman, 2001; Javidan & House, 2002) and provide a basis for interpreting situations and behaviors of others (Fiske & Taylor, 1991). Hodgkinson and Payne (1998) showed that selection methods differ internationally, in terms of the usage of personality tests, graphology, cognitive tests, assessment centers, and traditional interviews (Clark, 1993; DiMilia, Smith, & Brown, 1994; Shackleton & Newell, 1991; Shackleton & Newell, 1994; Smith & Abrahamsen, 1992). Studies on the effect of the recruiter's cultural background on the evaluation of job applicants are scarce to date. Zao (2006) investigated expectations of recruiters in China, showing that recruiters from foreign companies have higher expectations concerning endogenous qualities (e.g., analysis skills) than recruiters from state-owned companies.

With respect to self-promoting behavior, we have reason to assume that not only gender but also cultural background affects how this behavior is evaluated. We expect that Canadians value self-promoting behavior more positively than Swiss people do. Chhokar et al. (2007) describe in their GLOBE study "Anglos" (Australian, Canada, England, Ireland, New Zealand, South Africa, and the United States were gathered in one cluster named "Anglo") as being unique, outstanding, assuming personal choices, being proactive, making their voice heard, and being forceful. According to social identity theory (Tajfel & Turner, 1979), members of one and the same group evaluate each other more positively than out-group members (in-group bias). Thus, if a person shows a behavior that is valued by a specific group, this person is evaluated more positively by members of that specific group. To illustrate, if Canadians have a tendency to self-promote, a person showing self-promoting behavior will be evaluated particularly positively.

The Swiss culture is characterized by diplomacy, modesty, team orientation, and avoidance of confrontations (Brodbeck et al., 2000; Chhokar et al., 2007). We therefore expect that modesty, understood as "the underrepresentation of one's positive traits, contributions, expectations or accomplishments" (Wosinska et al., 1996, p. 230) is particularly valued by the Swiss, at least more so than by Canadians. An investigation in China has shown that modesty is in general highly accepted and that people who are responding modestly to their performances are liked better than those who exhibited boastful behavior (Bond, Leung, & Wan, 1982).

One challenge in conducting cross-cultural research is that when we compare two countries, often the language is different. We can therefore not be sure whether the observed effects among different cultures are differences emerging from the fact to belong to different language cultures. In our study, we aimed at controlling for language differences by holding them constant. We compared native French speaking Swiss recruiters with native French speaking Canadian recruiters. If part of the cultural identification

goes with the language (French), we have no reason to assume that this would be different for native French speaking Swiss compared to native French speaking Canadians. Therefore, if there are cultural differences between native French speaking Swiss and native French speaking Canadians, they most likely stem from the cultural differences in their respective home countries – Switzerland and Canada. These are the ones we are interested in because the Swiss culture is more prone to positively evaluate modesty whereas the Canadian culture is more prone to positively evaluate self-promotion.

More specifically, if in Switzerland, the expected presentation style of a job applicant in a job interview is modesty and in Canada it is self-promotion, we expect that Canadian recruiters will be more inclined to hire a self-promoting as compared to a modest applicant and that Canadian recruiters will be more inclined than Swiss recruiters to hire self-promoting applicants.

Method

Participants

The sample consisted of 44 native French speaking recruiters from Switzerland and 40 native French speaking recruiters from Canada ($n = 84$). The average age of the sample was 42 years ranging from 24 to 61 years. Fifty-four female (31 Swiss and 23 Canadian) and 30 male (13 Swiss and 17 Canadian) recruiters participated in the study. Recruiters self-selected and there was no compensation for participating in the study.

We contacted different job placement agencies in Switzerland and Canada by phone or by e-mail while focusing in both countries on companies recruiting for a broad array of different domains. Recruiters were informed that the study investigated cultural differences between Swiss and Canadian recruitment practices. When recruiters decided to participate in the study, they received an e-mail with instructions that contained a link to the Web page created for the purpose of this study. Participants described themselves as human resource assistants, recruitment experts, consultants, or HR directors.

Material

Stimulus Videotapes

We video recorded a mock job interview with a male Swiss amateur actor (30 years old) who played the role of a job applicant being interviewed. The actor portrayed a job applicant who was either self-promoting or modest. In the self-promoting version, the actor introduced himself as a person being sure about his personal values, confident, and ready to convince the recruiter that he is the best match for the job profile (Gilmore & Ferris, 1989; Rudman, 1998; Stevens & Kristof, 1995). In the modesty version, the actor introduced himself as an undemanding person who chooses his words reasonably

and does not consider himself as a person who outperforms other potential applicants (Gilmore & Ferris, 1989; Stevens & Kristof, 1995; Wosinska et al., 1996).

The applicant in the video applies for a position as a human resource consultant to a company named Conseils-Plus SA. He is asked three questions by a recruiter (not visible only audible on the video tape) that are presumably based on the applicant's CV. Additionally, the applicant is asked how he managed stressful situations in the past and how he usually prioritizes tasks. We used behaviorally based interview questions (e.g., Campion, Cheraskin, & Stevens, 1994; Janz, 1982; Motowidlo et al., 1992) which are widely used by practitioners (Barclay, 1999; Chapman & Zweig, 2005; Simola, Taggar, & Smith, 2007).

We manipulated self-promotion and modesty on the verbal and the nonverbal level. Although research on the nonverbal aspects of self-presentation is scarce (Stevens & Kristof, 1995), self-presentation becomes evident not only in verbal but also in nonverbal behavior (DePaulo, 1992). Stevens and Kristof state that nonverbal behavior accompanies different impression management tactics. Based on Stevens and Kristof (1995) description of self-promoters as using "... (a) entitlements – claims of responsibility for positive events, (b) enhancements – claims that the event for which one is responsible is more positive than it initially appears, or (c) descriptions of how they overcame obstacles while pursuing goals ..." (p. 589), the verbal statements of the self-promoting applicants were conceived together with the accompanying nonverbal behavior (e.g., fluent speech).

Modesty has not yet gained much research attention as a self-presentation style. Rudman (1998) used modesty – which she called self-effacing – as a self-presentation style and compared it to a self-promoting style. Modesty in her study was manipulated on the verbal and on the nonverbal level. Modest applicants were characterized by speaking modestly of one's skills and accomplishments and by using a speaking style with disclaimers (e.g., "I don't know") and hedges (e.g., "Isn't it?"). Moreover, the self-promoters used more powerful nonverbal status cues than the self-effacer such as, for instance, direct eye contact.

We based our manipulation of the verbal and nonverbal presentation style for the self-promoting and the modest version on the cited available literature and paid attention to the fact that the content of the statements uttered by the applicants remained identical in both conditions (e.g., receive a positive evaluation). We altered the way the applicant explained the facts to the recruiter (e.g., external attribution for failure and internal attribution for success in the self-promoting condition and the reverse for the modest condition). Also, the presentation style of the applicant varied in the two conditions with respect to his verbal (e.g., expression style and filler words) and nonverbal behavior (e.g., body movement, nodding, hand gesture, and posture). As an example, in the self-promoting version, the applicant comments on a very good recommendation the recruiter asks him about in the following way: "Yes, as I already mentioned, I completely met my employer's expectations. I think that I am excellent in everything I do. I usually do a good job and my superiors are in general satisfied. "In the modest version the applicant said: "Oh, thank you

(shy)! I have to admit that at the beginning I wasn't sure if I would meet my employer's expectations but I tried to perform well. I don't know if I deserve so many compliments, I just did my job". When the applicant is asked why he once quitted an internship after only two weeks, the applicant in the self-promoting version said: "... I had the impression the job profile did not meet my expectations and ambitions ...", whereas in the modest version the applicant stated: "... how should I say... we have decided that I did not completely match the job profile".

Moreover, in the self-promoting version the applicant answered the questions quickly and fluently whereas in the modest version the applicant hesitated when answering; the applicant in the modest condition had reduced speech fluency and he used many more filler words like "ahm" when compared to the applicant in the self-promoting condition. Also, there were differences in postural behavior in that in the self-promoting version the applicant appeared relaxed in his chair whereas in the modest version, the applicant was tensely leaning forward. Also, in the modest version, the applicant appeared unsure about himself, for instance, he fidgeted much more on his chair than in the self-promoting version. Finally, in the modest version the applicant nodded more than in the self-promoting version. The duration of the video in the self-promoting version was 5 minutes and in the modest version it was 6.5 minutes. The latter version lasted longer because of the increased speech latencies and the many filled pauses (e.g., "um", "uh"; Knapp & Hall, 2010).

We used a male applicant in the video because self-promotion is a successful self-promotion strategy for men but not for women. In women, it can even hamper their success so that women are evaluated more negatively when they self-promote (Butler & Geis, 1990; Heilman, Block, Martell, & Simon, 1989). Because men seem in line with what is well documented in the personnel selection literature, namely that self-promotion is an effective and successful impression management strategy (Baron, 1989; Liden & Parsons, 1989; Rosenfeld, 1997), we chose a male actor for this study.

Measures

Perceived Modesty

All participants, regardless of the condition they were in, indicated to what degree they perceived the applicant as modest by rating the applicant on two adjectives, *modest* and *moderate*, on a 5-point Likert scale labeled at the end-points with 1 (*not at all*) and 5 (*completely*). The scores on the two items were averaged (Cronbach $\alpha = .69$; $M = 2.65$, $SD = 1.49$).

Perceived Self-Promotion

All participants, regardless of the condition they were in, reported how self-promoting they perceived the applicant to be by rating the applicant on two adjectives, *pretentious*

and *dominant*, on a 5-point Likert scale labeled at the endpoints with 1 (*not at all*) and 5 (*completely*). The scores on the two items were averaged (Cronbach $\alpha = .92$; $M = 2.20$, $SD = 1.26$).

Intended Likelihood of Hiring

Recruiters indicated the intended likelihood of hiring the applicant. They were asked to indicate “What is the likelihood you would hire the applicant based on the job interview you just witnessed” on an 11-point scale ranging from 0% to 100% (with an iteration of 10) ($M = 32.14\%$, $SD = 23.80$).

Because intended likelihood of hiring was assessed with one item only, we also measured how competent the recruiter perceived the applicant to be with the two items *competent for this position* and *inexperienced for this position* (reverse scored) each on a 5-point Likert scale labeled at the endpoints ranging from 1 (*not at all*) to 5 (*completely*). The scores on the two items were averaged (Cronbach $\alpha = .80$; $M = 3.20$, $SD = 1.02$). Intended likelihood of hiring was significantly related to perceived competence, $r(84) = .64$, $p = .001$, suggesting that intended likelihood of hiring is a valid measure although it consists of one item only.

Control Variables

Recruiters’ age and gender, as well as perceived applicant’s authenticity were used as control variables. We measured to what degree participants perceived the applicant as being *authentic* or *fake* (reverse scored) (perceived authenticity) on a 5-point Likert scale ranging from 1 (*not at all*) to 5 (*completely*). The scores on the two items were averaged (Cronbach $\alpha = .84$; $M = 3.47$, $SD = 1.07$).

Procedure

Participants were randomly assigned to one of two conditions. They either watched the video with the self-promoting job applicant (“sp-group”) or the video with the modest applicant (“m-group”). On the Web page, recruiters were thanked for their participation and told to first watch the video (random assignment to either the “sp-group” or the “m-group”) by clicking on the corresponding button and then to fill in a questionnaire by clicking on a second button labeled with “answer questionnaire.” Recruiters were informed that they will see an applicant interviewing for a job as a consultant in a firm named ConseilPlus SA. No other specific job requirements were mentioned. Aside from this introduction, the recruiters did not have access to any information about the applicant (e.g., CV or letter of recommendation).

After having watched the video, participants first assessed the intended likelihood of hiring the applicant and indicated then how modest, self-promoting, competent, and authentic they perceived the applicant to be. Perceived modesty, self-promotion, competence, and authenticity were

assessed with the adjectives described above in an intermixed order. Participants then reported their age and gender.

Results

The manipulation check confirmed the predicted effects in that self-promoting applicants were perceived as significantly more self-promoting ($M = 3.09$) than modest applicants were ($M = 1.35$), $t(82) = 8.69$, $p = .0001$, and modest applicants were perceived as significantly more modest ($M = 3.83$) than self-promoting applicants were ($M = 1.43$), $t(82) = 12.42$, $p = .0001$.

To test whether Swiss recruiters were less inclined to hire self-promoting compared to modest applicants whereas Canadian recruiters were more inclined to hire self-promoting compared to modest applicants, we calculated a 2 (applicant presentation style: self-promoting vs. modest) by 2 (recruiter culture: Swiss vs. Canadian) by 2 (recruiter gender) ANOVA with intended likelihood of hiring as the dependent variable. Note that we included recruiter’s gender as a factor in the analysis to control for potential recruiter gender effects.

If our hypothesis is confirmed, there should be a significant presentation style by culture interaction effect. This is what we found, $F(1, 76) = 8.44$, $p = .005$ (Table 1). There was also a significant applicant presentation style main effect, $F(1, 76) = 15.94$, $p = .0001$, showing that self-promoting applicants were more likely to be hired than modest applicants were, and a significant recruiter culture main effect, $F(1, 76) = 5.46$, $p = .022$, indicating that Canadian recruiters were more inclined to hire applicants than were Swiss recruiters. There was no significant recruiter gender main effect, $F(1, 76) = 0.29$, $p = .59$, and there were no other significant interaction effects, all F ’s < 1.04 , all p ’s $> .30$. Note that we repeated the same analysis and included age of the recruiter and perceived authenticity of the applicant as covariates and the results remained unchanged.

Table 1. Swiss and Canadian recruiter’s intended likelihood of hiring a self-promoting or a modest job applicant

Cultural background	Self-presentation style of applicant	
	Modesty	Self-promotion
Swiss recruiters	23.82 (4.79) _{ac}	28.99 (4.87) _c
Canadian recruiters	21.11 (4.83) _a	53.93 (4.54) _b

Notes. Judgments were made on a 11-point Likert scale (0% = *no intended likelihood of hiring the job applicant*, 100% = *maximal intended likelihood of hiring the job applicant*). Entries are means with standard deviations in parentheses. For comparisons within the cultural background (within one column) and within the self-presentation style (within one row), means that do not share the same subscript differ at $p < .001$ in the planned contrast- t test.

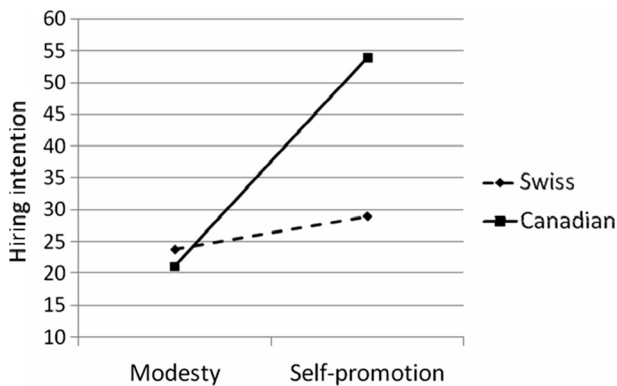


Figure 1. Probability of hiring the applicant according to recruiter culture (Swiss vs. Canadian) and applicant presentation style (self-promotion vs. modesty).

To better understand the pattern of results (Figure 1), we conducted contrast analyses. For Canadian recruiters, there was a significant preference for hiring self-promoting as compared to modest applicants, contrast- $t = 7.62$, $p = .0001$, whereas for Swiss recruiters, there was no significant hiring preference for self-promoting as compared to modest applicants, contrast- $t = 1.12$, $p = .127$.

Looking at the results from a different perspective, we can say that self-promoting applicants are significantly more likely to be hired by Canadian than by Swiss recruiters, contrast- $t = 5.79$, $p = .0001$. There was no significant difference between Canadian and Swiss recruiters with regard to hiring the modest applicants, contrast- $t = 0.57$, $p = .285$.

In order to understand the mechanism of how presentation style influences the hiring intention, we investigated whether perceived applicant competence explained why self-promotion was related to an increased intention to hire. We tested whether perceived applicant competence mediated the relation between presentation style and the hiring intention. Mediation means that the relation between the presentation style and the hiring intention becomes nonsignificant when controlling for perceived competence. Figure 2 shows that applicant presentation style was related to the hiring intention ($\beta = .40$, $p = .0001$, controlling for recruiter gender and recruiter cultural background) and to perceived applicant competence ($\beta = .49$, $p = .0001$, controlling for recruiter gender and recruiter cultural background). Perceived applicant competence was related to the hiring intention ($\beta = .61$, $p = .0001$, controlling for recruiter gender and recruiter cultural background). When the relation between applicant presentation style and the hiring intention was controlled for perceived applicant competence, it became nonsignificant ($\beta = .13$, $p = .182$, again also controlling for recruiter gender and recruiter cultural background) (Figure 2). This decrease was significant, $Z = 3.99$, $p < .0001$ (Sobel test; Baron & Kenny, 1986).

Discussion

The goal of this study was to investigate how the cultural background of Swiss and Canadian recruiters affects their

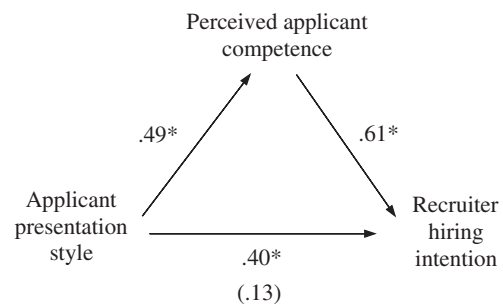


Figure 2. Mediation of the relation between applicant presentation style (coded as modest = 0 and self-promoting = 1) and hiring intention by perceived applicant competence. Numbers are standardized beta coefficients from regression analyses all controlling for recruiter gender and cultural background. * $p < .0001$.

perception and evaluation of self-promoting and modest job applicants. Results confirmed our hypotheses that Canadian recruiters were more inclined to hire self-promoting as compared to modest applicants and that self-promoting applicants elicit more hiring intentions in Canadian than in Swiss recruiters. However, there was no difference between Swiss and Canadian recruiters with respect to their inclination to hire modest applicants and Swiss recruiters were not more inclined to hire modest as compared to self-promoting applicants.

That Canadian recruiters were more inclined to hire self-promoting than modest applicants is in line with studies showing that applicants who use impression management by emphasizing their success have greater hireability success (Gilmore & Ferris, 1989; Kacmar & Carlson, 1994; Rosenfeld, 1997; Stevens & Kristof, 1995; Wiley & Eskilson, 1985). Thus, impression management in form of self-promotion is an effective and successful strategy in job interviews and particularly so in cultures that value self-promotion. Canadian recruiters behaved according to the social identity theory (Tajfel & Turner, 1979); they favored a presentation style that is in line with their culturally valued characteristics (Brodbeck et al., 2000; Chhokar et al., 2007). Although we did not measure recruiter expectations, differences in expectations among Swiss and Canadian recruiters might explain our results: Swiss recruiters do not expect job applicants to behave in a self-promoting way while Canadian recruiters do. If the applicants' behavior fulfills these expectations, evaluations are favorable. Canadian recruiters evaluated self-promoting applicants more favorably than modest applicants. However, it has to be noted that we are not able to tell whether it is the violation of behavioral expectations that makes the evaluation worse (i.e., modest applicants are hired less likely) or whether it is the correspondence of the perceiver's expectations and the applicant's behavior that makes the evaluation better (i.e., self-promoting applicants are hired more likely). We did not have a "neutral" applicant (with respect to modesty or self-promotion) to compare the effects of the modest and the self-promoting applicant to.

For Swiss recruiters the results were different. The presentation style did not affect the evaluation of the applicant. This also means that contrary to the well-documented advantage of self-promotion as an impression management strategy, for Swiss recruiters there was no significant hiring preference for self-promoting applicants. This result goes to show that cultural background can be a powerful factor influencing how likely applicants with a different presentation style are hired.

The fact that there was no difference in intended likelihood of hiring among the Swiss and the Canadian recruiters with respect to the modest applicant might be explained by the fact that the modest presentation style was closer to a neutral presentation style and that the self-promotion presentation style was really the one that stood out and affected the judgments. Alternatively, the modest presentation style might have been simply a bad self-presentation and it might have been so bad that both Swiss and Canadian recruiters simply disliked it and this is why there was no effect of culture.

We also showed that self-promotion was successful because self-promoting applicants were perceived as being competent. The applicant who points out his success and experience seems to be perceived as more competent by the recruiter than the modest applicant. This result confirms statements by other researchers suggesting that self-promotion is successful because recruiters use it as a source of information indicating an applicant's competence, confidence, and ambition (Stevens & Kristof, 1995; Wiley & Eskilson, 1985).

Note that because we manipulated both verbal and non-verbal behavior of the self-promoting and modest applicant, we do not know whether the intention to hire the applicant is due to his verbal or nonverbal behavior or to a specific aspect of one or the other (e.g., speech fluency). However, the goal of the study was to examine the effect of cultural background on the intention to hire when the applicant conveyed being and was perceived as self-promoting or modest. This is why we aimed at manipulating the impression or overall perception of the applicant as self-promoting (or modest). The manipulation check shows that we succeeded in doing so.

Using excerpts of mock job interviews enabled us to standardize the job applicant and to manipulate only the variable of interest in order to test for a causal link between the self-presentation style of the job applicant and the recruiter's hiring intentions. This comes at the expense of ecological validity because in a real job interview, the recruiter interacts with the job applicant and has access to additional information about him or her. We therefore checked to what extent the recruiters perceived the job interview as authentic and found that perceived authenticity was medium ($M = 3.5$) on a scale of 1 (*not at all authentic*) to 5 (*completely authentic*).

Recruiters in Canada most likely picked up on the fact that the applicant was Swiss (by his accent) and might therefore have evaluated the applicant less favorably because he was foreign. However, our results show that Canadian recruiters were more inclined to hire the applicant than the Swiss recruiters, and especially so when he showed

self-promoting behavior. The applicant being Swiss can therefore not explain the results found.

We only looked at recruiter culture (and gender) as potentially influencing factors of the effect of self-promotion on interview outcomes. It goes without saying that other factors such as the job profile and requirements influence how self-promotion is evaluated in an applicant. As an example, a recruiter might look for signs of extraversion and self-assurance in an applicant for a sales position while he or she might select a rather introverted and self-doubtful person for an accountant position.

Future research might want to test whether the results are different for female job applicants. Because self-promotion in women is judged less favorably than in men (Baron, 1989; Kacmar & Carlson, 1994; Rudman, 1998; Wosinska et al., 1996), one might wonder how the cultural background of the recruiter affects this relation. Maybe women presenting themselves in a self-promoting way would have been hired even less likely in Switzerland. In other words, maybe showing a behavior that neither conforms to the gender-role expectations nor to the cultural expectations is a double disadvantage. Thus, the interaction effect of applicant presentation style and cultural background of the recruiter might be even more pronounced in female applicants compared to male applicants.

With increased globalization and an ever growing number of international mergers, cross cultural interactions in job interviews become more and more frequent. Knowing the effects of different self-presentation styles in different cultures becomes crucial when job applicants and recruiters of different cultural background meet. We have shown that the cultural background of the recruiter and the behavior of the applicant can affect hiring intentions and therefore, cultural effects are not trivial. Recruiter and job interview training might thus want to put an emphasis on the potential influence of culture. A recruiter might miss a highly skilled and ideally qualified applicant for a given position just because something in the way the applicant presented him- or herself made the recruiter judge the applicant more negatively. We believe that such expectations are often unconscious and this is why it becomes even more important to study them in order to be able to provide concrete guidelines for interviewer training. In training, a first step should be to make interviewers aware of the fact that their decisions can be affected by culturally shaped behavioral expectations. By the same token, job applicants need to know that different self-presentation styles can have dramatically different outcomes depending on the cultural background of the recruiter.

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F. Article 5

Hiring Gender-Occupation Incongruent Applicants

The Positive Impact of Recruiter Interpersonal Sensitivity

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Abstract. Gender-occupational stereotypes that recruiters harbor toward male and female applicants still exist. However, there might be individual differences in recruiters that account for more or less stereotyping when facing male and female applicants who do not correspond to attributes of the job opening (e.g., male-typical vs. female-typical job). In this study, we tested whether recruiters high on interpersonal sensitivity are more likely to hire gender-occupational incongruent applicants. Seventy-three participants in the role of a recruiter conducted a job interview with either a gender-occupational incongruent (woman applying for a male-typical job or man applying for a female-typical job) or a gender-occupational congruent applicant. Results showed that the likelihood of hiring a gender-occupation incongruent applicant increased the more the recruiter was interpersonally sensitive, whereas interpersonal sensitivity did not affect hiring decision regarding gender-occupation congruent applicants.

Keywords: interpersonal sensitivity, job interview, gender-occupational stereotypes, information processing

Recruiters are not immune to stereotypes and stereotypes can affect recruiters' hiring decisions (e.g., Anderson & Shackleton, 1990; Cohen & Bunker, 1975; Przygodzki-Lionet, Olivier, & Desrumaux, 2010). Especially, the effect of gender stereotypes on hiring decisions is well documented. Women are in most cases still less likely to be hired for male-typical jobs and men's chances to be considered for female-typical jobs are also still reduced (e.g., Cohen & Bunker, 1975; Przygodzki-Lionet et al., 2010). This can be explained by the lack of fit model (Heilman, 1983) postulating that unfavorable hiring decisions are based on the incongruity between attributes of the applicant and the "perceived nature of the job requirements" (Przygodzki-Lionet et al., 2010, p. 53). When stereotypically expected characteristics of women (e.g., caring, other-oriented) are not congruent with characteristics of a given job (e.g., dominant, competitive), the female applicant for that job will less likely be hired because the gender-occupation incongruity leads to a so-called backlash effect (reprisals for being perceived as counter-stereotypically) (Rudman & Glick, 1999, 2001).

Given how widespread gender-occupational stereotypes are, there is astonishingly little research addressing how they can be overcome on the part of the recruiter. Who are the recruiters whose hiring decisions are less influenced by commonly held gender stereotypes? The goal of the present study was to investigate whether the degree of recruiter interpersonal sensitivity – the skill to correctly

infer others' traits and states (Hall & Bernieri, 2001) – affects the extent to which a recruiter hires women and men for gender-incongruent jobs.

Many jobs are associated with specific gender stereotypical expectations about the characteristics of the job holder. Typical *male* jobs are accountant, package material handler, or security guard, whereas typical *female* jobs are sales person, assembly worker, or receptionist (Athey & Hautaluoma, 1994; Buttner & McEnally, 1996). Gender-occupational stereotypes can result in women being less likely hired than men when applying for male-typical jobs and vice versa. Indeed, research shows that male applicants are less likely hired for female-typical jobs and female applicants are less favorably evaluated when applying for male-typical jobs (Cohen & Bunker, 1975; Przygodzki-Lionet et al., 2010; Reinhard, Schindler, Stahlberg, Messner, & Mucha, 2011). Although the majority of the research seems to point to such a backlash effect, the findings are not unequivocal. Sharp and Post (1980) showed that female and male applicants were not less likely hired for gender-incongruent jobs. Maybe the differences among the studies come from differences in the recruiters. Some recruiters might be more prone to stereotyping than others.

People who have a tendency to stereotype others tend to engage in quick evaluations of others (i.e., high need to evaluate) and do not put much effort in wanting to understand and reflect on the world around them including the social interaction partners (i.e., low need for cognition)

(Carter, Hall, Carney, & Rosip, 2006). Interpersonally sensitive individuals, on the contrary, are people who endorse cognitive complexity (Davis & Kraus, 1997). Typically, stereotyping and interpersonal sensitivity are seen as opposing constructs. Accurate assessments of others necessitate a cognitive engagement and effort resulting in a more deliberate information processing which is opposite to the more automatic information processing common in stereotypical assessment of others (Fiske, Lin, & Neuberg, 1999).

Recruiter interpersonal sensitivity, we assume, works to protect against the commonly observed backlash effect when confronted with gender-occupation incongruent applicants. We hypothesize that when gender-occupational stereotypes are violated by women applying for male-typical jobs or by men applying for female-typical jobs, the hiring decision becomes more favorable, the more interpersonally sensitive the recruiter is. In a situation of gender-occupation incongruity, interpersonal sensitivity makes the recruiters less prone to stereotyping, which is what we call the buffer effect of interpersonal sensitivity. Interpersonal sensitivity can prevent stereotyping because it might result in more deliberate cognitive processing and/or increased motivation or effort in processing cues from others. Conversely, in a situation of gender-occupation congruent applicants, we predict interpersonal sensitivity not to affect hiring. When no stereotypes are violated, interpersonal sensitivity has nothing to “act upon” and does therefore not affect recruiter decision making.

Recruiter interpersonal sensitivity has gained limited research attention. So far, it has been shown that recruiters are accurate at assessing applicants' personality traits based on the applicants' CVs (Cole, Feild, Giles, & Harris, 2009; Cole, Feild, & Stafford, 2005; Schmid Mast, Frauendorfer, & Sutter, 2013) or on excerpts of applicants' job interviews (Schmid Mast, Bangerter, Bulliard, & Aerni, 2011). Moreover, Hilliard and Macan (2009) found that participants who scored high on social skills evaluated applicants more correctly with respect to the applicants' personality than did raters with low social skill scores. In the present study, we are interested in *individual differences* among recruiters with respect to interpersonal sensitivity and how these differences influence stereotyping toward gender-occupational incongruent applicants.

Focusing on recruiter interpersonal sensitivity is a promising avenue because there is pronounced variability among individuals in their levels of interpersonal sensitivity (Bernieri, 2001) and because interpersonal sensitivity is a skill that can be learned (for a review see Hartigan, 2012). This means that if our prediction is verified, recruiters low in interpersonal sensitivity can be trained in this particular skill to reduce the influence of gender-occupational stereotypes in their hiring decisions.

The Present Study

We investigated whether increased interpersonal sensitivity relates to greater likelihood of hiring members of stereotype-incongruent groups. In the present study, we use a

sales and an accountant job. Salespeople are seen as being more socially competent and extraverted and accountants are rated as being less sociable and more persistent (Brown & Campion, 1994; Jackson, Peacock, & Holden, 1982). Sales therefore corresponds rather to female stereotypes (e.g., interpersonal skills and extraversion), whereas accounting is rather related to male stereotypes (e.g., math ability and less sociability). Indeed, male applicants were more likely to be hired for a job in accounting than were female applicants and female applicants were more likely to be hired for a job in sales than were male applicants (Buttner & McEnally, 1996).

To ensure that our participants perceived the jobs in the intended way, we pretested whether sales and accounting are indeed seen as a more female- or male-typical job, respectively. Twelve participants (six male, six female) were asked to rate different jobs such as sales, accounting, custodial worker, and production scheduler (the last two jobs served as fillers; the literature reports them as gender neutral) (Athey & Hautaluoma, 1994) in terms of masculinity/femininity on a scale ranging from 1 (*male*) to 5 (*female*) with three indicating neither male nor female. Sales was perceived as being significantly more feminine ($M = 3.85$, $t(11) = 3.98$, $p = .002$, statistical comparison with the gender-neutral midpoint of the scale, 3) and accounting as being significantly more masculine ($M = 2.45$, $t(11) = 3.25$, $p = .008$).

We used an immersive virtual environment, a highly standardized method enabling us to keep the applicant behavior constant across all conditions so that the variance in the dependent variable can solely be explained by the differences in the participants' (recruiters') behavior and is not confounded with the individual differences in the behavior of the applicant.

Method

Participants

Seventy-three participants (42 females, 31 males, mean age 26 years, $SD = 9.88$) were recruited on two university campuses in the French speaking part of Switzerland. The majority of the participants (77%) were master or bachelor students of different domains (e.g., psychology, sociology, or geology) and the rest were employees (e.g., teachers, engineers, or nurses). Participants were either approached by a research assistant or they were contacted via email (participant pool list of our department). Each participant obtained a lottery ticket (price of the ticket US\$2) with which they could gain prices up to 1,000 US\$.

Material and Measures

The Virtual World

Immersive Virtual Environmental Technology (IVET) immerses participants in a physical and social environment in which the immersed participant can interact with human

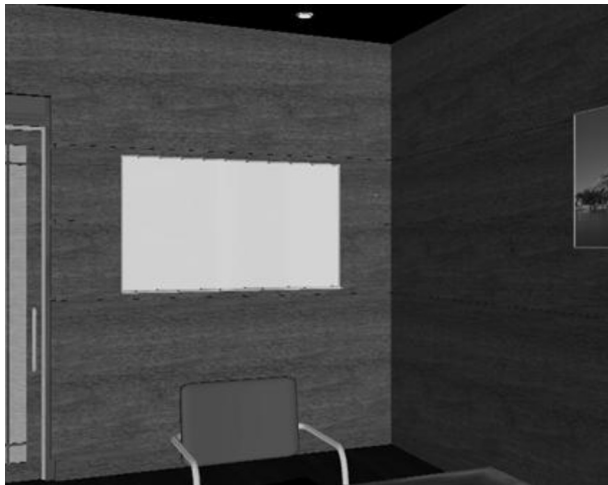


Figure 1. Office space presented in the virtual world (IVET).

avatars. IVET has been applied and validated for different domains of psychological research (Blascovich et al., 2002a, 2002b). The participant wears a head-mounted-display (HMD) through which he/she perceives the virtual world and is able to move and look around in the virtual world quite similarly to the real world. IVET therefore provides a highly ecologically valid social interaction environment. Furthermore, it enables the experimenter to control for factors, which are uncontrollable in real life. For instance, the behavior (e.g., verbal and nonverbal) of the social interaction partner (the human avatar in IVET) is always the same because it corresponds to a preset computer algorithm.

In the present study, participants were in the role of the recruiter, interviewing a job applicant (a human avatar) in a virtual office space (Figure 1). We programmed the human avatar to answer four questions that the recruiter (participant) was instructed to ask the applicant (described in more detail below).

Interpersonal Sensitivity

The short version of the Profile of Nonverbal Sensitivity test (PONS; Rosenthal, Hall, DiMatteo, Rogers, & Archer, 1979) is a 27-min video containing 40 visual segments with no sound, each lasting about 2 s. The scenes contain a Caucasian woman expressing different scenarios with her face and body. The test-taker chooses among two answer alternatives the one that he/she thinks is correct (e.g., returning a faulty item to the store or expressing motherly love). The correct answer is the one that the actress intended to display. The correct answers are summed up ($M = 30.00$, $SD = 2.53$).

Perceived Applicant Attractiveness

Applicant attractiveness is a strong predictor of the intended likelihood of hiring (e.g., Hosoda, Stone-Romero, & Coats,

2003; Langlois et al., 2000). To control for how attractive recruiters perceived applicants to be, we assessed perceived attractiveness of the applicant with the following adjectives: *attractive*, *likable*, *friendly*, *appealing*, and *disagreeable* (reversed adjective), each on a 5-point Likert scale ranging from 1 (*not at all*) to 5 (*very much*). The scores on the five adjectives were averaged and higher numbers indicate more perceived attractiveness (Cronbach's $\alpha = .82$, $M = 3.86$, $SD = 0.57$).

Intended Likelihood of Hiring

To what degree the recruiter intended to hire the (virtual) applicant was measured with four items on a 5-point Likert scale ranging from 1 (*not at all*) to 5 (*very much*): "Would you hire this applicant for the job opening?", "Do you find it realistic to hire this applicant based on the job interview you conducted?", "Would you reject this applicant for the job opening?" (reversed item), and "Do you find it realistic to reject the applicant based on the job interview you conducted?" (reversed item). The scores were averaged and higher numbers indicate greater intended likelihood of hiring (Cronbach's $\alpha = .79$, $M = 3.62$, $SD = 0.85$).

Procedure

First, participants performed the PONS (Rosenthal et al., 1979). They were then told that they will take on the role of a recruiter and interview a job applicant (human avatar). The applicant was either applying for a sales or an accounting opening and was either male or female. The design was a 2 (job domain: sales vs. accounting) $\times$ 2 (applicant gender) between-subjects design with random assignment of participants to one of the four conditions.

Participants were informed that they would interview a job applicant with four questions to be asked: (1) "Why do you think we should hire you for this job?", (2) "Could you give me an example illustrating your sense of responsibility?" (3) "Could you give me an example showing how you mastered a stressful situation?", and (4) "Could you give me an example showing that you are able to set priorities in terms of your different tasks at work?" Participants were told not only to ask each of these questions but also to elaborate on each of them and to add information and to make the job interview as similar as possible to a real job interview. Participants were given 5 min to prepare the interview. Then, participants entered the virtual world. In front of them was a human avatar standing next to a wall (Figure 2). The participant was instructed to welcome the applicant and then to start asking the first question. The answers of the applicant (human avatar) were identical in all conditions with reference to either sales or accounting. The answers were preregistered and activated via key strike by the experimenter. They were constructed to promote a positive picture of the applicant without being too brilliant to prevent a ceiling effect (the applicant being so perfect that everybody would want to hire him or her). The goal



Figure 2. Male and female applicants presented in the virtual world (IVET).

was to obtain enough variance in the intended likelihood of hiring variable. After the job interview (average duration of 4 min), participants completed the intended likelihood of hiring measure and reported how attractive they perceived the applicant to be. Participants were debriefed, given a lottery ticket, and thanked.

Results

Because recruiter gender and perceived applicant attractiveness influence the hiring decision process (e.g., Cole, Feild, & Giles, 2004; Langlois et al., 2000; Przygodzki-Lionet et al., 2010), we tested whether recruiter gender and applicant attractiveness affected the intended likelihood of hiring (to either exclude these two variables from the main analysis if they are unrelated – to maintain more statistical power of the analysis – or to control for them if they are related). We conducted a multiple regression analysis, regressing intended likelihood of hiring on recruiter gender (dummy coded: male = 0, female = 1) and on perceived applicant attractiveness (mean centered). Results showed that recruiter gender did not have an impact on the intended likelihood of hiring ($b = -.03$, $SE = .18$, $p = .862$). However, perceived applicant attractiveness affected the intended likelihood of hiring significantly ($b = .67$, $SE = .16$, $p < .001$). Based on these results, recruiter gender was not included in our main analysis, whereas perceived applicant attractiveness was included as a covariate.¹

We collapsed the female-accounting and the male-sales conditions to obtain the gender-occupation incongruent condition because the results did not differ between the

two conditions. Similarly, we combined the female-sales and the male-accounting conditions into the gender-occupation congruent condition. Table 1 shows the correlation matrix of all the variables separately for the gender-occupation congruent and incongruent conditions. The percentage of employees present in the sample did not differ between the congruent (22%) and the incongruent (25%) conditions.

We conducted a hierarchical multiple regression analysis with recruiter interpersonal sensitivity (mean centered) and gender-occupational congruency (dummy coded: incongruence = 0, congruency = 1) as predictors in the first step (Aiken & West, 1991). Moreover, we included perceived attractiveness as a control variable. In the second step, we added the two-way interaction between recruiter interpersonal sensitivity and gender-occupational congruency. Results of the second step show a significant recruiter interpersonal sensitivity main effect and a significant two-way interaction between recruiter interpersonal sensitivity and gender-occupational congruency (Table 2). There was no significant gender-occupational congruency main effect. To better understand the two-way interaction, we analyzed the simple slopes of the two conditions separately (Figure 3).

For gender-occupational incongruent applicants, the simple slope was positive and significantly different from 0, $b = 0.16$, $SE = 0.05$, $p = .001$ (Table 2): the more interpersonally sensitive the recruiters were, the more likely they hired the (gender-occupational incongruent) applicants. For gender-occupational congruent applicants, the simple slope was negative but not significantly different from 0, $b = -0.03$, $SE = 0.05$, $p = .608$. When male and female applicants applied for jobs they are expected to apply for, recruiter interpersonal sensitivity did not influence the recruiter's hiring decision.

Table 1. Correlation matrix with variables included in the study

Measure	1	2	3	M	SD
1. Intended likelihood of hiring	–			3.76/3.47	0.79/0.89
2. Perceived applicant attractiveness	.33*/.51**	–		3.97/3.74	0.48/0.62
3. Recruiter IS	-.13/.48**	-.13/.04	–	30.19/29.69	2.46/2.61
4. Recruiter gender	-.17/-.06	-.32*/-.08	.15/-.07	1.62/1.53	0.49/0.51

Notes. Values reported before the slash are correlation coefficients for the gender-occupational *congruent* condition and values reported after the slash are correlation coefficients for the gender-occupational *incongruent* condition. Recruiter gender was coded as follows: 1 = male, 2 = female. * $p < .05$. ** $p < .01$. + $p < .10$.

¹ Note that there was no interaction between recruiter gender (dummy coded: male = 0, female = 1) and applicant gender (dummy coded: male = 0, female = 1), $b = -.30$, $SE = .61$, $p = .622$.

Table 2. Hierarchical multiple regression analyses with recruiter interpersonal sensitivity, gender-occupational congruency predicting intended likelihood of hiring with the following dummy coding: 0 = incongruence, 1 = congruency (perceived applicant attractiveness included as a control variable)

Variable	Step 1		Step 2	
	B (SE B)	β	B (SE B)	β
Perceived applicant attractiveness	0.66 (0.16)	.44***	0.63 (0.15)	.42***
Recruiter IS	0.07 (0.04)	.21*	0.16 (0.05)	.47***
Gender-occupational congruency	0.11 (0.18)	.06	0.17 (0.17)	.10
Recruiter IS $\times$ Gender-Occupational Congruency			−0.18 (0.07)	−.38**

Notes. $\Delta R^2 = .07$ for Step 2 ($p = .009$). Recruiter IS means recruiter interpersonal sensitivity. * $p \leq .05$. ** $p < .01$. *** $p \leq .001$.

Discussion

The goal of the present study was to investigate whether when confronted with gender-occupational incongruent applicants, the more a recruiter is interpersonally sensitive, the more likely he/she hires those applicants. This was pitted against a situation in which gender role expectations and job expectations were congruent. In this case, we did not expect recruiter interpersonal sensitivity to influence hiring decisions. Our results confirm these predictions: Increased recruiter interpersonal sensitivity was related to greater likelihood of hiring members of stereotype-incongruent groups but recruiter interpersonal sensitivity was unrelated to hiring decisions of stereotype-congruent group members. In other words, a backlash effect (e.g., Rudman & Glick, 2001) occurred for recruiters who were less interpersonally sensitive when confronted with gender-occupational incongruent applicants. Thus, recruiters low on interpersonal sensitivity behaved according to common stereotypes.

The present results fall in line with previous research showing that people high in perspective-taking or empathy (constructs that are related to interpersonal sensitivity) stereotype less than people with lower scores on these con-

structs (Batson et al., 1997; Galinsky & Moskowitz, 2000; Pettigrew & Tropp, 2008). Interpersonal sensitivity does not only seem to be the opposite of stereotyping (Fiske et al., 1999), it can prevent or *buffer* stereotyping. In a situation in which stereotypes are salient and activated (when facing gender-occupation incongruent applicants), increased interpersonal sensitivity is related to increased likelihood of hiring, most likely because more interpersonally sensitive people try to form accurate impressions of others, put effort into the task, and/or rely less on quick and automatic stereotypical judgments.

It is possible that personality characteristics related to interpersonal sensitivity explain why more interpersonally sensitive recruiters were less under the influence of the gender-occupational stereotype when taking a hiring decision. Interpersonal sensitivity is related to extraversion, conscientiousness, and openness (see meta-analytical review Hall, Andrzejewski, & Yopchick, 2009). Thus, maybe interpersonally sensitive recruiters are more conscientious and therefore more motivated to overcome biased decisions. Future research might want to investigate whether cognitive and/or motivational factors explain the buffer effect.

We used the PONS to assess recruiter interpersonal sensitivity. Research suggests that people who perform well on the PONS use local information processing style (i.e., deliberate information search focusing on individual features) (Schmid, Schmid Mast, Bombari, & Mast, 2011). Maybe if we used a different test to assess interpersonal sensitivity, the results might have come out less strongly because other interpersonal sensitivity tests might favor a more global information processing style (Bombari et al., in press).

The goal for the recruiter is to find the best person for the job. A recruiter missing a highly qualified applicant because he/she did not fulfill the recruiter's stereotypical expectations is costly for the company. This is why recruiter training programs are of great importance. Our results suggest that recruiter interpersonal sensitivity might be crucial to overcome gender stereotypes contributing to ongoing discussions about how to resolve stereotype usage in the work and organizational context. Brief (2008) argues that self-regulating training might be successful in reducing stereotype usage because it focuses on the refinement of self-observation skills in social interactions. Thus, training on the self, such as improving recruiter's interpersonal sensitivity could be an important asset in recruiter training (Ambady, Bernieri, & Richeson, 2000).

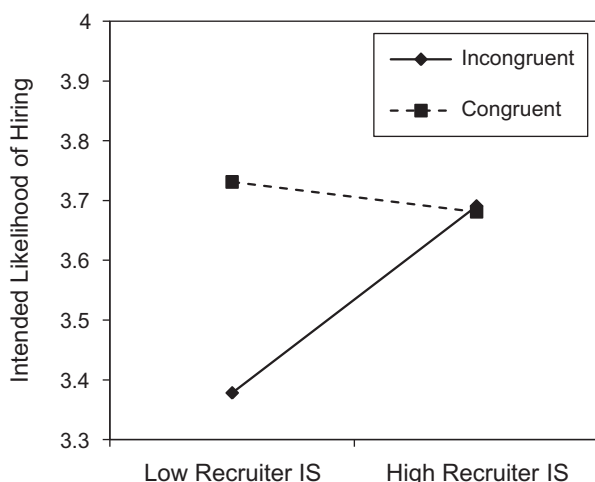


Figure 3. Intended likelihood of hiring by level of recruiter interpersonal sensitivity (Recruiter IS) and gender-occupational congruency.

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G. Article 6

To Add or not to Add a Photograph? Accuracy of Personality Judgments from Resumes
with and without Photographs

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Abstract

In the present study, we investigate whether the applicant photograph on a resume boosts or hampers the accurate assessment of the applicant's personality and general mental ability (GMA) and whether these assessments are less accurate when only the photograph is presented. One hundred and fourteen participants rated 8 applicants (4 male and 4 female) in terms of applicant personality traits and GMA. The design was a 3 (condition: resume with photograph, resume only, and photograph only) x 2 (participant gender) between-subjects design. Results show that in all conditions, personality traits (with the exception of agreeableness) and GMA were assessed at better than guessing level. Adding a photograph to the resume did not change the accuracy of the personality assessment.

Keywords: first impression, resume, photograph, personality traits, accuracy

To Add or not to Add a Photograph? Accuracy of Personality Judgments from Resumes with and without Photographs

1. Introduction

When reading job applicants' resumes, recruiters form first impressions about the applicants' personality and these impressions in turn affect the later stages of the selection process. For instance, resume-based first impressions of recruiters influence which questions are asked during the job interview (Binning, Goldstein, Garcia, & Scattaregia, 1988), how the applicant will be evaluated after the interview (Macan & Dipboye, 1990), and how much positive information from the job interview the recruiter will recall (Dipboye, Stramler, & Fontenelle, 1984). To the extent that such resume-based first impressions are accurate – meaning that the impressions about the applicant correctly represent the applicant – they might help to improve recruiter decision making. However, if these impressions are not accurate, they introduce bias in the selection process and thus decrease the predictive validity of the recruiter's assessment.

The information gathered from a resume is used by the recruiter to form an impression about the applicant's abilities (e.g., language, technical, educational degree, job experience) and the applicant's personality (e.g., interpersonal, leadership) (Brown & Campion, 1994). Cole and colleagues have provided ample evidence that recruiters are indeed able to accurately assess applicants' personality traits based on the applicants' resumes, at least with respect to certain personality traits (Cole, Feild, Giles, & Harris, 2009; Cole, Feild, & Stafford, 2005). These results were obtained when studying US job applicants' resumes that typically do not contain a picture of the applicant (Watkins & Johnston, 2000). In the European context, and especially in Switzerland, it is more common to include a

photograph in one's resume (Doyle, 2011). We set out to test whether adding a photograph to the resume decreases or enhances the accuracy with which the applicant's personality is assessed and we also tested whether the applicant personality can be assessed accurately just by looking at the applicant photograph.

1.1. Accurate Assessment of Applicant Personality and GMA

Barrick, Patton, and Haugland (2000) showed that applicants' extraversion, openness, and agreeableness were judged correctly by recruiters in a 30-min job interview. Recruiters and laypersons correctly assessed applicants' personality profiles, their openness, extraversion, and conscientiousness after having watched a 2-min excerpt of a job interview (Schmid Mast, Bangerter, Bulliard, & Aerni, 2011). Contrary to personality trait accuracy (e.g., accurate assessment of extraversion or conscientiousness) personality profile accuracy describes the extent to which the applicant is assessed accurately across all five personality traits (see a more detailed description in the method section).

Correct applicant personality assessment is not only possible based on observing applicants in a social interaction (i.e., job interview) but is also possible based on an applicant's resume. Students correctly inferred applicants' openness to experience and conscientiousness based on the applicants' resumes (Cole et al., 2005). Undergraduates judged two applicant resumes and inferred the applicant's personality traits using the Big Five personality framework. As the criterion for applicant personality, the authors used the applicant's self-reported personality on the NEO-FFI (Costa & McCrae, 1992). In a further study, Cole and colleagues (2009) found that only extraversion could be assessed correctly by recruiters based on resumes (not conscientiousness or openness to experience, as was the case in their previous study). Each applicant resume was reviewed independently by a pair

of recruiters who inferred extraversion, openness to experience, agreeableness, neuroticism, and conscientiousness of the applicants. The applicant's actual personality was measured by the applicant's self-report on the NEO-FFI personality questionnaire (Costa & McCrae, 1992). Recruiters are obviously able to correctly infer some personality traits of applicants based on the applicants' resumes. However, which traits those are, differs from study to study. With respect to assessing GMA based on resumes, applicants who submit an electronic resume are viewed as more intelligent than applicants who submit a paper resume (Elgin & Clapham, 2004). Whether or not, an applicant's GMA can be assessed correctly based on his or her resume has not yet been investigated. However, people are generally rather good at correctly assessing others' GMA based on excerpts of social interactions (Borkenau & Liebler, 1992; Murphy, Hall, & Colvin, 2003) and even based on portrait photographs only (Zebrowitz, Hall, Murphy, & Rhodes, 2002).

1.2. Effects of Applicant Photograph

In various countries, it is customary that resumes include a photograph of the applicant (Doyle, 2011). Research clearly shows that photographs on resumes affect the recruiter's evaluation of the applicant (e.g., Colarelli, Poole, Unterborn, & D'Souza, 2010; Dipboye, Fromkin, & Wiback, 1975). So far, the focus often was on the so-called halo effect (also the "what is beautiful is good" effect) (Thorndike, 1920) that photographs on resumes can evoke. That is, attractive (male and female) applicants (photographs attached to the resume) are rated as being more suitable for the job regardless of their job relevant experience documented in their resume (Marlowe, Schneider, & Nelson, 1996). Also, attractiveness (based on a photograph) boosts the evaluation of the recruiter when the quality of the

resume is mediocre whereas when the quality of the resume is good, attractiveness does not influence the recruiter's evaluation (Watkins & Johnston, 2000).

Whether adding a photograph to a resume when inferring the personality of the applicant affects the accuracy of the personality assessment has not yet been investigated. The photograph might hamper accurate personality assessment to the extent that the photograph leads to biased perception (e.g., Marlowe et al., 1996; Watkins & Johnston, 2000) or it can help accurate personality assessment to the extent that it contains valid information about the applicant's personality that can be inferred from the photograph. To illustrate the latter point, a very expressive face might be interpreted as a sign of extraversion and if the person actually is extraverted, the photograph can increase accuracy. It is also possible that the photograph does not affect accuracy when the photograph contains the same information as the resume or when the photograph is ignored when assessing the applicant based on the resume.

1.3. The Present Study

The goal of the present research was to uncover whether adding a photograph to the resume affects the accuracy of the personality assessment of an applicant. Also, we test whether personality can be assessed accurately just based on the applicant's photograph. Our research is also the first to address whether GMA can be assessed accurately based on a resume and it extends existing research on accurate personality assessment based on resumes by testing whether not only the single personality traits but also the personality profile of an applicant can be assessed accurately.

2. Method

2.1. Participants

Participants were 75 women and 39 men ($N = 114$) with a mean age of 27 years (ranging from 19 to 62 years). They were recruited in public places (e.g., cafeteria) at two different universities of French-speaking Switzerland. Most were bachelor and master students in psychology, education, economy, natural science, language translation, law, and philosophy. Some participants were working as doctors, pharmaceutical assistances, or teachers, for instance.

2.2. Procedure

Each participant assessed the personality characteristics of 8 job applicants (4 female and 4 male Caucasians) based either on the applicants' resumes (with or without photograph) or on their photographs only, in a 3-condition between-subjects study design. After having read each of the 8 resumes (either with the applicants' photographs attached to the resumes or not) or after having seen each of the 8 photographs, participants reported their perception of the applicant's personality including GMA. At the end of the experiment, participants were thanked, debriefed, and given a small gift (e.g., pen).

2.3. Material and Measures

Target applicant resumes. Participants viewed either 8 different target applicant resumes with photographs, without photographs or the 8 photographs only. The resumes with the corresponding photographs were real and obtained from 4 men and 4 women (mean age 28 years, ranging from 25 to 33 years). The resumes contained information about the professional career, education, and hobbies of the applicants. In the photograph-only condition, no information besides the photographs of the applicants was presented.

Target applicants' personality self-assessment. We used an abbreviated form of the NEO Big Five personality trait measure (Schallberger & Venetz, 1999). Each dimension of

the NEO was assessed with six items in a semantic differential form, e.g., for agreeableness, participants indicated whether they are *very social* (1), *pretty social* (2), *rather social* (3), *rather solitary* (4), *pretty solitary* (5), or *very solitary* (6). Scores on the items pertaining to each dimension were averaged and larger values indicate a stronger presence of a given trait. Target applicants filled in the NEO about themselves. Also, they asked two good friends of theirs to report how they see the personality of the target applicant using the NEO. Friends returned the questionnaire in a stamped envelope directly to the researchers in order to assure confidentiality. Combining the friends' with the self-ratings typically increases the reliability of the assessment and is common practice in research on accurate personality perception (Colvin, Vogt, & Ickes, 1997; Funder & Colvin, 1988; Funder, Kolar, & Blackman, 1995).

The correlations between the friends' and the self-ratings across the 5 dimensions ranged from -.22 to .95 (median = .72). Correlations among friends' ratings ranged from .00 to .96 (median = .70). We averaged the targets' personality self-report scores and the two friends' personality assessment scores concerning the target applicant for each dimension of the NEO. These aggregated ratings served as the criterion to which each participant's perception of the target applicant was compared to in order to assess accuracy.

Personality assessment of target applicants. Participants assessed each of the 8 target applicants on two adjectives for each personality dimension (similar to the self-reported NEO dimensions except that for each dimension, only 2 instead of 6 items were used). Internal consistency (Cronbach alpha) varied between .65 and .83 (median = .78) for extraversion, between .38 and .60 (median = .45) for agreeableness, between .77 and .85

(median = .80) for conscientiousness, between .58 and .85 (median = .67) for neuroticism, and between .63 and .86 (median = .72) for openness.

Specific personality trait accuracy. To measure how well participants assessed each of the 5 NEO dimensions, we used a correlational approach (Davis & Kraus, 1997; Schmid Mast, Bangerter, Bulliard, & Aerni, 2011). We correlated each participant's ratings of the targets on a specific dimension (e.g., extraversion) with the target applicants' self-ratings (aggregated with the friends' ratings) for that specific NEO dimension. Note that these correlations are across 8 targets within one NEO dimension. The correlation coefficient thus becomes an indicator of accuracy with higher numbers denoting more accuracy. For all subsequent analyses we first Fisher-transformed the correlation coefficients for normalization. The reported means are correlation coefficients that were back transformed into Pearson r .

Personality profile accuracy. To measure how well participants assessed the personality profile of each target applicant (the relation of each NEO dimension to each other), we correlated each participant's ratings of one target on each NEO dimension with that target applicant's self-ratings (previously aggregated with their friends' ratings) on the 5 NEO dimensions. Note that this correlation is across the 5 NEO dimensions, performed separately for each of the 8 target applicants. For each participant, we then averaged these correlation coefficients across all eight targets.

Applicant GMA. We assessed the target applicants' GMA via the Wonderlic Personnel Test (Wonderlic, 2001) which is a valid measure of cognitive ability (Dodrill, 1983; McKelvie, 1989). This paper-pencil test consists of 50 items which measure the target applicant's vocabulary, arithmetic reasoning, and spatial ability. The test-taker has 12

min to answer as many items as possible. We assessed the target applicant's GMA based on the number of correctly answered items ($M = 23.87$, $SD = 3.87$).

Perceived target applicant GMA. Participants indicated how intelligent they perceived each target applicant to be. We used 5 items: “the applicant has difficulties with arithmetic reasoning” (reverse scored), “the applicant is used to solving problems”, “the applicant is good at mathematical logics”, and “the applicant has problems answering exercises on logical reasoning” (reverse scored), all measured on a scale from 1 (*I do not agree at all*) to 5 (*I totally agree*) and “how intelligent do you perceive the applicant to be?” on a scale of 1 (*not intelligent at all*) to 7 (*very intelligent*). In all conditions, the internal consistency across all 5 items was high (Cronbach alphas varied between .73 and .91; median = .82). We thus averaged the scores across all 5 items after having standardized them.

Accuracy of GMA assessment. To measure how accurately the participant assessed the target applicants' GMA, we again used a correlational approach (Davis & Kraus, 1997). For each participant, we calculated the correlation between his or her ratings of the target applicant's GMA and the Wonderlic Personnel Test score of the target applicant (number of correctly answered items) across the 8 target applicants. Note that the resulting correlation coefficient is treated as an indicator of accurate GMA assessment and that for all subsequent analyses conducted, we first Fisher-transformed the correlation coefficients for normalization. The reported means, however, are correlation coefficients that were back-transformed into Pearson r .

3. Results

People's ability to correctly infer others' characteristics based on reading applicants' resumes (with or without photographs) or on watching applicants' photographs was tested by calculating simple *t*-tests against 0 for the personality profile accuracy, for each of the specific personality trait accuracies, and for GMA, for each of the 3 conditions separately. The test value of 0 was used because a correlation coefficient of 0 would be expected if participants assessed the traits of the target applicants with random accuracy. Table 1 displays the results. Participants were able to assess above chance all aspects of the applicants' characteristics in all 3 conditions with the exception of agreeableness in the resume-only and in the photograph-only conditions.

To test whether accuracy differed according to the characteristic assessed, we calculated pair-wise *t*-tests among the accuracy assessments of openness, conscientiousness, extraversion, agreeableness, neuroticism, and GMA and corrected the alpha level for multiple tests with the Bonferroni formula. This way, for a difference to be significant at $p = .05$, the p -level of the pair-wise comparisons had to be $p < .003$. *Figure 1* shows that for all 3 conditions, conscientiousness was significantly more accurately assessed than agreeableness and neuroticism, the latter with the exception of the photograph-only condition.

To test how the information at hand (resume with photograph, resume only, or photograph only) affects accuracy, we calculated a 3 (resume with photograph, resume only, and photograph only) by 2 (participant gender) ANOVA for each of the accuracy measures separately.

For the **profile accuracy**, there was a significant participant gender main effect, $F(1, 108) = 7.00, p = .010$, showing that women were more accurate ($M = .31^1$) at assessing the applicants' personality profile than were men ($M = .23$). Moreover, there was a significant condition main effect, $F(2, 108) = 6.34, p = .002$, indicating that applicants' personality profile was assessed most accurately when viewing the resume only ($M = .32$). When the resume was accompanied by a photograph, participants assessed applicants' personality profile more accurately ($M = .29$) than when seeing photographs only ($M = .19$). To better understand these differences, we conducted contrast analyses (*Figure 2*). There was no significant difference in how accurately applicant profile personality was assessed between the resume-with-photograph and the resume-only conditions, contrast- $t = 0.96, p = .170$. However, applicants were more accurately assessed in the resume-only than in the photograph-only condition, contrast- $t = 3.69, p < .001$ and in the resume-with-photograph than in the photograph-only condition, contrast- $t = 2.80, p < .01$. There was no significant interaction effect, $F(2, 108) < 0.56, p > .571$.

For the trait-specific accuracy of **agreeableness**, there was no significant gender main effect, $F(1, 107) = 0.75, p < .390$ and no significant condition main effect, $F(2, 107) = 0.09, p < .917$. However, there was a marginally significant interaction effect between participant gender and condition, $F(2, 107) = 2.59, p < .079$. Women were relatively more accurate in assessing the applicant's agreeableness than men when either provided with a resume with photograph or with a resume only. For the photograph-only condition, men were more

¹ Note that the means reported are Pearson r s, thus back-transformed from the Fisher r s used for the calculations.

accurate judges of applicant agreeableness than women. Note, however, that agreeableness was a trait that was assessed accurately only in the resume-with-photograph condition.

For the trait-specific accuracy of **extraversion**, there was a marginally significant participant gender main effect, $F(1, 108) = 3.38$ $p = .069$, indicating that female participants were more accurate at assessing applicants' extraversion ($M = .29$) than male participants ($M = .17$). There were no other significant effects (all F 's < 1.53 , all p 's $> .222$).

For the trait-specific accuracy of **conscientiousness**, **neuroticism**, **openness**, and **GMA**, there were no significant main or interaction effects, all F s < 2.59 , all p s $> .111$.

4. Discussion

The goal of the present research was to investigate how adding a photograph to the resume affects the accuracy with which first impressions about applicants' personality characteristics are formed. We tested how accurately participants perceived applicants' resumes with and without photographs and photographs only with respect to the applicants' personality profile, personality traits, and GMA. Results reveal that in all three conditions, the applicant's personality profile as well as each of the specific personality characteristics were assessed at better than chance level (with the exception of agreeableness which was accurately assessed only in the resume-with-photograph condition). Similar to Cole and colleagues (Cole et al., 2009; Cole et al., 2005), the traits most accurately assessed in our study are conscientiousness, openness, and extraversion. That more traits were assessed accurately in our study compared to Cole and colleagues might be due to the different methodologies used. In the Cole et al. studies (2009, 2005), either two recruiters rated one applicant resume or all judges ($N = 52$) rated the same two applicant resumes. In our study, each applicant resume ($N = 8$) was assessed by all participants ($N = 114$). This increase in

number of judges (compared to both Cole et al. studies) might have enhanced the reliability of the judgment and therefore resulted in higher correlations and therefore better accuracy. Also, the test against 0 which we employed as the significance test for accuracy is statistically powerful.

That conscientiousness was more easily assessed than agreeableness in all 3 conditions is in line with previous research about assessing personality traits in social interactions (Borkenau & Liebler, 1992; Watson, Clark, & Tellegen, 1988). Agreeableness seems difficult to assess when seeing a picture (Borkenau & Liebler, 1992) or interacting with a stranger (Funder & Colvin, 1988) and also when basing judgments on written information such as applicant resumes. This is also confirmed by research showing that when the photograph contains expressive nonverbal behavior, people are more accurate at assessing the target's agreeableness and openness compared to photographs which did not include expressive nonverbal behavior (Naumann et al., 2009). Photographs accompanying resumes typically show a more stern and serious and less expressive face and this was certainly the case for the photographs in our study.

Our main finding is that adding a photograph to the resume did not affect judgment accuracy. More astonishing, even when judges only viewed the photograph of an applicant, accuracy of the personality assessment remained unchanged, with the exception of personality profile accuracy. In the photograph-only condition, the applicants' personality profile was assessed significantly less accurately than in the resume-with-photograph and in the resume-only conditions. Note however, that overall, accuracy was still above chance for assessing the personality profile in the photograph-only condition. All in all, adding one's photograph to the resume seems not to be a better or worse custom than not adding it – at

least with respect to the impression an applicant conveys about his or her personality.

Applicant photographs therefore do not necessarily lead to biased recruiter hiring decisions.

So far, research has shown a rather negative impact of applicant photographs on hiring decisions, due to the so called halo effect, for instance (e.g., Colarelli et al., 2010; Dipboye et al., 1975). Our study does not negate that photographs can bias grossly how a person is evaluated; it just demonstrates that looking at an applicant's photograph does not bias the assessment of that applicant's personality. On the contrary, applicant photographs contain a wealth of nonverbal information and research shows that certain nonverbal cues are indicative of a person's personality and that some of these cues are used by observers to infer a person's personality (e.g., Borkenau & Liebler, 1992; Naumann et al., 2009). Research shows that personality traits such as extraversion and conscientiousness (and in some studies also agreeableness) (e.g., Borkenau, Brecke, Möttig, & Paelecke, 2009; Borkenau & Liebler, 1992) as well as intelligence, status, and leadership (e.g., Antonakis & Dalgas, 2009; Schmid Mast & Hall, 2004) can be assessed accurately based on photographs only. Confirming these results, our study shows that even a photograph alone without a resume can be a sufficient basis for the correct assessment of a person's personality characteristics (with the exception of agreeableness).

Our results suggest that there is some redundancy in the personality information contained in the resume and in the photograph and although the photograph does not add information to the resume, it does not distract from it either. In other words, the negative image of the applicant photograph probably needs to be revised. There is ample evidence showing that correct judgments about people are possible from a picture and this is also true in the context of a selection procedure. So the intuitively correct first impressions we

form based on a photograph are not just fantasies or projections of the perceivers but also contain accurate information about the personality of an applicant.

In line with the literature documenting that women are more accurate at assessing others than men (Hall, 1984), women were better than men at correctly assessing applicants' personality profiles and at correctly assessing applicants' extraversion (marginally). Thus, women are not only better at assessing others' states and traits when seeing another person interact (e.g., on video), but also when judging applicants' personality based on resumes. Note that there was no significant interaction effect between participant gender and condition, meaning that women outperformed men in all conditions, also in the photograph-only condition.

5. Conclusion

In sum, the bad reputation of adding a photograph to one's resume seems unsubstantiated when it comes to how accurately raters assess the personality of applicants. To the extent that the selection process focuses more and more on personality traits (Bartram, 2005), maybe there is a more prominent role to play for applicant photographs in the selection process.

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Table 1

Test of Better than Chance Accuracy for Each Type of Accuracy for each of the Conditions

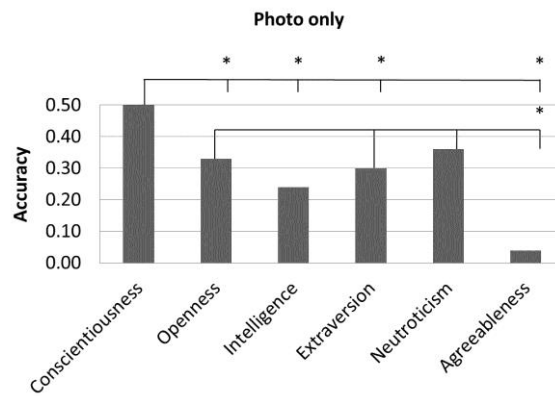
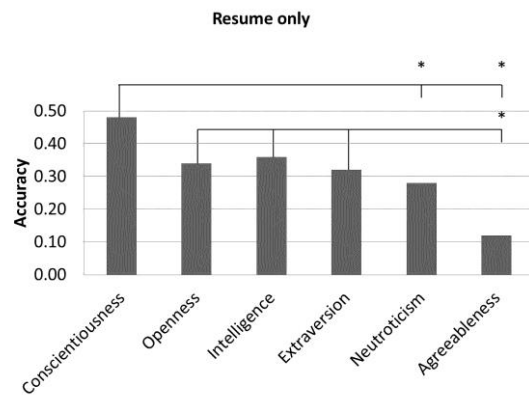
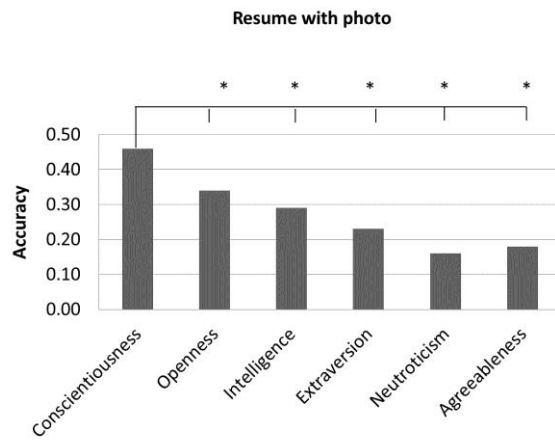
	Condition		
	Resume with photograph <i>df</i> = 40	Resume only <i>df</i> = 40	Photograph only <i>df</i> = 31
Type of accuracy			
Personality profile	.32***	.33***	.19***
Specific traits			
Conscientiousness	.39***	.40***	.47***
Openness	.27***	.26***	.26**
Extraversion	.21***	.28***	.28***
Neuroticism	.12*	.25**	.30***
Agreeableness	.15*	.11	.04
GMA	.26***	.29***	.19**

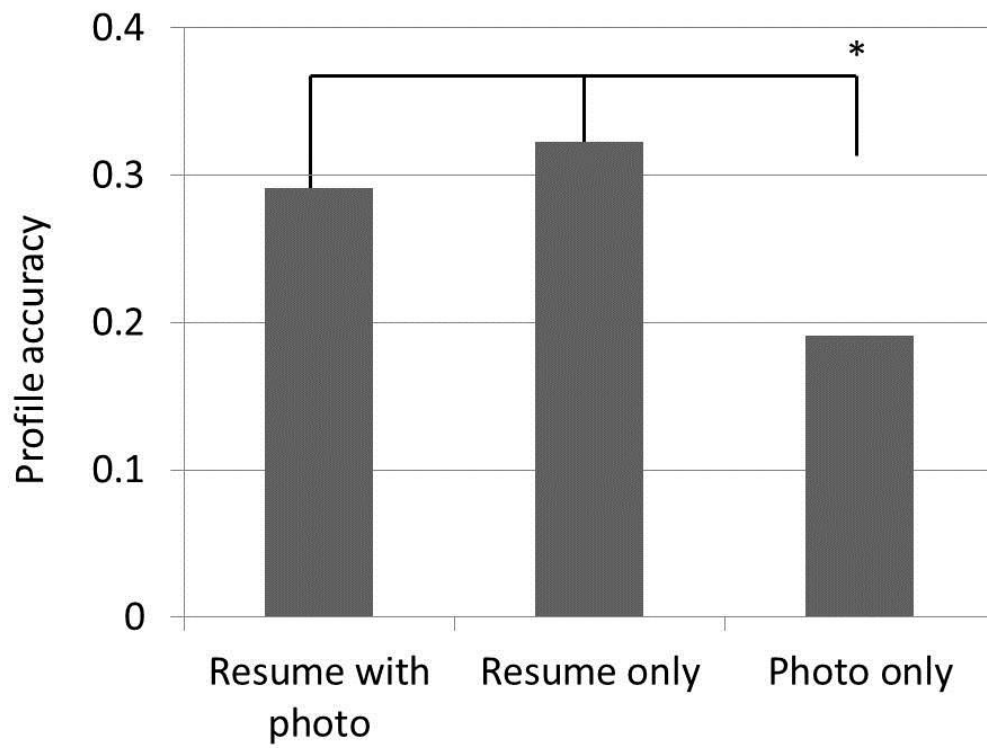
Note. Entries are Pearson *r*'s (back transformed from Fisher *r*'s), significance testing is a *t*-test against 0. * $p < .05$; ** $p < .01$; *** $p < .0001$.

Figure Captions

Figure 1. Differences in accuracy according to the trait to be assessed, for resumes with photograph, for resume only, and for photograph only. Asterisks indicate a significant difference at least at the $p < .05$ level (after Bonferroni correction).

Figure 2. Condition main effect of profile accuracy. Note that the means are Pearson r 's, thus back transformed from the Fisher r 's used for the calculations.





* $p < .01$

H. Book chapter

The Impact of Nonverbal Behavior in the Job Interview

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The Impact of Nonverbal Behavior in the Job Interview

Introduction

In human resources, employee selection plays a major role. Given that an organization functions only with its members, the selection of a member who contributes the most and best to the productivity is aspired (Guion & Highhouse, 2006). Thus, the selection has a powerful impact on the company's outcome, going both ways; as much as a good selection can have a positive impact, a bad selection can have a negative impact on the company.

While a wide array of different employment selection tools are used such as ability tests, personality tests, and assessment centers (Gatewood, Feild, & Barrick, 2011), the job interview is the most frequently used selection tool across countries, jobs, and levels (McDaniel, Whetzel, Schmidt, & Maurer, 1994; Salgado, Viswesvaran, & Ones, 2001). Recruiters value the job interview to a large extent because they believe that a better hiring decision can be made after having met the applicant in person than from evaluating the applicant's biographical data or test scores only (Gatewood et al., 2011). Moreover, research has shown that recruiters tend to trust their first impressions more than objective tests (Dipboye, 1994). Thus, to get in contact with the applicant and to draw inferences about him or her based on his or her interpersonal behavior seems to be a desired aspect by practitioners.

Because the job interview is a dyadic social interaction in which the applicant and the recruiter normally meet for the first time, the nonverbal cues such as one's smiling, nodding, eye contact, body posture (i.e., visual cues) but also voice pitch, speaking rate, and speaking time (i.e., paralinguistic or vocal cues) play an important role. Both the applicant and the recruiter try to form a first impression of their interaction partner. In case

of the applicant's behavior, the recruiters try to infer different characteristics relevant for the job such as a specific personality profile, certain skills, job-relevant competences, but also motivation, values, leadership, and company attraction (Gatewood et al., 2011).

Although this information can be drawn from the verbal behavior, the nonverbal behavior is often more important (Arvey & Campion, 1982) because useful information expressed nonverbally can very often not be expressed verbally (Schlenker, 1980). For instance, if an applicant emphasizes in a job interview being very stress resistant while at the same time nervously fidgeting in the chair, the recruiter might have the impression that this applicant might not be the right person for a job in which stress resistance is an important competence.

When using nonverbal behavior to form a first impression, different questions can be raised such as how the applicant's nonverbal behavior is linked to the recruiter's hiring decision? What information is conveyed by the applicant's nonverbal behavior? Which applicant nonverbal cues are used to infer certain characteristics? How accurate are the inferences based on the nonverbal behavior? And, what is the impact of the recruiter's nonverbal behavior on the applicant? We first introduce results concerning the link between the applicant's nonverbal behavior and recruiter evaluation and then present the Brunswikian lens model (1956) based on which we summarize the literature focusing on the role of the applicant's (i.e., sender) nonverbal behavior, the recruiter's (i.e., perceiver) perception, and the judgment accuracy of the recruiter. In a last section we review literature on recruiter nonverbal behavior and how it influences the perception and behavior of the applicant.

The applicant's nonverbal behavior and job interview outcomes

It is widely accepted that the first impression of the applicant by the recruiter is not only based on *what* the applicant says but also on *how* the applicant answers the recruiter's questions (Imada & Hakel, 1977). In other words, applicants convey a first impression through their expressed nonverbal behavior during the job interview. For instance, an applicant who shows a high amount of smiling and uses extensive hand gestures might reveal the impression of being an extraverted person. This first impression can affect different outcomes, such as how favorably the applicant is evaluated.

Research shows that there is a positive relation between applicant *positive nonverbal behavior* and recruiter evaluation. Positive nonverbal behavior can be defined as immediacy behavior which elicits proximity and liking in the interaction partner as for example a high level of eye contact, smiling, confirmative nodding, hand gestures, and variation in pitch and speaking rate (Guerrero, 2005). Applicants who used more immediacy behavior (i.e., eye contact, smiling, body orientation toward interviewer, less personal distance) were perceived as being more suitable for the job, more competent, more motivated, and more successful than applicants using less immediacy behavior (Imada & Hakel, 1977). Forbes and Jackson (1980) showed that selected applicants maintained more direct eye contact, smiled more, and nodded more during the job interview than applicants who were not selected for the job. Moreover, applicants who maintained a high amount of eye contact with the recruiter, who showed a high energy level, were affective, modulated their voice, and spoke fluently during the job interview were more likely to be invited for a second job interview than applicants revealing less of those nonverbal behaviors (McGovern & Tinsley, 1978). Parsons and Liden (1984) found that speech patterns such as articulation, voice intensity, and pauses predicted recruiter hiring decision, above and

beyond objective information (e.g., school and extracurricular activities). Also, selected applicants showed more eye contact and more facial expression during the job interview than non-accepted applicants (Anderson & Shackleton, 1990). Finally, applicants who showed authentic smiles were evaluated more favorably than applicants with a fake or neutral smiling behavior (Krumhuber, Manstead, Cosker, Marshall, & Rosin, 2009).

The impact of applicant immediacy nonverbal behavior on job interview outcome has also been investigated in relation to other factors, such as job or applicant characteristics. For instance, applicants who avoid eye contact with the recruiter when applying for a low-status job (blue-collar job) are not evaluated significantly less favorably compared to applicants gazing regularly at the recruiter. In contrast, applicants who avoid eye contact with the recruiter are significantly less favorably evaluated (compared to applicants gazing regularly at the recruiter) when applying for a high-status job (white-collar job) (Tessler & Sushelsky, 1978). Moreover, applicant smiling behavior had a negative impact on jobs which are more masculine (e.g., newspaper reporter) and for which the job holder is expected to smile less (Ruben, Hall, & Schmid Mast, 2012).

In terms of applicant characteristics, applicants high in communication apprehension who used more nonverbal avoidance behavior (i.e., less talking, less eye contact, less fluent talking) were less effective in mock job interviews and were perceived as less suitable for the job than applicants with low levels of communication apprehension (Ayres, Keereetaweep, Chen, & Edwards, 1998). And, applicant gazing had a reversed effect for male compared to female applicants (Levine & Feldman, 2002): The more the male applicant maintained eye contact with the recruiter the less he was liked, whereas the more the female applicant gazed at the recruiter the more she was liked.

Applicant nonverbal behavior as an impression management (IM) strategy

Whether nonverbal behavior can be used consciously by applicants to convey a favorable impression has been debated. While some argue that nonverbal behavior is more spontaneous, less under control, and thus less conscious than verbal behavior (Peeters & Lievens, 2006), others argue that even if people are not always fully aware of their nonverbal behavior, they are still able to regulate it, especially for self-presentation purposes (Stevens & Kristof, 1995). Research that confirms the former view shows that even if applicants were told to convey a favorable impression (i.e., using more positive nonverbal behavior) during the job interview, they did not express more or less nonverbal behavior than applicants who were told to be as honest as possible (Peeters & Lievens, 2006). Contrary to this, applicants can use their nonverbal behavior as an impression management (IM) strategy. In this case, they consciously modify their nonverbal behavior in order to positively impress the recruiter (Steven & Kristof, 1995). Nonverbal IM typically includes positive nonverbal cues such as applicant smiling, gazing, affirmative nodding, and gesturing.

In the nonverbal IM literature, applicant nonverbal behavior is mostly measured based on self-report questionnaires rather than on coding of actual behavior. This approach rests on the assumption that positive nonverbal behavior is used in a conscious way to convey a favorable impression. Applicants are asked how much they think they smiled during the job interview or how often they think they had eye contact with the recruiter (Kristof-Brown, 2000; Stevens & Kristof, 1995; Tsai, Chen, & Chiu, 2005). Using such self-reports of applicant nonverbal behavior, the results look very similar to those obtained by more objective behavioral observation methods: The more the applicant reported to have used

nonverbal IM during the job interview the better he or she was evaluated by the recruiter (Steven & Kristof, 1995). Also, nonverbal IM had a remarkable impact on the recruiter's hiring decision when the job interview was less structured compared to a structured job interview (Tsai et al., 2005). Finally, nonverbal IM positively influenced perceived recruiter similarity: the more the applicant expressed positive nonverbal behavior during the job interview the more he or she was perceived by the recruiter as being similar whereas nonverbal behavior IM did not increase the perceived qualification of the applicant (Kristof-Brown, Barrick, & Franke, 2002).

Overall, there are only few studies that did not show an effect between applicant nonverbal immediacy behavior and a favorable hiring decision (Kristof-Brown et al., 2002; Sterrett, 1978) and meta-analytical analyses reveal a clear net effect showing that the more the applicant uses nonverbal immediacy behavior, the better the interview outcome for the applicant (e.g., better chances of getting hired or of being evaluated positively): $r_w = .40$ (Barrick, Shaffer, & DeGrassi, 2009) and $r_w = .34$ (Frauendorfer & Schmid Mast, 2013b).

How to explain the applicant nonverbal behavior hiring decision link

Why does the applicant's nonverbal behavior influence how the applicant is evaluated? Different explanations are provided by the literature.

First, Forbes and Jackson (1980) suggest that the nonverbal behavior helps the recruiter to judge the applicant more correctly, as the pre-screening of the applicants might not have delivered much information about how the applicants differ from each other in terms of competences, education, or work experience. Thus, specific nonverbal cues might make the differences among applicants more salient, especially in a rather homogenous group of applicants. This is the so-called *salience hypothesis*. Investigating mentally retarded

individuals, research confirms this salience hypothesis in that a group of mentally retarded applicants (who were homogenous in their ability to respond and to articulate), their nonverbal behavior explained a greater portion of the variance in the recruiter's hiring decision than in a group of mentally retarded applicants who were heterogeneous (ranging from people who could not answer questions to people who were responsive) (Sigelman & Davis, 1978; Sigelman, Elias, & Danker-Brown, 1980). Thus, in a situation of homogenous applicants, the focus is rather on the nonverbal behavior, because this helps to differentiate between similar individuals (Edinger & Patterson, 1983).

A second explanation is based on the *reinforcement theory*, claiming that recruiters make their decision already at the very beginning of the job interview and reinforce their first impression of the applicant during the job interview based on the applicant's behavior (Webster, 1964). In this case, the nonverbal behavior of the applicant is nothing else than the response to the recruiter's reinforcement during the job interview. This means that the recruiter's first impression can cause the applicant to behave in a manner that confirms the recruiter's impression (behavioral confirmation; Darley & Fazio, 1980; Snyder & Swann, 1978). According to Forbes and Jackson (1980) this second explanation does not necessarily contradict the first one, because the first impression drawn by the recruiter could be based on the salient nonverbal behavior of the applicant at the very beginning of the job interview.

A third explanation considers the *immediacy hypothesis* claiming that through nonverbal immediacy behavior (e.g., eye contact, smiling, hand gestures, closer interpersonal distance), applicants reveal more proximity and perceptual availability which entails positive affect in the recruiter and therefore leads to a better evaluation (Imada &

Hakel, 1977). Put differently, liking might act as a mediator on the relation between applicant nonverbal behavior and hiring decision (Edinger & Patterson, 1983). Also the explanation based on the *immediacy hypothesis* goes hand in hand with the *reinforcement theory* in that the positive affect elicited in the recruiter can result in reinforcement towards the applicant.

Differences in nonverbal behavior expression

Research has not only shown that the applicant's nonverbal behavior has a positive impact on job interview outcomes, but also that the frequency of nonverbal behavior expression varies according to situation and among individuals. How frequently certain nonverbal behaviors are exhibited in a job interview depends on different factors, such as the situation, the applicant personality, the applicant gender, and the applicant race, among other factors.

Situational factors. Situational factors that are typically considered in the job interview are the type of job interview (past-behavioral vs. situational) and the degree of structure in the job interview (structured vs. unstructured). Past-behavioral means that the recruiter addresses questions to the applicant about specific situations in the past with the intention to know how the applicant behaved in those situations. In situational job interviews recruiters ask applicants about possible future situations and how they think they would behave in those situations (e.g., Campion, Cheraskin, & Stevens, 1994; Janz, 1982; Motowidlo et al., 1992). Structured job interviews mean that the recruiter addresses standardized questions to the applicant and evaluates the applicant according to standardized criteria. In contrast, unstructured job interviews do not follow any preset procedure (McDaniel et al., 1994). Investigating the frequency of nonverbal behavior IM in

different types of job interviews, no significant difference was found between past-behavioral and situational interviews. In both types the same amount of nonverbal impression management was used (Peeters & Lievens, 2006). However, when investigating the structure of the job interview, significant differences were found in terms of specific nonverbal cues, such as applicant self-touch (Goldberg & Rosenthal, 1986). Applicants in the unstructured condition (chat for a few minutes about no specific topic) revealed more self-touch (hair, face, arm, and hand) than applicants in the formal job interview condition. Men showed more face touching and women showed more hair touching. Future research might want to focus on systematic research to obtain a clearer picture about the effects of different situations on the use of nonverbal behavior by applicants.

Personality factors. Investigating the relation between applicant's personality and the applicant's nonverbal behavior during the job interview, research shows that more agreeable applicants express more positive nonverbal behavior during the job interview (i.e., smiling and maintaining eye contact) (Kristof-Brown et al., 2002), especially when applicants are told beforehand to evoke a favorable impression (Peeters & Lievens, 2006). Moreover, high self-monitoring women maintained more eye-contact with the recruiter than low self-monitoring men and women (Levine & Feldman, 2002). And, high self-monitoring applicants used more nonverbal behavior during the job interview in general, than low self-monitoring applicants (Peeters & Lievens, 2006). However, this was only the case if applicants had specific instructions to use more nonverbal behavior. When there were no such instructions, applicant self-monitoring was unrelated to applicant nonverbal behavior (Peeters & Lievens, 2006). So far only little research focused on personality differences in the context of the applicant's nonverbal behavior. Especially personality

traits such as extraversion and conscientiousness might be interesting to investigate in the future, because they have shown to predict future job performance. It might be crucial for the recruiter to know how highly extraverted and conscientious applicants express those traits nonverbally.

Gender differences. There are also gender differences concerning the use of nonverbal cues, such as smiling, gazing, interpersonal touch, interpersonal distance, and vocal behavior during the job interview. For instance, female applicants smile and nod more than male applicants (Frauendorfer, Schmid Mast, Nguyen, & Gatica-Perez, 2013b; Van Vianen & Van Schie, 1995). In one study conducted in our lab, female applicants also provided more visual back-channeling (i.e., nodding while speaking), spoke faster and louder, and varied more in their speech loudness than did male applicants. In terms of pitch variation, results were inconsistent; in one of our studies men revealed higher pitch variation than women whereas in another study, the reversed effect emerged. For gazing and speaking time, there seems to be no gender difference (Frauendorfer et al., 2013b; Van Vianen & Van Schie, 1995). Moreover, male applicants keep a larger interpersonal distance from (male) recruiters than do female applicants from (female) recruiters (Levine & Feldman, 2002). In sum, results on gender differences are very similar to the ones found in the general population (Dixon & Foster, 1998; Hall, 1984; Hall & Carter, 2000).

Race differences. In terms of race differences, white applicants maintained more eye contact with the recruiter of both races than did black applicants. Moreover, black and white applicants gazed more at the white recruiter than at the black recruiter (Fugita, Wexley, & Hillery, 1974). The least amount of eye contact was exchanged when both, the applicant and the recruiter were African American and the most eye contact was exchanged

when the applicant and the recruiter were European American (Fugita et al., 1974). Thus, white people use more eye contact in job interviews than do blacks. The latter might have other nonverbal IM strategies to make a good impression (Pelligrini, Hicks, & Gordon, 1970). More research needs to be conducted to obtain a clear insight into how race affects the use of nonverbal behavior.

Summary of role of the applicant's nonverbal behavior in the job interview

Applicant nonverbal behavior seems to have a remarkable impact on the job interview outcome. The more immediacy (or positive) nonverbal behavior the applicant shows during the job interview, the more positive recruiter evaluations of the applicant are. Moreover, different explanations of why applicant immediacy nonverbal behavior positively influences job interview outcome can be found in the literature: the salience hypothesis, the reinforcement hypothesis, or the immediacy hypothesis. Although these explanations have different rationales, they are not necessarily mutually exclusive. They might be considered as an integrative way of explaining the nonverbal behavior-hiring decision link. Finally, which nonverbal behavior is expressed depends on different factors, such as the situation, the personality, the gender, or the race of the applicant. In the next section we will present a Brunswikian perspective investigating what the applicant's nonverbal behavior expresses and what recruiters infer when basing their judgment on the applicant's nonverbal behavior.

A Brunswikian perspective towards the encoding and decoding of applicant characteristics via nonverbal behavior

So far, several questions remain unanswered, such as what exactly it is that *recruiters* infer from nonverbal cues, or which nonverbal cues express applicant characteristics, and how accurate recruiters are at inferring applicants' characteristic when basing their

judgment on the applicant's nonverbal behavior. Before we present the Brunswikian lens model (1956), it is important to look at which applicant characteristics are normally inferred by recruiters who try to gain a first impression about applicants.

The most frequently measured constructs in the selection process are applicant personality traits and cognitive ability (Ng & Sears, 2010; Van Vianen & Van Schie, 1995) because they have shown to predict later job performance (Barrick & Mount, 1991; Dunn, Mount, Barrick, & Ones, 1995; Nicholls & Visser, 2010; Schmidt & Hunter, 1998; Tews, Stafford, & Tracey, 2011). While cognitive ability and conscientiousness predict job performance in all job categories (Schmidt & Hunter, 1998), extraversion is a valid predictor for jobs requiring social interactions (Barrick & Mount, 1991). Moreover, applicant personality traits do not only influence future job performance but also have an impact on the job interview outcome. For instance, applicants with a high level of extraversion, openness to experience, and conscientiousness use more social preparation (e.g., talking to others) before the job interview and are therefore more successful in the job interview (Caldwell & Burger, 1998). Thus, applicant personality traits are crucial in the job interview context because they are the most frequently assessed characteristics (besides general mental ability) and they have shown to predict the job interview outcome and job performance.

The Brunswikian lens model (1956) posits that target characteristics are expressed through the target's nonverbal behavior on which in turn the perceiver bases his or her judgment. Thus, the nonverbal behavior mediates the relation between the target's characteristics and the perceiver's judgment. *Encoding* means the relation between the actual target characteristics and the corresponding expressed nonverbal behavior and

decoding means the relation between the target's nonverbal behavior and the perceiver's judgment. Encoding gives information about how a given target characteristic is expressed in behavioral cues (i.e., cue validity) whereas the decoding process gives information about which behavioral cues the perceiver uses for his or her judgment (i.e., cue utilization). Finally, the relation between the perceiver's judgment and the target's characteristic is an indicator of judgment accuracy. The more cue validity and cue utilization are similar, the higher the accuracy of the perceiver's judgment (Ambady, Hallahan, & Rosenthal, 1995; Gifford, 2011; Sommers, Greeno, & Boag, 1989). Based on the lens model, the following sections review the literature on cue utilization, cue validity, and judgment accuracy in the job interview.

Recruiter assessment through applicant nonverbal behavior

On which nonverbal cues does the recruiter base his or her judgment (i.e., cue utilization according to the Brunswikian lens model)? One study, for instance, has shown that the more the applicant showed eye contact and was facially expressive, the more he or she was perceived as being *interesting, relaxed, strong, successful, active, mature, enthusiastic, sensitive, pleasant, dominant, and liked* (Anderson & Sheckleton, 1990). And, applicants showing more postural change were perceived as more *enthusiastic* and more applicant head movement was perceived as being more *sensitive*. Moreover, constructs such as *social skills* of an applicant were inferred based on the applicants' amount of gesturing, and time talked and applicant's *motivation* for the job was based on the applicant's smiling, gesturing, and time talked (Gifford, Ng, & Wilkinson, 1985). The more applicants used these nonverbal cues the more they were perceived as being socially skilled and motivated. Also, a high amount of applicant eye contact predicted perceived

competence and *personal strength* whereas more positive facial expressions predicted perceived *liking* and *motivation* (Anderson, 1991). Finally, in one of the studies conducted in our lab, applicant *extraversion* was inferred based on numerous applicant vocal cues (i.e., more applicant speaking time, less short utterances - such as “mmhh”, “ah” - less speaking turns, and a higher speaking rate), *openness* was inferred through more speaking time, *neuroticism* was negatively related to speaking time and positively related to number of turns during the job interview, *agreeableness* was inferred based on visual cues (i.e., more smiling and gazing behavior), and vocal cues (i.e., higher speaking rate, higher variation in speaking rate and more speaking fluency), and *conscientiousness* was positively related to more nodding behavior and higher speaking rate. *Intelligence* was inferred based on more nodding, speaking time, a higher speaking rate, less short utterances (i.e., “mmhh”, “ah”), and less turns. (Frauendorfer et al., 2013b).

Investigating composites of nonverbal cues, DeGroot and Gooty (2009) found that perceived applicant *conscientiousness* and *openness to experience* were positively related to a composite of applicant visual cues (i.e., overall index of physical attractiveness, amount of smiling, gazing at the recruiter, hand movement, and body movement towards the recruiter). And, perceived applicant *extraversion* was positively related to a composite of applicant vocal cues (i.e., overall index of pitch, pitch variability, speech rate, pauses and amplitude variability). Moreover, perceived applicant *conscientiousness*, *openness to experience*, and *extraversion* mediated the positive relation between applicant nonverbal behavior (i.e., visual and vocal cues) and the job interview outcome. The more the applicant revealed vocal and visual cues the more he or she was perceived as being conscientious, open, and extraverted which in turn lead to a more favorable evaluation (DeGroot & Gooty,

2009). Thus, personality traits are not only inferred based on single applicant nonverbal cues but also based on composites of different nonverbal cues.

Table 1 provides an overview of studies investigating nonverbal cues upon which diverse applicant personality traits and characteristics are assessed. As can be seen, applicant eye contact and facial expressiveness are used to assess most applicant characteristics (e.g., success, dominance, personal strength, likability). Interestingly, characteristics which are similar to each other such as intelligence and conscientiousness are assessed based on the same nonverbal cues, as for instance, applicant nodding and speech rate. Moreover, extraversion and neuroticism are assessed mostly based on vocal nonverbal behavior, whereas conscientiousness is mostly assessed via visual nonverbal cues (except for speaking rate). And, when inferring applicant agreeableness, both visual and vocal nonverbal behavior is used. Finally, openness seems to be least often assessed by applicant nonverbal behavior.

Applicant traits and skills expressed in nonverbal behavior

Which applicant nonverbal cues convey the applicant's personality traits and skills during a job interview? To date, there has been little research conducted answering this question. Because the illustration of cue validity in job interviews is highly relevant for the present review, we will briefly summarize research conducted in non-job interview situations. We focus on so called zero-acquaintance situations because in the job interview, typically, the recruiter meets the applicant for the first time.

One study, for instance, shows that *extraversion* is expressed by a powerful voice, a friendly expression, smiling, and head movements, *agreeableness* is indicated by a high voice, friendly expression, less frequent hand and head movements, and *neuroticism* is

expressed via a powerful voice (Borkenau & Liebler, 1992). Another study reports *extraversion* being correlated with a friendly expression, smiling, and a powerful voice, *conscientiousness* with a powerful voice, *neuroticism* with a less friendly expression and a weak voice, and *openness* and *intelligence* with a low voice (Borkenau & Liebler, 1995). In yet another study, *intelligence* was mostly expressed through less fidgeting behavior and more eye contact with the interaction partner (Murphy, Hall, & Colvin, 2003).

Research on cue validity in the job interview is scarce. Using the Brunswikian lens model approach, Gifford, Ng, and Wilkinson (1985) found that applicant *social skills* were positively related to gestures and time talked during the job interview. Moreover, applicant *motivation* was revealed through trunk recline (Gifford et al., 1985). Based on two studies conducted in our lab, a high level of applicant *extraversion* was encoded by more speaking time, higher speaking rate, and more speaking rate variation, a high level of applicant *openness* was revealed by more audio back-channeling (i.e., short utterances while recruiter is speaking) and a louder voice, a higher level of applicant *neuroticism* was shown by less speaking time and higher pitch, a higher level of applicant *agreeableness* is revealed through more audio back-channeling and more smiling, and a higher level of applicant *conscientiousness* was encoded by a higher amount of speaking time and more eye contact with the recruiter (Frauendorfer et al., 2013b). Finally, applicant's *intelligence* was revealed through less speaking time.

Table 2 provides an overview of studies investigating the nonverbal behavior that is indicative of actual applicant characteristics. As can be seen, extraversion is mostly expressed through vocal nonverbal behavior. And, constructs similar to each other such as

intelligence and conscientiousness are expressed through the same nonverbal cues (i.e., speaking time).

Conclusions have to be drawn carefully because there is little research so far investigating the link between actual applicant personality traits and expressed applicant nonverbal behavior. Moreover, Gifford (2006) argues that the encoding process faces different complexities. For instance, not all nonverbal behaviors might be relevant in all situations. That is, dominant nonverbal behavior might be less relevant in job interviews for a position in accounting than for a position in management. Also, the encoding might depend on the interaction partner, as the target might not encode the same nonverbal cues facing different interaction partners. There might be differences in encoding, depending on how the interaction partner behaves, for instance (e.g., Kanki, 1985; Kenny, 1994). We will indeed show later in this chapter, that the recruiter's nonverbal behavior can affect how the applicant behaves nonverbally as well as the outcome of the job interview for the applicant.

The relation between nonverbal behavior and personality can also vary between different combinations of traits, for instance, a person who is sociable *and* shy reveals different nonverbal behaviors than somebody who is sociable *but not* shy. Certain personality traits might also be encoded by a combination of different nonverbal behaviors (e.g., looking at the interaction partner while speaking) than by one specific nonverbal cue alone. Encoding might also differ between males and females with a given personality trait encoded by one nonverbal behavior for one sex but not holding up for the other. Finally, personality encoding might differ between cultures. Thus, the lens model approach is affected by different factors that can influence the validity of the inferences drawn. This might be a reason for the fact that it is not yet clear whether the nonverbal behavior

explains variance above and beyond applicant competences and verbal content or whether it lowers the validity of the hiring decision (Harris, 1989).

When comparing cue validity and cue utilization in job interviews, it clearly emerges (based on Table 1 & 2) that extraversion and neuroticism are assessed based on valid vocal nonverbal cues. Applicant agreeableness, however, is inferred from applicant eye contact, smiling, speaking rate, speaking rate variation, and speaking fluency whereas agreeableness is actually expressed by applicant smiling only. Openness is inferred based on visual and vocal behavior, whereas it is actually expressed through audio back-channeling only. Given this, the question can be asked how accurate recruiters are when inferring applicant characteristics. For many personality characteristics, they seem to use the “wrong”, meaning non-diagnostic cues.

Accuracy of recruiter inferences

There is evidence that recruiters perform quite well when assessing applicants based on only short excerpts of a job interview. For instance, Blackman (2002a) found that participants in the role of a recruiter are accurate at assessing the applicant's personality traits after a mock job interview. Also, recruiters were accurate at assessing applicants' personality traits based on 30-min job interviews (Barrick, Patton, & Haugland, 2000). And, Gifford et al., (1985) showed that social skills are accurately assessed by recruiters after having watched a videotape of a job interview.

Even being provided with only a short glimpse of the applicant behavior, recruiters are able to accurately assess personality traits: Judges predicted applicant personality traits based on 10-sec (Prickett, Gada-Jain, & Bernieri, 2000) and 2-min slices of a mock job interview (Schmid Mast, Bangerter, Bulliard, & Aerni, 2011). Moreover, we showed that

recruiters were able to correctly infer the applicant's future job performance as well as their personality traits, after having watched a 40-sec thin-slice of an applicant answering two job interview questions (Frauendorfer & Schmid Mast, 2013a). Interestingly, the first impression might not become more accurate when the thin-slice behavior is extended. Research outside the context of the job interview suggests that there is no significant difference in judgment accuracy when the judgment is based on 30s or 5 min excerpts (Ambady & Rosenthal, 1992, 1993; Murphy, 2005).

Research on situational (e.g., job interview structure) and personal (e.g., years of experience of the recruiter) factors influencing judgment accuracy has shown that personality is more accurately assessed in face-to-face job interviews than in telephone interviews, in which no visual nonverbal behavior is available (Blackman, 2002a). The author argues that more behavioral information is available in the face-to face interview, which results in higher accuracy judgment. Moreover, personality judgment was more accurate in unstructured compared to structured job interviews (Blackman, 2002b). This relation was mediated by the amount of applicant talking during the job interview. Thus, the unstructured job interview might put the applicant more at ease, which increases the quantity of disclosed behavior (speaking time) and this in turn makes personality judgments about the applicant more accurate. Interestingly, we found that additional information, such as a photograph on an applicant's resume does not impact assessment accuracy. Personality traits and intelligence of the applicant were assessed significantly accurately, regardless of whether the applicant's resume contained a photograph or not (Schmid Mast, Frauendorfer, & Sutter, 2013). And, recruiter experience was unrelated to personality judgment accuracy (Frauendorfer & Schmid Mast, 2013a; Schmid Mast et al., 2011).

Applicant nonverbal behavior does not only provide the recruiter with information about the applicant's personality traits or intelligence, but can also tell whether the applicant uses deceptive IM strategies. Especially the nonverbal behavior (compared to the verbal behavior) is indicative of whether the applicant is dishonest or not (DePaulo, 1992). Deceptive IM strategies are known to be used by applicants in order to polish their competency profile (Gilmore & Ferris, 1989; Levashina & Campion, 2007). This dishonest strategy might decrease job interview validity (Delery & Kacmar, 1998; Gilmore, Stevens, Harrell-Cook, & Ferris, 1999; Levashina & Campion, 2006; Marcus, 2006). In other words, the recruiter might miss a highly qualified applicant while selecting a less qualified applicant who used deceptive IM. Research so far has shown that recruiters are able to correctly detect lies and that they are better than lay people (Roulin, Bangerter, & Levashina, in press; Schmid Mast et al., 2011), however, their level of detecting honest answers is higher than their level of detecting dishonest answers (Roulin et al., in press).

In sum, recruiters are quite good at correctly assessing applicant's personality and at detecting deceptive answers based on the applicant's nonverbal behavior. Situational factors such as the structure and the type of the job interview have a remarkable impact on both, accurate personality judgment and lie detection. The role of the personal factors regarding the recruiter such as the years of experience show an unclear picture with respect to accuracy in personality judgment and lie detection.

Recruiter nonverbal behavior

The recruiter's behavior is a crucial factor in the job interview as it is one of the main reasons for the applicant to accept a job offer (Glueck, 1973). The better the general impression the applicant has of the recruiter, the more favorably the company is perceived

by the applicant and therefore the more likely the applicant is to accept the job. Moreover, the recruiter's nonverbal (and verbal) behavior is constantly interpreted by the applicant to obtain signs regarding the chances to obtain the job (Connerley & Rynes, 1997; Rynes & Miller, 1983). This can be explained by the fact that applicants often have only little information about the job offer and they use the recruiter's behavior as a signal to know more about the employment characteristics. Indeed, it is shown that recruiter (nonverbal) behavior only has an impact on company attraction when the applicant has little information about the job and the company (Powell, 1984; Rynes & Miller, 1983). Moreover, the more the recruiter shows nonverbal behavior such as maintaining eye contact and smiling, the better the impression the applicant forms about the recruiter and the job (Gilmore & Ferris, 1989; Keenan & Wedderburn, 1975; Turban, Forret, & Hendrickson, 1998). And, the more nonverbally friendly the recruiter behaves during the job interview, the more the applicant makes positive inferences about the organization (Goltz & Giannantonio, 1995). Recruiter listening skills – most likely conveyed through nonverbal behavior (e.g., smiling, nodding, and facial expression) - had a positive impact on the applicant's willingness to accept the job offer (Harn & Thornton, 1985). Also, the recruiter's nonverbal behavior affects the applicant's evaluation of the recruiter and the applicant's nonverbal behavior. The more the recruiter interrupted the applicant during the job interview, the less the recruiter was perceived as being an empathic listener by the applicant (McComb & Jablin, 1984). And, interviewees rated interviewers as least attractive, gave the shortest answers, and were sitting furthest away from the interviewer when the interviewer did not maintain eye contact (Kleinke, Staneski, & Berger, 1975).

Recruiter nonverbal behavior does not only have an impact on the applicant's perception but also on how the applicant is perceived by strangers. For instance, outside observers perceived the applicant as liking the recruiter more when the recruiter shook the applicant's hand at the beginning of the job interview (Staneski, Kleinke, & Meeker, 1977). And, the more the recruiter showed nonverbal approval behavior (i.e., smiling, eye contact, and gesturing) the more the applicant was rated (by neutral observers) as being comfortable and as having conveyed a better impression (Keenan, 1976; Keenan & Wedderburn, 1975; Washburn & Hakel, 1973). Thus, there are also inferences made about the applicant, based on the recruiter's behavior only.

Research investigating moderators that influence the relation between recruiter nonverbal behavior and applicant behavior shows that recruiter nonverbal behavior (cold vs. warm) had a more pronounced impact on applicants with low self-esteem than it had on applicants with high self-esteem (Liden, Martin, & Parsons, 1993). Low self-esteem applicants performed significantly better (based on verbal and nonverbal behavior) when the recruiter showed warm nonverbal behavior compared to a recruiter showing cold nonverbal behavior, whereas for high self-esteem applicant the recruiter behavior (cold vs. warm) did not influence the applicant's performance. In sum, recruiter nonverbal behavior has a remarkable impact on the applicant perception about the recruiter and the company as well as on the applicant behavior.

Implicit stereotypes and the self-fulfilling prophecy

Often, recruiter nonverbal behavior is elicited by (gender or racial) stereotypes recruiters might harbor. This in turn can influence the applicant's performance during the job interview (Anderson & Shackleton, 1990; Word, Zanna, & Cooper, 1974). For instance,

European American interviewers revealed less immediacy behavior (in terms of physical distance, forward lean, eye contact, and shoulder orientation), more speech errors, and spoke less when facing a black applicant compared to when facing a white applicant (Word et al., 1974). This recruiter behavior in turn had a negative impact on the applicant's behavior, as a subsequent study of the same authors showed. Less recruiter immediacy behavior, more recruiter speech errors, and less recruiter speaking time decreased applicants' job interview outcomes, whereas applicants interviewed by a recruiter with nonverbal approval behavior (i.e., smiling, head nodding, and eye contact) performed better in the job interview. In this study both applicants and interviewers were white (Keenan, 1976; Word et al., 1974).

This is in line with the behavioral *confirmation theory* claiming that a perceiver's beliefs (e.g., recruiter) can cause the target (e.g., applicant) to behave in a manner that confirms the perceiver's beliefs (i.e., self-fulfilling prophecy; Darley & Fazio, 1980; Snyder & Swann, 1978) and this relation tends to be mediated by recruiter nonverbal behavior. In the same vein, research shows that the more a male recruiter possessed an implicit gender bias, the less well a female applicant performed in a job interview (Latu, Schmid Mast, & Stewart, 2013). The mechanism through which this effect happens is most likely linked to the recruiter emitting subtle nonverbal cues that convey expectations of incompetence to female applicants who then confirm these expectations – maybe also on an implicit level. In the aforementioned study, male recruiters tended to communicate their implicit gender stereotypes through their interruption behavior. The more the recruiter harbors implicit gender stereotypes the more he tended to interrupt the female applicant, which in turn led to a lower applicant job interview outcome (Latu et al., 2013). And,

sexual harassment behavior of the recruiter (i.e., showing flirting behavior) influenced female applicants, as they spoke less fluently, gave lower quality answers, and asked fewer job relevant questions than when the recruiter did not show sexual harassment behavior (Woodzicka & LaFrance, 2005).

In sum, recruiter implicit stereotypes towards the applicant seem to be transmitted through recruiter nonverbal behavior, which in turn can decrease the applicant's performance during the job interview. In other words, recruiter nonverbal behavior can be responsible for the subtle transfer of recruiter attitudes towards the applicant.

Summary

Research shows a clear link between applicant nonverbal behavior and recruiter hiring decision. In particular, immediacy nonverbal behavior, such as a high amount of applicant smiling, nodding, eye contact, hand gestures, and pitch variation are positively related to recruiter evaluation. While one line of research has focused on nonverbal behavior measured based on objective observations (e.g., Anderson & Shackleton, 1990; Forbes & Jackson, 1980; Fugita et al., 1974), another line of research assessed nonverbal behavior based on self-reports which reflects the subjective perception of the applicant to what extent he or she expressed certain nonverbal behaviors during the job interview (Kristof et al., 2002). Both methods reveal a positive link between applicant nonverbal immediacy behavior and recruiter hiring decision.

The literature has also evidenced factors influencing the extent to which different nonverbal behaviors are expressed in the job interview. These factors include the situation, the personality, the gender, and the race of the applicant. Depending on these factors, one

might use more or less nonverbal behavior during the job interview (Fugita et al., 1974; Peeters & Lievens, 2006; Van Vianen & Van Schie, 1995).

Based on the Brunswikian lens model approach (1956) it becomes evident that many more nonverbal cues are used to infer applicant's personality traits than are cues actually revealing these traits. This is line with previous research showing that many more nonverbal cues are used to infer dominance, for instance, than are actually indicative of dominance (Hall et al., 2005). However, even if recruiters use more nonverbal cues than are actually related to applicant characteristics, recruiters are still accurate in assessing applicants (Frauendorfer & Schmid Mast, 2013a; Schmid Mast et al., 2011; Schmid Mast et al., 2013).

Research has not only focused on the applicant's nonverbal behavior in the job interview, but also on the recruiter's nonverbal behavior and its impact on the applicant's perception. Overall, the more the recruiter reveals warm nonverbal behavior (e.g., smiling, maintaining eye contact, and confirms the applicant with head nods) the better is the impression the recruiter conveys and the higher is the likelihood of the applicant to accept the job offer (e.g., Goltz & Giannantonio, 1995; Harn & Thornton, 1985; Keenan & Wedderburn, 1975; Turban, 1992). Nonverbal behavior of the recruiter can also be responsible for a subtle delivery of stereotypical expectations and attitudes. For instance, interruption behavior of the recruiter can lead to a decrease in the applicant's job interview performance, in case the applicant is not confirming (implicit) racial or gender stereotypes (Latu et al., 2013; Word et al., 1974).

Outlook

So far, most research investigating social perception in the job interview process focused on the recruiter's inference, providing information about which nonverbal cues the recruiters use to infer certain applicant personality traits. By doing so, the lens model approach as a whole has been neglected. That is, cue utilization, cue validity, and assessment accuracy have rarely been investigated in one and the same study (except Gifford et al., 1985). However, only if the lens model approach is considered as a whole can all sides of the lens be investigated and compared. Moreover, recruiters seem to use the nonverbal cues that are not diagnostic to assess applicants – in a sense they use the wrong cues – and are still accurate in assessing applicants' personality. It remains therefore largely unknown how the recruiters make those correct inferences. Future research might want to refer increasingly to the lens model approach, which will enable researchers to compare adequately the cue utilization with cue validity and assessment accuracy (Gifford, 2011) and to assess an even wider array of nonverbal behaviors or nonverbal behavior composites.

One way of facilitating the nonverbal behavior coding necessary for this, would be to welcome methodological innovation by using devices which automatically sense and extract the nonverbal behavior of the applicant. Even if the present book chapter is based on ample research about nonverbal behavior in the job interview, studies which investigate a wide array of nonverbal behavior of the applicant are still scarce. Behavioral research stays a time and cost intensive endeavor in which human coders have to view the same social interaction over and over again, in order to accurately code different behaviors (Furnham, 2008; Reis & Charles, 2000). We showed that nonverbal behaviors can be automatically sensed and extracted during the job interview (Frauendorfer, Schmid Mast, Nguyen, &

Gatica-Perez, 2013a) and vividly encourage researchers to invest in such promising methods so that behavioral data collection can be conducted as efficiently as possible. *Automated social sensing* is typically done in two steps: first, the applicant's behavior is sensed and recorded based on ubiquitous computing; second, the applicant's nonverbal behavior is extracted automatically based on computational models and algorithms (Gatica-Perez, Guillaume, Odobez, & McCowan, 2007). Ubiquitous computing stands for the computer environment that adapts to the human environment. It does therefore not require the human to enter the computer environment but the computer and the sensing devices are implied in the everyday environment; the surrounding becomes "smart". The automated extraction of the nonverbal behavior is conducted based on algorithms which are developed by computer scientists (Ba & Odobez, 2011; Basu, 2002; Biel, Aran, & Gatica-Perez, 2011).

The advantage of automated social sensing is that numerous different nonverbal cues from several interaction partners can be extracted at the same time and over long recording periods. Moreover, the automated extraction is very quick. Large amounts of data can be processed once the algorithms for data extraction are developed. Also, automated social sensing has shown to be accurate as long as the setup of the devices fulfills the pre-defined conditions, such as the lightning of the room and camera angles.

Using automated social sensing, we could show that similar results are obtained when extracting the applicant's nonverbal behavior automatically compared to when the nonverbal behavior is coded manually. Automatically sensed and extracted applicant immediate nonverbal behavior such as gazing, speech fluency, and tempo variation predicted recruiter hiring decision (Frauendorfer et al., 2013a). In a further step, we aimed

at showing that automated social sensing can also be used as a valid tool in personnel selection. In other words, we were interested in whether the automatically extracted nonverbal behavior of the applicant would also predict future job performance, especially when the job contains social interactions as a main characteristic, such as sales. Based on previous research showing that the nonverbal behavior of sales people predicts job performance (Leigh & Summers, 2002; Peterson, 2005; Taute, Heiser, & McArthur, 2011; Wood, 2006), we assumed that for sales, the applicant's nonverbal behavior revealed during the job interview might be indicative for future job performance. And indeed, using a door-to-door sales job, we found that the applicant's vocal nonverbal cues such as speaking time, audio back-channeling, and speech fluency all together predicted objectively measured job performance (Frauendorfer, Schmid Mast, Nguyen, & Gatica-Perez, 2013c). Even if there has to be done more research on the usage of automated social sensing in job interviews, we showed first evidence that such a novel method can be predictively valid.

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Table 1

Overview of Studies Investigating the Relation between Inferred Applicant Personality Traits and Nonverbal Behavior

Applicant nonverbal cues	Inferred applicant characteristics
<i>Visual nonverbal behavior</i>	Conscientiousness, openness ¹
Eye contact	Interesting, relaxed, strong, successful, active, mature, enthusiastic, sensitive, pleasant, dominant, liked, competent, strong, <i>agreeableness</i>
Facial expressiveness	Interesting, relaxed, strong, successful, active, mature, enthusiastic, sensitive, pleasant, dominant, liked, motivated
Smiling	Motivation, <i>agreeableness</i>
Gestures	Social skills, motivation
Nodding	<i>Conscientiousness</i> , intelligence
Postural change	Enthusiastic
Head movement	Sensitive
<i>Vocal nonverbal behavior</i>	Extraversion ¹
Speaking time	Social skills, motivation, <i>extraversion</i> , <i>openness</i> , <i>neuroticism</i> (-), intelligence
Speaking turns	<i>Extraversion</i> (-), <i>neuroticism</i> , intelligence (-), communication skills (-)
Speaking rate	<i>Extraversion</i> , <i>agreeableness</i> , <i>conscientiousness</i> ,

	intelligence
Speaking rate variation	<i>Agreeableness</i>
Speaking fluency	<i>Agreeableness</i>
Short utterances	<i>Extraversion (-), intelligence (-)</i>

Note. This overview summarizes the studies mentioned in the present review (Anderson, 1991; Anderson & Sheckleton, 1990; DeGroot & Gooty, 2009; Gifford, et al., 1985; Frauendorfer et al., 2013b). Characteristics in italic refer to the big five personality traits (Costa & McCrae, 1992).

¹ Results of DeGroot and Gooty (2009) investigating visual and vocal nonverbal behavior as composites.

Table 2

Overview of Studies Investigating the Relation between Actual (Applicant) Personality Traits and Nonverbal Behavior

(Applicant) nonverbal cues	Actual (applicant) characteristics
<i>Visual nonverbal behavior</i>	
Eye contact	<i>Conscientiousness, intelligence²</i>
Smiling	<i>Agreeableness, extraversion²</i>
Facial expressiveness	<i>Extraversion², agreeableness², neuroticism (-)²</i>
Head movements	<i>Extraversion², agreeableness (-)²</i>
Gestures	<i>Social skills, agreeableness (-)²</i>
Fidgeting behavior	<i>Intelligence (-)²</i>
Trunk recline	<i>Motivation</i>
<i>Vocal nonverbal behavior</i>	
Speaking time	<i>Social skills, extraversion, neuroticism (-), conscientiousness, intelligence (-)</i>
Speaking turns	
Speaking rate	<i>Extraversion</i>
Speaking rate variation	<i>Extraversion</i>
Audio back-channeling	<i>Openness, agreeableness</i>
Pitch ¹	<i>Neuroticism, agreeableness², openness (-)², intelligence (-)²</i>
Voice energy	<i>Openness, extraversion², neuroticism²,</i>

Note. This overview summarizes the studies mentioned in the present review (Borkenau & Liebler, 1992; Frauendorfer et al., 2013b; Gifford et al., 1985; Murphy, Hall, & Colvin, 2003). Characteristics in italic refer to the big five personality traits (Costa & McCrae, 1992).

¹ High value in pitch means a higher voice. A positive correlation therefore indicates that the more the applicant characteristic is present the more it is expressed through a higher voice.

² Results from non-job interview studies (Borkenau & Liebler, 1992; Murphy, Hall, & Colvin, 2003)