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Perceivers routinely draw inferences about others from their behavior in an attempt to make sense of the world. Previous research has established that spontaneous inferences include stable characteristics such as traits and a number of variable person-related concepts such as goals, intentions, and motivations. The current research investigated the occurrence of more general spontaneous state inferences. In a series of four pre-registered studies ($N = 883$), we adapted two established experimental paradigms frequently used in spontaneous social inference research to the investigation of spontaneous trait and state inferences. In Studies 1 and 2, we observed evidence for the occurrence of spontaneous state inferences from state-implying statements. In Studies 3 and 4, we observed the simultaneous occurrence of spontaneous trait and state inferences from statements that allowed for both inferences. In a fifth study ($N = 97$), we provide evidence that people represent states and traits as functionally different: Participants judged the likelihood of behavioral repetition higher when the same behavior was related to a trait-inference than a state-inference. The observation of multiple simultaneous spontaneous inferences in the current research suggests that further theory building regarding the underlying mechanisms and processes of spontaneous impression formation in person perception from behavior is warranted.

People routinely attempt to make sense of the world they perceive around them. In order to do so, perceivers often go beyond the information that is available to them. One percept of particular interest to lay people and psychologists alike are other people. For our everyday life, making sense of the people around us is paramount: It helps us deal with the sheer complexity of our social environment by attributing causes to observed events (e.g., Kelley, 1967) and predicting future behavior (e.g., Dunning, Griffin, Milojkovic, & Ross, 1990; McCarthy & Skowronski, 2011b; Nussbaum, Trope, & Liberman, 2003), thereby reducing uncertainty (e.g., Heider, 1958; Trope & Gaunt, 2000) and maintaining the illusion of controllability (Biner, Angle, Park, Mellinger, & Barber, 1995; Bruner, 1957).

When trying to make sense of peoples' behavior, observers have a tendency to disproportionally focus on personal dispositions as presumed causes of behavior and disregard situational factors (Heider, 1958; Malle, 2008; Olcaysoy Okten & Moskowitz, 2018), a phenomenon known as the correspondence bias (Jones & Davis, 1965), previously termed fundamental attribution error (Ross, 1977). In psychological research and theorizing, these personal dispositions have frequently been equated with personality *traits*: internal, enduring, and invariant qualities underlying the individual differences in peoples' experiences and behaviors across contexts (Cantor & Mischel, 1977, 1979). Classic theories on impression formation from behavior focused entirely on traits as dispositional attributions (e.g., Gilbert, Pelham, & Krull, 1988; Trope, 1986). Some even assumed that trait attributions occur spontaneously and effortlessly once

behavior is identified, whereas the inclusion of further factors that might have caused or constrained the actor's behavior requires a more effortful, deliberate information search and processing (e.g., Krull & Erickson, 1995; Trope & Gaunt, 2000).

Spontaneous Trait Inferences

A large body of research has indeed supported the assumption that people form trait inferences *spontaneously* when confronted with an actor's behavior. If we learn, for instance, that Daniel laughed at a joke, we may infer that Daniel is a *jolly* person, thus assuming a trait as cause of the observed behavior - a *spontaneous trait inference* (STI; for recent reviews, see Moskowitz & Olcaysoy Okten, 2016; Uleman, Rim, Saribay, & Kressel, 2012). When drawing such inferences, we go beyond the given information and supplement self-generated information, for example by assuming that Daniel's single behavior was representative of an underlying stable disposition to be good-humoured. Research has demonstrated that we draw these inferences instantaneously when encoding behavioral information (Uleman, Hon, Roman, & Moskowitz, 1996), and require only a minimum of our attention (Todorov & Uleman, 2003) and cognitive resources to do so (Wells, Skowronski, Crawford, Scherer, & Carlston, 2011). More importantly, we draw these inferences independent of whether or not we have an explicit intention to form an impression of an actor (e.g., Carlston, Skowronski, & Sparks, 1995; Carlston & Skowronski, 1994; Ferreira et al., 2012; McCarthy & Skowronski,

2011a), and even when it counteracts our current processing goals (e.g., interfering with current task performance, Ham & Vonk, 2003; Todd, Molden, Ham, & Vonk, 2011; Todorov & Uleman, 2004, 2002, 2003), or we actively try to avoid impressions (e.g., Shimizu, 2017). This spontaneity and uncontrollability of trait inferences may offer one explanation why perceivers so often fall prone to the correspondence bias (e.g., Moskowitz, 2005).

Multiple Social Inferences

Spontaneous trait inferences have been investigated intensively, and the evidence in their support has repeatedly been called ubiquitous (Schneid, Carlston, & Skowronski, 2015; Uleman, 2005). Unfortunately, it seems that the ubiquity of evidence for the occurrence of spontaneous trait inferences is often misconceived as evidence for the ubiquity of trait inferences in impression formation from behavior. For example, many established textbooks in social psychology refer only to trait inferences when discussing spontaneous person perception (e.g., Hewstone, Stroebe, & Jonas, 2016; Myers & Twenge, 2018). This representation, however, overlooks two important aspects: On the one hand, researchers have repeatedly discussed and empirically documented multiple spontaneous inference activation, especially simultaneously occurring person and situation attributions (e.g., Lupfer, Clark, & Hutcherson, 1990; Todd et al., 2011). On the other hand, person dispositions as attributions of behavior can encompass more than only personality traits. For example, studies on deliberate impression formation have documented a wide array of different person inferences, ranging from intentions and desires to values and beliefs (e.g., Malle & Holbrook, 2012), which questions the presumed inevitability or priority of trait inferences. In this line, a number of studies on spontaneous impression formation demonstrated spontaneous goal inferences (e.g., Hassin, Aarts, & Ferguson, 2005; Olcaysoy Okten & Moskowitz, 2019; Van Overwalle, Van Duynslaeger, Coomans, & Timmermans, 2012), and motivational inferences (e.g., Reeder, 2009a, 2009b; Reeder, Hesson-McInnis, Krohse, & Scialabba, 2001). Thus, when making sense of others' behavior, perceivers are able to spontaneously draw multiple inferences: I may infer that Daniel is a *jolly person*, while simultaneously inferring that the *joke* he is laughing about may be very *funny*, and/or that Daniel may have the current goal of *being entertained* and having a good time.

In light of these more recent findings, it seems clear that spontaneous impressions of others are not limited to traits, but may encompass a variety of person attributions. Evidence for some of these attributions already exists in the literature. We argue that these may not be limited to goals and motivations, but more generally include inferences about an actor's current mental states, such as affective or emotional states (e.g., happy, surprised, anxious, ashamed), cognitive and attentional states (e.g., focused, interested, dis-

tracted, bored) and physiological states (e.g., hungry, full, sick, tired). We not only presume that people *spontaneously* draw multiple inferences from behaviors but also that these multiple inferences occur *simultaneously* upon encoding others' behaviors.

Spontaneous State Inferences

Psychological theorizing and research has separated traits from states in a number of different ways. A common theoretical account defines traits as stable, inter-individual differences in peoples' proneness, tendency, style, or disposition to behave, feel, or think in certain ways (e.g., Hamaker, Nesselroade, & Molenaar, 2007). States also describe person dispositions for thoughts, feelings, or behaviors. However, states refer to transient *intra*-individual differences that reflect peoples' continuous adaptation to situational demands. Thus, whereas traits are typically conceptualized by their relative stability, consistency, and in-variance over time and across situations, states are characterized by their relative instability, inconsistency, and variance (Hamaker et al., 2007). In our research, we thus operationalize traits and states by their relative temporal stability: Although by no means a binary criterion, traits tend to endure over time, while states are rather short-lived phenomena. This implies that trait and state inferences could hold a different functional value for the perceiver because they may influence predictions about future behavior in different ways.

There are several theoretical and empirical perspectives that support the assumption of spontaneous state inferences. First, and most importantly, some theoretical accounts of spontaneous impression formation actually take state inferences as a given (e.g., Uleman, 2005), at times even regard them as the "default mode" of understanding behavior (Korman & Malle, 2016; Malle & Holbrook, 2012). For example, Heider (1958) originally assumed in his considerations of peoples' naive analyses of action that person inferences for causal attributions of behavior include contemplations of transitory person states such as fatigue and mood, attitudes and needs, or social and legal status. Similarly, in their considerations of correspondence inferences, Jones & Davis (1965) argue that trait inferences about actors rely on inferences about actors' intentional states. A similar argument is brought forward in Reeder's multiple inference model (MIM; Reeder, 2009a, 2009b). It is striking that although several of the most seminal theoretical accounts of interpersonal impression formation and attribution have explicitly addressed state inferences, research on spontaneous impression formation has not given these inferences that much attention. Indeed, the need to investigate whether and to what extent people spontaneously infer states from behavior has been stated repeatedly (e.g., Lillard & Skibbe, 2006; Uleman, Saribay, & Gonzalez, 2008).

Mental states have seen some more attention in research

on deliberate impression formation. There is indeed empirical evidence that people infer mental states from behavior when explicitly prompted to form impressions (e.g., Ames, 2004) or when asked to write about their impressions of others (McClung & Reicher, 2018), and readily explain intentional actions in terms of beliefs, desires, values, and internal states (e.g., Malle, 2004; Malle & Holbrook, 2012; Olcaysoy Okten & Moskowitz, 2019, Experiment 3). Related research in the field of developmental psychology has repeatedly documented children's and adults' ability to deliberately infer and use others' affective and cognitive states, termed *mentalizing* or *theory of mind* (e.g., Kiley Hamlin, Ullman, Tenenbaum, Goodman, & Baker, 2013; Ruffman, 2014; Scott & Baillargeon, 2017). However, we lack empirical research investigating if and to what extent any of the above listed state inferences occur spontaneously (e.g., Apperly, Riggs, Simpson, Chiavarino, & Samson, 2006; Lillard & Skibbe, 2006).

There is another field of research, which may provide important insights for the current research question, namely the field of text comprehension. Given that most STI research relies on written statements about others' behavior (but see Fiedler & Schenck, 2001; Fiedler, Watling, Menges, & Schenck, 2005), theorizing and research on text comprehension may provide helpful insights to the question which inferences people draw spontaneously from written behavior statements. There are indeed several theoretical accounts of text comprehension that describe spontaneous inferences about mental states from text (e.g., Cook & O'Brien, 2017; Graesser, Singer, & Trabasso, 1994; Kintsch, 1998), and empirical evidence for their occurrence has been provided, at least for emotional states (e.g., Diergarten & Nieding, 2016; Gernsbacher, Goldsmith, & Robertson, 1992). However, it remains an open question if and to what extent text comprehension effects actually represent inferences about actors of behavior or merely represent mere activation of semantic associations.

There are good reasons why mental state inferences could and should occur *spontaneously* in the social inference process. First, research on person perception has already documented that people are generally able to spontaneously process situational information when forming impressions (e.g., Reeder et al., 2001). Trope's (1986) model of impression formation and attribution even assumes that situational information is initially processed and used in order to identify observed behavior (i.e., situational inducement). Technically, we cannot assume that situations directly *cause* behavior but have to assume that situations or their appraisals impact people who in turn respond with behavior. Previous research has indeed documented that people process others' mental states when thinking about eliciting situations (e.g., Thornton & Tamir, 2020).

Second, it has been repeatedly argued that the presumed dominance of trait inferences in impression formation results

from their high functional value: Knowing a person's stable dispositions allows predicting their future behavior (e.g., Heider, 1958; Hoffman, Mischel, & Mazze, 1981; McCarthy & Skowronski, 2011b). However, drawing state inferences can be equally informative. On the one hand, inferring others' mental states does enable a perceiver to derive situation-specific short-term behavioral expectations and tailor their own responses accordingly (e.g., Thornton & Tamir, 2020). On the other hand, state inferences can also signal that the current observation may not warrant predicting future behavior, or that behavior predictions should be limited to the very short-term, thus preventing erroneous over-generalizations about others. Consequently, spontaneous state inferences may turn out to be equally functional and adaptive as spontaneous trait inferences.

Finally, recent theorizing in personality psychology actually defines the person-descriptive aspects of traits as density distributions of states (i.e., whole trait theory; Fleenor & Jayawickreme, 2015; Jayawickreme, Zachry, & Fleenor, 2019). In this understanding, a trait-ascription is related to a person's frequent manifestations of trait-related states. For example, a person who is described with the trait label *shy* is expected to *feel and act in shy ways* frequently and in many situations, an idea originating with Mischel (1968). Applying whole trait theory to person perception suggests that in order to ascribe a trait to an actor, observers might need to recognize the actor's current state, infer that the actor experiences this state frequently and in many situations, and thus generalize that this current state is a representative manifestation of an underlying trait.

In summary, there are several theoretical and empirical reasons that support our notion that perceivers may spontaneously infer mental states from behaviors. When referring to mental states, we explicitly include *any* behavior-related person condition that is temporally limited. We thus propose a wider range of inferences than the considerations of intentionality, desire, and belief proposed by Malle (e.g., Malle, 2005; Malle & Holbrook, 2012), and further include affective, emotional, cognitive, attentional, and physiological states.

The goal of our research was (a) to provide empirical evidence that state inferences can occur spontaneously, (b) to investigate whether perceivers can simultaneously draw trait and state inferences from the same behaviors or whether trait and state inferences from the same behavior would be mutually exclusive, and (c) to demonstrate that state and trait inferences have a different functional value for perceivers.

The Current Research

We conducted a series of five studies using different stimulus materials and established experimental paradigms. In the first set of two studies, we employed single-implication behavioral descriptions that allow for either unambigu-

ous trait inferences (e.g., "I gave the homeless man five euros"—generous) or unambiguous state inferences (e.g., "When my sister and her husband exchanged rings, I just couldn't hold back the tears"—touched). We used a false recognition paradigm (Todorov & Uleman, 2002), collected data online (Study 1), and compared results with data collection in the lab (Study 2). We then developed a second set of dual-implication behavioral stimuli that allowed for simultaneous trait and state inferences (e.g., "Vanessa read the book until late at night"—studious, interested) which we employed in a false recognition paradigm (Study 3) and a probe recognition paradigm (Study 4; Todd et al., 2011). To foreshadow results: All four studies provided robust evidence for the spontaneous and simultaneous occurrence of state and trait inferences. Finally, in Study 5, we explored if and to what extent people functionally distinguish between state and trait inference in impression formation, focusing on the perceived predictability of future behavior. All studies were preregistered with the Open Science Framework (<https://osf.io/v5j78/>) where we also provide open access to materials, raw data, and analyses codes. We report how we determined our sample sizes, all data exclusions, all manipulations, and all measures in the description of each study and the online supplemental materials. The faculty's local ethics committee approved all procedures (protocol number: 2018_180).

Material generation

For the current research endeavor, it was paramount to create stimulus materials that allow for a valid differentiation between state and trait inferences without favouring either inference. We therefore conducted a pilot study and a series of pretests in order to develop one set of single-implication behavioral statements that exclusively allow for either trait or state inferences (to be used in Studies 1 and 2) and another set of dual-implication behavioral statements that allow for simultaneous trait and state inferences (to be used in Studies 3-5). We summarize this extensive preparatory research here and provide detailed descriptions and results of all pretests in the online supplemental materials.

Given that our studies relied on established experimental paradigms that use adjective probes, we first conducted a pilot study to establish a set of person-describing adjectives that people use unequivocally to either refer to traits or states. We briefed a sample of participants about trait and state concepts and asked them to rate the relative stability vs. variability of a list of 323 adjectives. Based on the resulting ratings, we chose those 69 adjectives that were rated as the most stable as traits (e.g., introverted, smart, ambitious) and the 72 most variable as states (e.g., bewildered, thirsty, disgusted) as basis for further stimulus generation. In a next step, we generated a set of 196 statements in German language that described single behaviors imply-

ing these selected states or traits (without explicitly mentioning the respective adjectives). We ensured that behavioral statements focused on relatively mundane behaviors and did not contain any additional linguistic markers that might elicit trait or state inferences. We submitted these statements to a pretest, in which we asked participants to name a person-describing adjective that came to mind when reading a statement. For Study 1 and 2, we selected only statements that reached a consensus score of 50% or higher.¹ The selected trait-implying and state-implying statements did not differ significantly in agreement rate or statement length (see online supplemental materials).

For Studies 3 to 5, we created a second set of dual-implication behavioral statements in English language that described more ambiguous behaviors potentially allowing for simultaneous trait and state inferences. For statement creation, we relied on a large sample of crowd-workers. We provided participants with a list of person describing states selected from our pilot study and asked them to think of a behavior that could be indicative of this state while at the same time being attributable to a person's trait (see online supplemental materials for detailed instructions). Based on these responses, we selected a set of 288 statements that we submitted to a further pre-test. We therefore briefed an independent sample of participants ($N = 171$) about the trait and state concepts as stable vs. variable actor characteristics and asked them to name both a state and a trait that may come to mind when reading a behavioral statement. Again, we only selected statements to be included in Studies 3, 4, and 5 that reached a consensus score of 50% or higher for both, trait and state, with the further constraint that mean consensus scores for traits and states did not differ across all selected stimuli.

Study 1

In the first study, our goal was to establish whether people show indications of spontaneous state inferences when presented with single-implication state-implying behavioral statements. We adapted the established false recognition paradigm (Todorov & Uleman, 2002). In this paradigm, participants are first asked to memorize a series of statements describing individual actors' behaviors. In a later recognition phase they are presented with the images of the actor and indicate whether a probe word occurred in the statement or not. In the crucial conditions, these probes are adjectives implied by the presented behavior. Spontaneous trait inferences are inferred from higher false recognition rates in the implied-trait condition (e.g., erroneously responding "yes"

¹Note that in some cases the adjectives named by participants were not identical with the pre-tested adjectives on which we had based stimulus generation. Separate analyses, however, revealed no significant differences in the pattern of results

to an adjective that was implied but not presented in a behavioral statement) as compared to a control condition. In the present study we implemented the paradigm using behavioral statements either unambiguously implying states or traits in order to (a) establish whether significant indicators of state inferences can be observed and to (b) provide a first effect size estimate for state inferences. We used a similar approach as Levordashka and Utz (2017), presenting behavioral statements to appear like ostensible posts on a social media platform.

Method

Sample size determination

Based on a minimum effect size of interest of Cohen's $d_z = 0.20$ for crucial one-tailed within-sample t -tests comparing between implied and implied-other conditions (see *Procedure*) for the trait and the state condition, both conditions required a minimum of $n = 156$ participants, respectively, to provide enough statistical power ($1 - \beta = .80$) with $\alpha = .05$, calculated using G*Power 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007). However, to avoid unnecessary spending, we relied on a sequential testing procedure (Lakens, 2014) with one interim analysis planned at 37 valid data sets or time = .26 for each condition, using a Pocock-type spending function calculated with the GroupSeq package for R (Pahl, 2018). We pre-registered to stop data collection if the observed effects were significant at the interim analysis at $\alpha_1 = .018$. If they were not, we planned to continue data collection until $N = 184$ valid data sets would have been collected and perform the final analysis with $\alpha_2 = .032$. In order to secure the required numbers of valid data sets after applying the pre-registered exclusion criteria, we overpowered both studies by 12.5%, thus planning to collect data from $n = 41$ and $n = 207$ participants per condition for the interim and final analyses, respectively.

Participants

The current study relies on valid data from a total of $N = 86$ participants (45 female; average age $M = 28.9$ years, $SD = 8.7$, ranging from 18 to 58). The majority of participants indicated being native speakers of German (87%), while 13% indicated to speak German as one of their native languages. Participants were recruited via Prolific (www.prolific.ac) and received monetary compensation of 1.49 GBP (approx. 1.91 USD) for the duration of ten minutes. Participants were randomly assigned to either the trait condition ($n = 45$) or the state condition ($n = 41$). Data of three initial participants who had received erroneous instructions due to a programming error were not included into analyses. Following our pre-registered exclusion criteria, we excluded three further participants because they did not pass the initial attention test and nine further participants because

they aborted the experiment before debriefing and thus did not give informed consent for data analyses.

Materials

We used a set of 18 single-implication statements that implied, but not explicitly mentioned a trait, as well as 18 single-implication statements that implied, but not explicitly mentioned a state. Each statement was presented together with a person's name and a portrait picture (selected from the 10k US adult faces database; Bainbridge, Isola, & Oliva, 2013), designed such that they appeared like messages from an instant messaging service application (Levordashka & Utz, 2017; see Figure 1 for an example).

Figure 1

Example Stimulus (Studies 1 and 2). Original Stimuli were in German language.

Design

We had pre-registered this research prior to data collection as two independent studies, one on trait inferences and one on state inferences. However, because both studies were conducted simultaneously and participants were randomly assigned to either of the studies, we collapsed data and treated both studies as a between-subjects condition in the analyses. Thus, the present study followed a 2 (Inference: trait vs. state) $\times$ 3 (Condition: implied vs. implied-other vs. new) mixed design with the factor Inference varying between participants and Condition varying within participants. We implemented an additional between-subjects factor based on stimulus-set assignment: Using a counter-balanced Latin square design, stimuli were assigned to separate sets of six to be presented equally often in the implied-, implied-other, and new condition.

Procedure

Data collection was conducted using the platform Qualtrics for online data collection (www.qualtrics.com). The study started with a welcome page that contained an initial attention check requiring participants to click on a logo instead of the continue button (Oppenheimer, Meyvis, & Davidenko, 2009). If participants failed the attention check, they received a notice and were asked to re-read instructions

on the welcome page. If they failed the attention check a second time, they were excluded from participation and directed back to Prolific.

Participants then started the learning phase of the false recognition paradigm (Todorov & Uleman, 2002), in which they were presented with one of two sets of stimuli (trait vs. state) containing 18 targets and nine fillers, presented in individual random order. Each individual stimulus was displayed for five seconds. Participants were instructed to read the stimuli carefully in preparation of a memory test.

Directly following the learning phase, participants completed the recognition task. In each recognition trial, an actor's name and portrait from the learning phase were presented together with a single probe adjective. Participants were instructed to click on a "yes" button when they recognized this probe word to have been presented earlier in the statement of the same actor and to click on a "no" button when they did not recognize the probe word to have been presented in the statement. The 18 portraits from the target trials of the learning phase were split into three recognition conditions, such that within each participant, six portraits each were presented with (a) the specific trait/state adjective previously implied by the respective actor's statement (implied trait/state probe), (b) with a trait/state adjective implied by a *different* actor's statement (implied-other trait/state probe), and (c) with a new trait/state adjective, which had not been implied in any of the statements (new trait/state probe). We further balanced the valence of implied-other and new control probes, so that half were of opposite valence, and half were of matching valence with regard to the implied trait or state (e.g., Schneid, Carlston, & Skowronski, 2015; Schneid, Crawford, Skowronski, Irwin, & Carlston, 2015).² All target probes required a "no" response. To avoid response biases, the recognition test included nine filler trials in which we presented the actors with the trait or state adjective that was explicitly mentioned in the filler statements during the learning phase, thus requiring "yes" responses. We recorded responses and response latencies. After the test phase, participants provided demographic information (age, gender, education, profession). Participants also self-reported language proficiency using a 7-point scale (1: "German is my only native language" to 7: "My German is not good enough to understand this question"). Finally, participants were fully debriefed about the purpose of the study and once again asked for consent for data storage and analyses. We had pre-registered an exploratory measure of Implicit Personality Theories (Dweck, Chiu, & Hong, 1995), which, however, was not included in this study because of a programming oversight. This measure was included in Study 2 instead.

Results

We conducted all data analyses using R 3.6.3 (R Core Team, 2020). As customary with the false recognition

paradigm, we focused analyses on false response rates (Todorov & Uleman, 2003). Analyses of response latencies for correct rejections and further exploratory analyses are reported in the online supplemental materials. The pre-registered main analyses use ANOVA to analyze differences between participants' scores averaged per condition, aggregated across statements. Data were submitted to a 2 (Inference: trait vs. state) x 3 (Condition: implied vs. implied-other vs. new) ANOVA with Inference varying between participants and Condition varying within participants. Results show a significant main effect for condition, $F(2, 168) = 28.56, p < .001, \eta_G^2 = .13, 90\% \text{ CI } [.06, .21]$, and a significant main effect for inference, $F(1, 84) = 11.45, p = .001, \eta_G^2 = .06, 90\% \text{ CI } [.01, .17]$, but no significant interaction, $F(2, 168) = 0.46, p = .634, \eta_G^2 < .01, 90\% \text{ CI } [0, .03]$, see upper left panel of Figure 2. Separate analyses confirmed expected effects in both inference conditions: In the trait inference condition, participants showed higher false recognition rates in the implied trait condition ($M = .30, SD = .27$) than in the implied-other trait condition ($M = .21, SD = .22$), $t(44) = 2.246, p = .03$ (one-tailed), $d_z = 0.376, 95\% \text{ CI } [0.03, 0.72]$ and in the new trait condition ($M = .11, SD = .15$), $t(44) = 4.818, p < .001$ (one-tailed), $d_z = 0.868, 95\% \text{ CI } [0.45, 1.29]$. More importantly, in the state inference condition, participants also showed higher false recognition rates in the implied state condition ($M = .45, SD = .27$), than in the implied-other state condition ($M = .33, SD = .22$), $t(40) = 2.508, p = .016$ (one-tailed), $d_z = 0.474, 95\% \text{ CI } [0.07, 0.87]$ and in the new state condition ($M = .20, SD = .24$), $t(40) = 5.124, p < .001$ (one-tailed), $d_z = 0.97, 95\% \text{ CI } [0.51, 1.43]$.

Discussion

The results of this first study provided initial evidence that people *can* spontaneously draw both trait and state inferences when processing behavioral information with clear trait- or state-implications: In our adaption of the false recognition paradigm, participants were more likely to falsely recognize state and trait adjectives that were implied by behavioral descriptions as compared to non-implied state or trait words. Furthermore, effect sizes were in a comparable range for both the state inference effects as well as the trait inference effects.

The interpretation of our results is, however, limited by the following caveat: When conducting the interim analyses according to the sequential testing procedure, we had erroneously accepted the difference between implied and implied-other conditions in the trait-inference condition as

²Exploratory analyses demonstrated that valence (in)congruence of implied-other and control traits did not significantly qualify the reported results. We therefore collapsed analyses across this factor.

Figure 2

Mean proportion of false recognition responses (Studies 1-3) and mean response latencies for correct responses (Study 4) as a function of type of inference and experimental condition. Error bars represent SE.

significant albeit the p -value of $p = .03$ did not fulfill the preregistered significance criterion of $p \leq .018$. We thus prematurely stopped data collection. However, given that the pattern of results replicated typical STI findings, we opted against resuming data collection when noticing our mistake, and decided instead to invest our resources into a replication study conducted in the laboratory.

Study 2

Study 2 served as close replication of Study 1 with the only difference being that data collection was conducted in the laboratory instead of online.

Method

Sample size determination

Based on the effect sizes resulting from Study 1, we aimed at providing enough statistical power ($1 - \beta = .80$) to detect effect sizes of $d_z = 0.30$ with $\alpha = .05$ (one-tailed) for both, the state and trait conditions of this study. This would require a sample size of $n = 142$ per condition, calculated using G*Power 3.1 (Faul et al., 2007). Again, we relied on a sequential testing procedure (Lakens, 2014) with one interim analysis planned at 68 valid data sets or time = .38. We pre-registered to stop data collection if the observed effects were significant at the interim analysis at $\alpha_1 = .025$. If they were not, we planned to continue data collection until 180 valid data sets would have been collected and perform the final analysis with $\alpha_2 = .025$. In order to obtain the required numbers of valid data sets after applying the pre-registered exclu-

sion criteria, we overpowered both studies by 12.5%, resulting in $n = 71$ and $n = 189$ for the interim and final analyses, respectively, for each condition. During data collection it became apparent that an unexpectedly high number of participants appeared to be non-native speakers of German—whose data would eventually need to be excluded from analyses (see sample description). Additionally, the randomized assignment of participants lead to a high imbalance of participants in the trait and state condition (with only $n = 28$ in the state and $n = 40$ in the trait condition at interim analyses). We therefore deviated from the pre-registered sample size and collected data from 117 participants in order to achieve a more balanced assignment of participants with sufficient language proficiency to both conditions. Note that interim analyses at the pre-registered $n = 68$ already fulfilled the aforementioned decision criteria to warrant applying the stopping rule (see online supplemental materials).

Participants

The current study relies on valid data from a total of $N = 91$ participants (34 female, average age $M = 29.9$, $SD = 11.2$, ranging from 18 to 71 years). The majority of participants indicated being native speakers of German (65%), 21% indicated to speak German as one of their native languages, and 14% indicated that they spoke German very well, albeit it was not their native language. Participants were mainly students from various faculties of a university in northern Germany, recruited via a university online job platform and were compensated 2.50 EUR (approx. 3.13 USD) for the duration of 15 minutes. Our study was the first to be conducted in an one-hour lab session followed by an unrelated study on face recognition. Participants were randomly assigned to either the trait condition ($n = 42$) or the state condition ($n = 44$). Following our pre-registered exclusion criteria, we excluded data from further participants: Six because they did not pass the initial attention test, twelve because they aborted the experiment before debriefing and thus did not give informed consent for data analysis, and 18 because they self-reported insufficient language proficiency.

Procedure

Study 2 used the same materials and followed the same procedure for the false recognition task as Study 1, with the exception that it was conducted in the laboratory. After completion of the false recognition paradigm, participants additionally completed a Navon task (Navon, 1977) and a measure of implicit personality theories (Implicit Personality Theories Questionnaire [8 items], translated into German; Dweck et al., 1995). A description and results of the exploratory analyses are reported in the online supplemental materials.

Results

Individual false recognition rates were submitted to a 2 (inference: trait vs. state) $\times$ 3 (condition: implied vs. implied-other vs. new) ANOVA with the factor inference varying between participants and condition varying within participants. Results show significant main effects for condition, $F(2, 168) = 40.75$, $p < .001$, $\eta_G^2 = .18$, 90% CI [0.10, 0.27] and for inference, $F(1, 84) = 12.56$, $p < .001$, $\eta_G^2 = .07$, 90% CI [.01, .18]. We also observed a significant interaction between inference and condition, $F(2, 168) = 5.84$, $p = .004$, $\eta_G^2 = .03$, 90% CI [.00, .08], see upper right panel of Figure 2. Separate analyses confirmed expected effects in both inference conditions: In the trait inference condition, participants showed higher false recognition rates in the implied condition ($M = .29$, $SD = .24$) than in the implied-other trait condition ($M = .20$, $SD = .21$), $t(43) = 2.779$, $p = .008$ (one-tailed), $d_z = 0.398$, 95% CI [0.1, 0.69], and in the new trait condition ($M = .14$, $SD = .18$), $t(43) = 4.224$, $p < .001$ (one-tailed), $d_z = 0.697$, 95% CI [0.33, 1.06]. In the state inference condition, participants also showed higher false recognition rates in the implied state condition ($M = .51$, $SD = .22$) than in the implied-other state condition ($M = .31$, $SD = .21$), $t(41) = 4.336$, $p < .001$ (one-tailed), $d_z = 0.937$, 95% CI [0.42, 1.45], and in the new state condition ($M = .18$, $SD = .20$), $t(41) = 8.061$, $p < .001$ (one-tailed), $d_z = 1.601$, 95% CI [1, 2.2].

Further analyses exploring the significant interaction effect of inference type by condition indicated that the mean difference of implied state and implied-other state ($M = .202$, $SD = .303$) was larger than the mean difference of implied trait and implied-other trait, albeit not significantly ($M = .091$, $SD = .217$), $t(74.123) = 1.996$, $p = .054$, $d_s = 0.425$, 95% CI [-0.01, 0.86].

Discussion

In Study 2 we observed a highly similar pattern of results as in Study 1, thus strengthening our previous conclusion that participants can spontaneously draw state inferences as well as trait inferences.

While Studies 1 and 2 serve as important proofs of concept and starting point for our research, there are, however, two characteristics of these first two studies that limit the interpretability of the results. On the one hand, we had implemented the state and trait conditions as a between-participants factor, which may have affected participants' general mode of information processing during the learning phase, increasing the general likelihood of inferring states or trait when only presented with strongly state-implying vs. trait-implying behaviors.

Furthermore, we employed only single-implication behavioral descriptions that exclusively and unambiguously implied *either* trait *or* state inferences. Past research on

spontaneous trait inferences has frequently employed stimulus materials created such that they strongly afford trait inferences by describing rather extreme behaviors (e.g., "The farmer paints a swastika on the synagogue wall"; Winter & Uleman, 1984), by including temporal markers indicating repeated behaviors and thus temporal consistency ("I attend my church *twice a week* ..."; Carlston & Skowronski, 1994 [emphases added]), or by including expressions of inner dispositions such as attitudes (e.g., "I *hate* animals. Today ... I saw this puppy. So I kicked it out of my way."; Carlston & Skowronski, 1994 [emphases added]). While the use of materials that strongly imply a specific inference is required to investigate process characteristics of any given inference, it provides strong stimulus-constraints and thus limits generalizability of results. Results of Studies 1 and 2 suggest that perceivers spontaneously draw trait inferences even from less extreme, relatively mundane behaviors, in the absence of strong trait-affording wording or temporal markers (see also Levordashka & Utz, 2017). Because we developed single-implication statements specifically for the investigation of spontaneous state versus trait inferences, these statements may possess certain characteristics that afford one type of inference only, while inhibiting other inferences. For example, if someone states that "*There is nothing going on this weekend, I am wasting my time channel-surfing*", this person is most obviously bored by the specific situation which is hardly attributable to a personal disposition - at least when no further information is provided. We thus decided to develop a new set of materials with dual-implication statements, that – in principle – allow for the simultaneous occurrence of state and trait inferences. For example, in our introductory example of Daniel laughing at the joke, one may assume that he is a *jolly* person who generally laughs a lot or that he is so *amused* by this one joke that he bursts out laughing. If participants draw state inferences even if a trait inference would be just as warranted, we can conclude that these inferences need not be mutually exclusive. We use a false recognition paradigm (Study 3) and a probe recognition paradigm (Study 4). While Studies 1 and 2 were conducted in German language (with native German speakers as participants), Studies 3 and 4 were conducted in English language (with native English speakers as participants).

Study 3

With Study 3, we aimed at providing an extended replication of our previous results by using novel behavioral descriptions during the learning phase of the false recognition paradigm that allowed for both, trait and state inferences to occur. Furthermore, all participants were probed for both, trait and state inferences during the recognition phase, thus avoiding potential systematic differences in processing mode that may have affected results based on the between-participants design of Studies 1 and 2.

Method

Sample size determination

Our primary interest in this study was the main effect of Condition (implied vs. implied-other) for both, trait and state inferences. In order to provide sufficient statistical power ($1 - \beta = .80$) to detect a main effect size of $\eta_p^2 = .091$ (estimation based on the smallest effect size observed in our previous studies) with $\alpha = .05$ in a 2×2 repeated-measures ANOVA, valid data of $N = 82$ participants were required. Because we aimed to additionally test for a potential interaction effect – thus directly comparing state and trait inference effects – we included it into our power analyses. For this interaction, we considered a small effect size of $\eta_p^2 = .022$ as the smallest effect size of interest. In order to provide sufficient statistical power ($1 - \beta = .80$) with $\alpha = .05$ for this effect size in a 2×2 interaction in a repeated-measures ANOVA, we planned to collect 352 valid data sets. Given an estimated exclusion rate of 5% with online data collection, we collected data from $N = 376$ participants. Power analyses were conducted using MorePower 6.0.4 (Campbell & Thompson, 2012).

Participants

The current study relies on valid data from a total of $N = 365$ participants (109 female, average age $M = 35.6$, $SD = 12.3$, ranging from 18 to 75 years). The majority of participants indicated being native speakers of English (96%), 3% indicated to speak English as one of their native languages, and 1 participant indicated that they spoke English very well, albeit it was not their native language. Participants were recruited using Prolific (www.prolific.ac) and received monetary compensation of 1.50 GBP (approx. 1.88 USD) for the average study duration of nine minutes. Following our pre-registered exclusion criteria, we excluded data of six further participants because they had failed an attention test and two further participants because they self-reported insufficient language proficiency. Data of 90 further participants were excluded because they aborted the experiment before debriefing and thus did not provide informed consent for data analyses.

Materials

We selected 24 dual-implication statements as target stimuli. These were intermixed with 12 filler statements of a similar structure to the target stimuli, with the exception that the fillers explicitly mentioned a trait or state word. Contrary to the previous studies, stimuli were not designed to look like messages from an instant messaging service application but formulated in third person and paired with a portrait and a name.

Design

We employed a 2 (Inference: trait vs. state) $\times 2$ (Condition: implied vs. implied-other) within-subject design with rate of false recognitions (answers 'yes' in test phase) as dependent variable. In Study 3, we omitted the new trait and state conditions, because the implied-other condition represents the more conservative test for the occurrence of trait and state inferences. We implemented an additional between-subjects factor based on stimulus-set assignment: Stimuli were randomly assigned to separate sets of six to be presented equally often in the implied and implied-other condition across participants (using a Latin square design), in individual random order.

Procedure

Study 3 followed the same procedure as Study 1, with the exception that participants self-reported language proficiency using a 6-point scale (1: "English is my first (native) language" to 6: "It is very hard for me to speak and understand English").

Results

False recognition rates were submitted to a 2 (Inference: trait vs. state) $\times 2$ (Condition: implied vs. implied-other) within-subject ANOVA. Results show significant main effects for inference, $F(1, 364) = 135.79$, $p < .001$, $\eta_G^2 = .05$, 90% CI [.02, .09], and for condition, $F(1, 364) = 43.89$, $p < .001$, $\eta_G^2 = .02$, 90% CI [0, .04], with no significant interaction, $F(1, 364) = 1.64$, $p = .202$, $\eta_p^2 < .01$, 90% CI [0, .01], see lower left panel of Figure 2. Separate analyses confirmed spontaneous person inference effects in both inference conditions: In the trait inference condition, participants showed higher false recognition rates in the implied trait condition ($M = .22$, $SD = .21$) than in the implied-other trait condition ($M = .18$, $SD = .20$), $t(364) = 4.009$, $p < .001$ (one-tailed), $d_z = 0.22$, 95% CI [0.11, 0.33]. In the state inference condition, participants also showed higher false recognition rates in the implied state condition ($M = .34$, $SD = .24$) than in the implied-other state condition ($M = .27$, $SD = .22$), $t(364) = 5.292$, $p < .001$ (one-tailed), $d_z = 0.29$, 95% CI [0.18, 0.4]. Albeit effect sizes were somewhat larger in the state condition as compared to the trait condition, the inference effects (calculated as difference scores of implied – implied-other) did not differ significantly between conditions, $t(728) = 1.28$, $p = .201$, $d = 0.094$, 95% CI [-0.05, 0.24]. We report further auxiliary analyses in the Supplemental Materials.

Discussion

Results of Study 3 replicate and extend the findings of Studies 1 and 2 by providing first evidence that participants can draw both trait and state inferences from one and the

same ambiguous behavior description. These results can, however, not yet be interpreted as indicators that trait and state inferences are *simultaneously* drawn when processing behavioral information (similar to the assumption of simultaneous trait and situation inferences in Krull & Ericson's (1995) model). Indeed, given our specific implementation of the false recognition paradigm, the same results would be observed if some behavioral descriptions exclusively or dominantly triggered trait inferences and other stimuli exclusively or dominantly triggered state inferences. Alternatively, some participants may have systematically only drawn trait inferences and no state inferences and other participants may have systematically drawn state inferences and no trait inferences. We conducted auxiliary correlational analyses that indicate that trait and state inferences seem not to have occurred at each others' expense, because we did not observe any negative correlation of state and trait inference effects, neither on a by-participant, nor on a by-item level (see online supplemental materials). Nevertheless, it is desirable to provide a more direct empirical test of the simultaneity and mutual non-exclusiveness of trait and state inferences.

The current results do also not fully refute the assumption that trait inferences may be the dominant inference from behavior. For example, one may assume that participants spontaneously only draw trait inferences at encoding of the behavioral information but later (re)consider state inferences once probed with a fitting state word during the recognition test. However, note that the same argument applies to the opposing assumption that participants spontaneously only draw state inferences at encoding and later (re)consider trait inferences when probed with a fitting trait word (but see Todorov and Uleman, 2002). We conducted auxiliary analyses of response times to explore whether response times of false recognition responses differed between the implied state and trait conditions, presuming that false recognition response based on inferences drawn at encoding may be faster as compared to responses after retrospect reconsiderations. However, there were no significant differences in false recognition response latencies between the implied-state as compared to the implied-trait condition (see online supplemental materials).

In Study 4, we used a more direct approach to investigate if and to what extent trait and state inferences are drawn *simultaneously* when participants process behavioral information about actors.

Study 4

In Study 4, we implemented a probe recognition paradigm (McKoon & Ratcliff, 1986) – another indirect paradigm frequently used in research on spontaneous trait and situation inferences (e.g., Ham & Vonk, 2003; Newman, 1991; Ramos, Garcia-Marques, Hamilton, Ferreira, & Van Acker, 2012). In this paradigm, participants read individual behav-

ioral statements, each *immediately* followed by several probe words. Participants decide as quickly and accurately as possible whether the probes were part of the statement or not. In typical studies on STIs, these probe words are trait adjectives implied by the behavior or non-implied control probes, thus both requiring a negative response. If encoding of the behavioral statement automatically triggers a trait inference, participants should have more difficulty rejecting the corresponding trait probe and thus demonstrate slower response latencies and/or higher error rates as compared to non-implied control trait probes. One advantage of this paradigm is that each behavioral statement can be followed by several probes, thus allowing to test for multiple inferences referring to the same statement (e.g., Todd et al., 2011). In our adaptation of the paradigm, behavioral statements were followed by both, implied state and implied trait probes, which allows investigating the simultaneous occurrence of both types of inferences.

Method

Sample size determination

We followed the same pre-registered sample size rationale as in Study 3, thus planning to collect valid data from 352 participants.

Participants

The current study relies on valid data from a total of $N = 341$ participants (211 female, four other, one unspecified, average age $M = 33.2$, $SD = 11.5$, ranging from 18 to 71 years). The majority of participants indicated being native speakers of English (96%), 3% indicated to speak English as one of their native languages, and one participant indicated that they spoke English very well, albeit it was not their native language. Following our pre-registered exclusion criteria, we excluded the data of six further participants because they aborted the experiment before debriefing and thus did not give informed consent for data analysis, five because they self-reported insufficient language proficiency, and two because they responded accurately in less than 60% of trials. Participants were recruited via Prolific (www.prolific.ac) and received 2.20 GBP (approximately 2.75 USD) for the duration of 15 minutes.

Materials

We used a different subset of 24 behavioral statements developed for Study 3 as target statements and 24 filler statements explicitly mentioning a state or a trait word (see online supplemental materials for the complete list of statements and pre-test results). Given the framing of the task as measuring automatic text comprehension, behavioral statements included the actor name but were presented on screen without images.

Design

We employed a 2 (inference: trait vs. state) $\times$ 2 (condition: implied vs. implied-other) within-subject design with response latencies of correct probe rejections of target trials as dependent variable.

Procedure

Participants completed the same introduction procedure and attention check as in the previous studies. The probe recognition paradigm was then introduced to participants as a study on language comprehension. The study was designed in PsychoPy 3.1.2 (Peirce et al., 2019) and conducted online on Pavlovia (www.pavlovia.org). Participants were presented with 48 behavioral statements (24 targets, 24 filler) in individual random order and were instructed to read them carefully. Each statement was presented for 3000ms. Immediately after each statement, participants completed eight probe recognition trials, in which they indicated for each probe word whether it had been part of the previous statement or not. Each probe was preceded by a blank screen (250ms) and a fixation cross (500ms) and remained on screen until a response was recorded. Participants were instructed to indicate via key press whether the word had appeared (press [D]) or not (press [K]) in the statement. Participants were instructed to respond as accurately and as fast as possible. Erroneous responses were signaled to the participants by a red cross displayed for 1000ms. After completion of all eight probe trials for each statement, the next statement was presented with an intertrial interval of 500ms.

Target probe trials always consisted of the trait and the state adjectives implied by the behavioral statement of the same person (implied condition), as well as a trait and a state adjective implied by the behavioral statement of another person (implied-other condition), thus all requiring a "no" response. In order to balance the ratio of correct "yes" and "no" responses for each trial, we additionally presented four filler probes consisting of words that had actually appeared in the statement (i.e., names, objects, verbs, and prepositions). In order to avoid that participants recognized that any type of probe consistently required a "yes" or "no" response, probes for the filler statements were chosen such that correct responses were "yes" for adjectives and "no" for names, objects, verbs, and prepositions. For each trial, the order of the eight probes was individually randomized, with the restriction that the first probe was never a target probe (Stewart, Weeks, & Lupfer, 2004). Responses and response latencies were recorded. After completion of the probe recognition task, participants provided demographic information (age, gender, language proficiency, education, profession). Additionally, participants were asked to indicate how seriously they complied with task instructions using a 10-point scale (0 = not at all and 10 = very much, $M = 9.5$, $SD = 0.8$) and asked to speculate about the hypothesis of the study. At the

end of the study, participants were fully debriefed about the purpose of the study and once again asked for consent for data storage and analyses.

Results

We had pre-registered response latencies of correct rejections as main dependent variable for our analyses. Analyses of response latencies usually require corrections of outlying slow responses (Ratcliff, 1993). To our knowledge, there is no convention how to correct for outliers in the probe recognition paradigm. Therefore, we applied different trimming criteria for slow responses (2500, 2000, 1500ms, individual $M \pm 2.5SD$), and transformations (log- and inverse transformation) and compared their impact on analyses. Across the different trimming criteria and transformations, effect sizes differed by small to medium amounts (trait inference effect: $d_z = 0.580 - 0.806$; state inference effect: $d_z = 0.790 - 1.117$; Inference $\times$ Condition interaction: $\eta_p^2 = .03 - .07$; see online supplemental materials). Analyses reported in the text are based on log-transformed data with a cut-off of 1500 ms. For ease of understanding, descriptive statistics are based on untransformed but trimmed response latencies.

The pre-registered 2 (inference: trait vs. state) $\times$ 2 (condition: implied vs. implied-other) repeated-measures ANOVA of response latencies for correct rejections of target probes documented significant main effects of inference, $F(1, 340) = 224.09$, $p < .001$, $\eta_G^2 = .01$, 90% CI [0, .04], and condition, $F(1, 340) = 592.05$, $p < .001$, $\eta_G^2 = .03$, 90% CI [.01, .07], that were qualified by a significant interaction, $F(1, 340) = 23.55$, $p < .001$, $\eta_G^2 = .001$, 90% CI [0, .02], see lower right panel of Figure 2. Separate analyses confirmed expected effects in both inference conditions: Participants were slower to reject the implied trait probes ($M = 592$ ms, $SD = 122$) compared to the implied-other trait probes ($M = 557$ ms, $SD = 105$), $t(340) = 13.928$, $p < .001$ (one-tailed), $d_z = 0.286$, 95% CI [0.25, 0.33]. Similarly, the participants were slower to reject the implied state probes ($M = 625$ ms, $SD = 115$) compared to the implied-other state probes ($M = 573$ ms, $SD = 115$), $t(340) = 19.502$, $p < .001$ (one-tailed), $d_z = 0.425$, 95% CI [0.38, 0.47]. The mean difference of implied state and implied-other state probes ($M = 51$ ms, $SD = 49$) was significantly larger than the mean difference of implied trait and implied-other trait probes ($M = 34$ ms, $SD = 46$), $t(680) = 4.794$, $p < .001$, $d_z = 0.367$, 95% CI [0.22, 0.52].

Discussion

The results of Study 4 conceptually replicate and complement the results of our previous studies in a different experimental paradigm. Again, we observed significant state and trait inference effects, with state effects being significantly larger than trait effects. Most importantly, the use of the

probe recognition paradigm in Study 4 allows the conclusion that observers drew state and trait inferences both spontaneously and simultaneously when encoding the behavioral information. As in Study 3, our auxiliary correlational analyses (see online supplemental materials) showed no significant interrelations of trait- and state-inference effects, neither on the participant level nor on the by-item level, supporting the conclusion that trait and state inferences did not occur at each others' expense.

Our research thus far strongly supports the notion that people draw spontaneous trait and state inferences when forming impressions from others' behaviors. However, the interpretability of these effects remains limited because the differentiation of trait and states in these studies entirely relies on our pilot study. In this study, we had asked participants to deliberately judge the single adjectives with regard to their perceived temporal and situational stability after explicitly instructing them about our theoretical conceptualization of states and traits. We cannot be entirely sure that participants draw the same conceptual distinction between traits and states when inferring them from specific behavioral statements. Albeit our pilot study clearly indicated that the employed adjectives by themselves were understood as either states or traits, several of these adjectives may still appear as possibly referring to both, states and traits - depending on the contexts in which they are used. For example, we may use the state adjective *sad* when considering a person to *feel sad* (state) or to be a *sad person* (trait). Because German and English have no clear linguistic markers that conceptually distinguish between traits and states (as in Spanish or Portuguese, for example), it is conceivable that the state inferences we observed in our studies are nothing but trait inferences in disguise. So far, we cannot conclude from our data that state inferences actually differ functionally from trait inferences in the eyes of perceivers. We thus conducted a fifth study in order to investigate whether participants actually represent our pre-defined state and trait inferences as functionally different from each other.

Study 5

From a theoretical standpoint, traits and states can be distinguished from one another quite precisely (e.g., Hamaker et al., 2007; but see Fleenor & Jayawickreme, 2015). The most obvious difference is their relative stability: Traits describe dispositions that are relatively stable over time and across situations; states describe dispositions that are considerably less stable over time and across situations. This stability advantage of traits over states renders trait attributions appealing for impression formation because by increasing the predictability of other peoples' future behavior they may reduce uncertainty to a higher degree than state attributions. Trait inferences should thus influence predictions about future behavior, and have been demonstrated to do so

(McCarthy & Skowronski, 2011b; Nussbaum et al., 2003). State inferences, on the other hand, describe variable, more fleeting properties of a person and should therefore have less influence on future behavior predictions. If people mentally represent this functional differentiation of trait and state inferences, they should rely on them differently when using observed behavior to make predictions about actors' future behavior. In Study 5, we investigated whether the traits and states that participants spontaneously inferred from the dual-implication behavioral statements used in Studies 3 and 4 do indeed hold differential value for predicting behavior. We therefore presented participants with the same behavioral statements, either paired with the implied state or the implied trait word, and asked them to judge how likely the actors would show such behavior again in the future. We chose this procedure (instead of presenting only the behavioral statements or only the probe actives) based on the following rationale: On the one hand, it would make little sense to only present the state and trait adjectives without the behavioral statements, because the meaning of the adjectives may vary with different behavioral contexts (e.g., *curious* means something different when inferred from the statement "My neighbour Betty is peeping through the curtain slit" or from "My neighbour Betty wants to learn everything there is to know about the Mars mission"; see also Kunda, Sinclair, & Griffin, 1997). Thus, while our pretests already suggested that the selected state and trait words generally differ in their perceived temporal stability, we needed to verify that this also applied to the specific behavioral contexts of our studies. On the other hand, it would make no sense to present only the behavioral statements without adding the trait vs. state inferences, because results from Studies 3 and 4 demonstrate that participants draw both state and trait inferences spontaneously and simultaneously. Thus, presenting only the behavioral statements would make it impossible to judge if and to what extent individual behavioral predictions were influenced by state vs. trait inference. By explicitly mentioning the implied state vs. the implied trait, the respective inference is made more salient to the participant. If these inferences have a functional value for further information processes, the more salient inference should influence judgments of future behavior more than the non-salient inference. We thus expected to observe that for one and the same behavior, the salient trait inference would lead to a higher perceived probability of repeated behavior, than the salient state inference.

Method

Sample size determination

Our primary interest in this study was the effect of Adjective (trait vs. state) in a *t*-test with prediction rating as the dependent variable. We aimed to provide sufficient statistical power ($1 - \beta = .80$) to detect the minimal effect size of interest

of $d_s = .50$ with $\alpha = .05$ for the between-subjects comparison of only the first response (see Analysis Plan). Thus, valid data of $N = 102$ participants was required. Power analyses were conducted using G*Power 3.1 (Faul et al., 2007).

Participants

The current analyses relied on valid data from a total of $N = 97$ participants (64 female, one other, average age $M = 33.7$, $SD = 11.9$, ranging from 18 to 66 years). Following our pre-registered exclusion criteria, we excluded the data of five further participants because they aborted the study before completion due to a programming error. Participants were recruited via Prolific (www.prolific.ac) and received 1.56 GBP (approximately 2 USD) for the duration of 10 minutes.

Materials

We used all 41 behavioral statements used in Studies 3 and 4 as target statements, paired with a statement describing the actor with the implied state or trait adjectives, respectively. Behavioral statements were presented on screen without images.

Procedure

Participants were introduced to a study on behavior prediction and memory performance. The study was designed and conducted in Qualtrics software. Participants were instructed to read the behavioral statements and judge how likely each actor would perform behavior such as the one described again in the future using a slider ranging from 0 to 100. Additionally, they were instructed to memorize actor name, behavior, and adjective for a later memory test. We implemented the additional memory test in order to ensure that participants actually process the trait and state adjectives and do not base their judgements on the relative frequency of the described behaviors only. Participants completed the same attention check procedure with the first instruction page as in the previous studies. They were then presented with 82 trials including each behavioral statement, once paired with the implied state, once paired with the implied trait. Participants submitted their slider responses by pressing the space bar, which allowed us to record responses and response latencies.

In order to verify that participants had actually processed behaviors and state and trait adjectives, they completed ten recognition trials consisting of an actor's name and one of the adjectives from the rating phase. In five of these recognition trials, the adjectives had been presented with that same actor, and in the other five, the adjectives had been presented with a different actor. Participants were asked to judge whether actor and adjective had been presented together before (correct decision rate: $M = .67$, $SD = .18$).

Finally, participants provided demographic information (age, gender, language proficiency, education, profession, ethnicity). Additionally, participants were asked to indicate how seriously they complied with task instructions using a 10-point scale (0 = not at all and 10 = very much, $M = 8.9$, $SD = 1.4$).

Analysis Plan

We had planned two ways of analysing the results of this Study. First, we planned a simple within-participants t -test in order to inspect whether participants attributed higher likelihood of behavior repetition when the behavioral statements were paired with the implied trait as compared to the implied state adjective. However, because this within-participants design asks participants to estimate the repetition likelihood for the same behavior twice, differences between implied state and trait adjectives may be under-estimated: Regardless of randomized sequence, participants may be inclined to base their second estimation on the response given to the same behavior earlier. To account for this possibility and rule out any form of cross-contamination, we planned a second analysis using only participants' first responses to each statement, discarding their second judgement.

Results

The within-participants analyses show that participants rated the probability for behavior repetition higher when the behavioral statement was paired with a trait adjective ($M = 73.46$, $SD = 11.4$) than with a state adjective ($M = 69.06$, $SD = 10.69$), $t(96) = 4.95$, $p < .001$ (one-tailed), $d_z = 0.398$, 95% CI [0.233, 0.563]. The planned additional analysis of the first judgements on each behavioral statement revealed a similar effect with a slightly larger effect size: Participants who saw the statement paired with a trait ($M = 73.21$, $SD = 11.68$) rated the probability of behavior repetition significantly higher than participants who saw the statements paired with the respective states ($M = 68.44$, $SD = 10.48$), $t(96) = 4.958$, $p < .001$ (one-tailed), $d_z = 0.427$, 95% CI [0.25, 0.605]. We observed the same pattern of results for the second presentation of statements with a slightly reduced effect size. Participants who saw the statement paired with a trait ($M = 73.68$, $SD = 12.11$) rated the probability of behavior repetition significantly higher than participants who saw the statements paired with the respective states ($M = 69.64$, $SD = 12.17$), $t(96) = 3.696$, $p < .001$ (one-tailed), $d_z = 0.332$, 95% CI [0.15, 0.514].

Auxiliary Analyses

We further conducted exploratory analyses in order to explore whether the relative strength of state and trait inferences in Studies 3 and 4 were related to the aggregated repetition predictions in Study 5. The rationale behind this anal-

ysis is the following: By-item analyses of data from Studies 3 and 4 suggest that not all state and trait inferences were equally strong for each behavioral statement (see online supplemental materials). If trait and state inferences are represented as functionally different in the perceivers' minds and trait inferences are more important for future predictions than state inferences, we would expect differential predictive values of the inference effects: That is, the magnitude of the trait inference should be positively related to the repetition likelihood ratings, whereas the magnitude of state inference should not matter for these predictions. We thus computed state and trait inference scores for each statement aggregated across participants as a simple difference between implied and implied-other responses. Because both studies used different dependent variables, we *z*-transformed these inference scores and averaged the *z*-values for those statements that were used in both studies. Simple bivariate correlations indicate that the size of spontaneous trait inferences in Studies 3 and 4 was related to the perceived likelihood of behavior repetition in Study 5, $r = .439$, $t(46) = 3.316$, $p = .002$, 95% CI [.177, .643], whereas the size of the state inference effects in Studies 3 and 4 was not significantly related to the repetition predictions in Study 5, $r = .078$, $t(46) = 0.533$, $p = .596$, 95% CI [-.210, .355]. Of course, these auxiliary analyses have to be interpreted with caution, because of the limited test power given the sample size of only $n = 47$ statements.

Discussion

Results of Study 5 support the assumption that participants processed trait and state inferences as indicating differential predictive value. Participants judged the likelihood that actors would repeat their behaviors in the future as higher when the behaviors were paired with the implied trait inference than the implied state inference. Albeit limited by their relatively low power, the exploratory by-item analyses further support this interpretation: The stronger the trait inference from a behavior, the more likely it seems that this behavior may be repeated in the future. No such relation was observed for state inferences drawn from the same behaviors. Note that this should not be read as causal interpretation; one could similarly conclude that the more a behavior elicited an expectation to be repeated in the future, the more likely participants draw a trait inference, whereas state inferences appeared independent of the perceived repetition likelihood. Nevertheless, the Results of Study 5 support the assumption that the trait and state inferences measured in Studies 3 and 4 do indeed represent functionally distinct inferences.

General Discussion

Previous research on impression formation from behavior has provided a vast amount of evidence that when observing others' behaviors, people spontaneously draw trait inferences (e.g., Moskowitz & Olcaysoy Okten, 2016; Uleman et al.,

2012). In a series of five pre-registered studies we provide consistent evidence that people spontaneously and simultaneously infer both traits and states from behavior.

In Studies 1 and 2, we employed behavioral statements with single-implications of either a trait or a state in a false recognition paradigm. We observed significant inference effects for both trait and state adjectives, in that participants more frequently falsely recognized implied trait and state probes as having been previously mentioned in an actor's behavioral statement, as compared to a trait or state implied by a different actor's behavior, or a new trait or state adjective. We thus replicated the established spontaneous trait inference effect and, more importantly, provided first evidence that people can spontaneously infer states as well.

In Studies 3 and 4, we used dual-implication stimuli, that is, behavioral statements that allowed for both trait and state inferences. Again, we observed significant inference effects for both trait and state adjectives in a false recognition paradigm (Study 3) and in a probe recognition paradigm (Study 4).

Results of Study 5 support the assumption that trait and state inferences are represented as functionally different: Participants rated actors as more likely to show similar behavior again in the future when the behavior was paired with the implied trait adjective, as compared to the implied state adjective.

On the spontaneity of spontaneous state and trait inferences

The results of our research are in line with the many findings from different domains of person perception showing that people have a strong tendency to spontaneously make sense of their social environment by going beyond the given information, adding self-generated information and thus drawing causal inferences and attributions.

Our studies show that person inferences from others' behaviors include both, considerations of the actors' enduring traits as well as considerations of their more transient states. Note that the semantic and pragmatic rules of the employed experimental paradigms and their instructions actually call for noninferences: Participants were never asked to form impressions of others – neither state nor trait impressions – but to merely process and memorize statements and images. Deliberate impression formation would have been a rather distracting activity during information encoding and also hindering during task performance, given that these inferences increase false recognition rates and slow down responding. Thus, the indirectness of the inference effects – the increase of false recognition responses to implied states and traits in the false recognition paradigm and the slowing of correct rejection responses in the probe recognition paradigm – support the assumption that both state and trait inference effects are *spontaneous* both in the sense of *unintentional* as well as

in the sense of *uncontrolled* (Uleman et al., 1996). Future research may systematically investigate further process characteristics of state and trait inferences, such as the relative efficiency and resource (in)dependence, general controllability, and subjective awareness of these inference processes and/or their outcomes.

Using actors' portraits for the assessment of inference effects in the recognition test of the false recognition paradigm further allows for the conclusion that the observed trait and state inference effects should not be interpreted as mere side-effects of text-comprehension, but as actor-specific person inferences. Furthermore, we always compared responses to the state and trait adjectives implied by the actors' behavior to trait and state adjectives implied by behaviors of other actors during the same learning phase. It is thus not mere familiarity or traces of prior activation of text-based associations of behaviors with trait or state words that increase false recognition rates (e.g., reading the verb *laughing* activating associations like *jolly* or *amused*), but inferences directly tied to the specific actors of that behavior (e.g., Laughing *Dave* is jolly and/or amused; see also Orghian, Ramos, Reis, & Garcia-Marques, 2018).

These considerations have been discussed previously and at length with regard to spontaneous trait inferences (e.g., Todorov & Uleman, 2002, 2003) and our research demonstrates that they apply to state inferences as well. Future research may more systematically investigate to what extent state and trait inferences are based on associative versus inferential processing (e.g., Carlston & Skowronski, 2005).

However, the more important contribution of our findings is that they show that state and trait inferences occur *simultaneously* at encoding of the behavioral information and are *mutually non-exclusive*. Specifically, in Studies 3-5, we employed dual-implication stimuli, that were carefully pretested to support both trait and state inferences in deliberate impression formation - and lead to both trait and state inference effects in both the false recognition and the probe recognition paradigm assessing effects of spontaneous impression in Study 3 and 4. To better understand the results of the false recognition effects in Study 3, we had conducted auxiliary correlational analyses both on the by-participant and the by-item level (see online supplemental materials). Observing negative correlations on either level would have implied that trait and state inferences may be mutually exclusive; on the participant level, if participants who show strong trait inference effects show weak state inference effects or vice versa; on the item-level, if statements leading to strong trait-inference effects (aggregated across participants) lead to weak state inference effects or vice versa. The results indicate, however, that state and trait inferences were not drawn at the expense of each other: There was no indication that participants within our samples had individual response tendencies towards either spontaneous trait

or spontaneous state inferences, nor that individual behavioral statements would only prompt either spontaneous state or spontaneous trait inferences. The strongest evidence for the mutual non-exclusiveness of simultaneously and spontaneously drawn state and trait inferences, however, stems from the probe recognition paradigm used in Study 4, in which we prompted participants with both implied trait and state adjectives immediately after encoding of the behavioral statements. Again, we observed both inferences effects and again we did not find any negative correlations between state and trait inferences neither on the participant nor on the item level. Thus, we feel confident to conclude that spontaneous person inferences simultaneously include considerations about stable person dispositions as well as transient mental states and that these are mutually non-exclusive at the stage of spontaneous information processing.

Multiple spontaneous social inferences in the impression formation process

Our findings complement empirical evidence that people can draw spontaneous situation inferences from behavior (Ham & Vonk, 2003; Todd et al., 2011). However, while states certainly have a situational component, they differ from situation inferences quite substantially. In the example *Pete tells the waiter the food tastes good* (adapted from Ham & Vonk, 2003), a situation inference would refer to a property of the situation: the food is *delicious*. In contrast, a state inference would refer to the person: Pete is *pleased*. Our results are also compatible with recent documentations of other spontaneous person inferences, such as goals (e.g., Hasin et al., 2005; Olcaysoy Okten & Moskowitz, 2019; Van Overwalle et al., 2012) or motivations (e.g., Reeder, 2009a, 2009b; Reeder et al., 2001). Without question, goals and motivations represent subcategories of mental states. However, our findings indicate that people infer mental states that go beyond these previously documented inferences. In the example above of Pete complementing the waiter on the food, he might have the goal of *wanting to be nice* which may be relatively independent of his state of being *pleased*. Our studies are the first to demonstrate that people spontaneously draw state inferences beyond behavioral goals.

In this respect, our findings are in line with theoretical accounts on social inferences that presume that behavior attribution includes inferences of subcategories of states. For example, in the MIM, Reeder (2009b) suggests that people might draw spontaneous inferences about both motives and traits simultaneously from behavior. Similarly, Malle (2001, 2007) proposed in their folk theory of mind that people deliberately make sense of other people's behavior mainly in terms of beliefs, desires, and intentions. Our research expands the empirical support of these approaches in two ways. On the one hand, and as previously discussed, we have provided empirical evidence regarding the spontaneity of these

inferences. Future research will help to further understand the process characteristics of both trait and state inferences. On the other hand, we enlarge the range of inferred states to affective or emotional states (e.g., happy, surprised, anxious, ashamed), cognitive and attentional states (e.g., focused, interested, distracted, bored) and physiological states (e.g., hungry, full, sick, tired), thus supporting the idea that observers' inferences about actors' states are not limited to motives, beliefs, desires, and intentions, but encompass a great variety of mental states. Future research may address the role of perceived intentionality in inference-making (i.e., whether there might be any differences between inferring intentional and unintentional states from behaviors).

Further implications for theory development

The finding of spontaneous and simultaneous trait and state inferences has potential implications for our theorizing about other effects of person perception and impression formation. For example, they question previous assumptions regarding the underlying mechanisms of the correspondence bias in person perception: Given that we are able to simultaneously and spontaneously draw trait and state inferences, how come that in deliberate impression formation we still favor dispositional inferences above all others? For example, Krull & Erickson's (1995) model of dispositional inference presumes that behavioral observations are initially and automatically processed only in terms of trait inferences, thus causing a dispositional bias in impression formation when controlled processes do not operate to correct these inferences (e.g., under cognitive load or time pressure; Gawronski, 2004). However, this assumption is difficult to uphold given the multiplicity of spontaneous social inferences.

In this line, Krull (1993) argued that the processing sequence and thus relative dominance of different inferences is not fixed, but depends on whether the inferential goal of the perceiver focuses on the acting person or the situation as causes of behavior: Whatever is in the perceiver's focal interest is processed spontaneously and effortlessly, thus dominates automatic inferences and is only revised given sufficient motivation and cognitive resources (Krull & Erickson, 1995). Based on this account, we may conclude that participants in our studies drew simultaneous state and trait inferences because both equally satisfy a predominant goal of forming an impression about the acting person. This rationale, however, cannot explain why and how perceivers generalize from spontaneous person impressions that initially include at least state and trait inferences – if not even further inferences – to correspondence biases that attribute behavior predominantly to only traits. While previous theorizing and research in the STI domain has treated person inferences as equal to dispositional inferences, our research along with others (e.g., Olcaysoy Okten & Moskowitz, 2018) documents that a more fine-grained theorizing is needed that in-

cludes different types of spontaneous person inferences from behavior (e.g., traits, states, intentions, values, etc.; Malle, 2005) and their functional consequences for impression formation. Even the more recent theories of spontaneous social inference processes so far fail to integrate the multiplicity of spontaneous social inferences into a coherent process model (e.g., Read & Miller, 2005; Trope & Gaunt, 2000).

We are convinced that future theorizing will benefit from more targeted considerations of different types of person inferences, how they may be related to each other and what independent and interactive roles they may have in impression formation from behavior. For example, one could speculate that spontaneous state inferences are inherently related to both trait as well as situation inferences from behavior. This conceptualization follows from an application of whole trait theory (Fleeson & Jayawickreme, 2015; Jayawickreme et al., 2019) to person perception. Whole trait theory defines traits as dispositions to experience trait-related states frequently and across many situations, hence to frequently feel and act in trait-specific ways. Construing traits this way suggests that perceivers may spontaneously infer an actor's current state and attribute it to a stable cause within the person. A similar mechanism could be construed for situational attributions: Perceivers may need to infer an actor's current state and attribute it to a situational cause outside the person. These speculations are not necessarily incompatible with long-standing models of impression formation (e.g., Gilbert et al., 1988; Krull, 1993; Trope, 1986), which assume that the first step in impression formation from behavior is "behavior categorization" (Trope, 1986), or "behavior interpretation" (Krull, 1993), followed by the actual attributional inference. It is possible that this processing stage may include inferring the actor's current state(s), which may then be attributed to traits or situations as causes of the behavior. It remains unclear, however, if states, traits, and/or situations are related in this fashion in spontaneous social inference processes. Just because we can theoretically construe a logical sequence of inferential processes, the actual processes or processing stages in spontaneous impression formation may look very different. However, our speculations illustrate the potential impact that these first results may have on further development of process-oriented theories and research on impression formation from behavior.

Besides the focus on understanding the psychological mechanisms of inference processes in spontaneous and controlled impression formation, we also think that considerations regarding the functional value of first impressions warrants further thought and development: How do spontaneous inferences that people draw from behavior affect their further judgement, decision making, and interaction behavior? Many scholars have offered a functional perspective of spontaneous impression formation processes, presuming that people draw inferences because they can make use of them for

forming expectations and adapting their own (interaction) behavior. This served as an explanation for a frequently presumed dominance of trait inferences - because inferring a stable personal disposition as cause of behavior allows predictions of future behavior and thus adaptation for future interactions (e.g., Newman, 1996). However, such functional consequences of first impression formation have only rarely been studied (but see Costabile & Madon, 2019; McCarthy & Skowronski, 2011a, for exceptions). The results of our research also question this simplified approach: While we show that participants simultaneously draw state and trait inferences from behavior, results of Study 5 demonstrate that these same inferences are related to different expectations regarding the future and the likelihood that the same kind of behavior will be repeated. Thus, people may not only draw spontaneous inferences in order to predict future behavior, but also to infer temporal characteristics whose predictive value is limited. Further research is needed to assess the functional properties of spontaneous state inferences in more detail. Also, because trait and state inferences may potentially differ with regard to other functional characteristics (e.g., internal vs. external person attributions), which may differentially affect impression formation and their functional consequences in social information processing.

Boundary conditions of spontaneous social inferences

Similarly, future theorizing and research could and should address whether there are specific conditions that impact whether one type of inference would outweigh the other in spontaneous impression formation. Are there any characteristics of situations, perceivers, targets, and/or behaviors that moderate the occurrence of different types of inferences? In order to measure spontaneous inferences in the present research, we selected only those stimuli for which a majority of participants had generated the same deliberate inferences in the pretests. The selected stimuli represent only a small fraction of all tested materials, let alone the theoretical space of all behaviors, which suggests that strong stimulus constraints may apply. It makes sense to expect that inferences drawn from behavioral statements are strongly regulated by the stimuli themselves. On the one hand, there may be (socially shared) classification rules about presumed causes of certain types of behavior (causal schemata, implicit personality theories, e.g., Anderson, 1981; Kelley, 1973). On the other hand, the additional information provided in a behavioral statement may also impact the likelihood of certain inferences. For example, linguistic markers of temporal consistency have been demonstrated to increase trait inferences in deliberate impression formation (Olcaşoy Okten & Moskowitz, 2018). Thus, behaviors and behavioral statements themselves present strong constraints with regard to the inferences that can be drawn from them. Similarly, target and/or perceiver effects are likely to influence inferences

drawn from behavior (Kenny, 2019). For example, research on the linguistic intergroup bias (LIB; Maass, Salvi, Arcuri, & Semin, 1989) has provided evidence that people represent others' behavior differently depending on its evaluation and whether it is performed by ingroup vs. outgroup members: Whereas desired ingroup behavior and undesired outgroup behavior is represented in more abstract terms (e.g., by using trait adjectives), undesired behavior of ingroup members and desired behavior of outgroup members is represented in less abstract forms (e.g., by using state verbs). Although we are not aware of any research investigating if the LIB applies to spontaneous impression formation as well, it is conceivable that observers apply state and trait inferences differently to the same behaviors based on the group memberships of actor and perceiver. A further moderating condition may be cultural differences in person construal. There is abundant research showing that people with an individualistic cultural mindset tend to construe individuals as rather separate entities with higher individualistic agency, whereas people with a collectivistic cultural mindset tend to construe individuals and their agency as fundamentally connected to their social and non-social environment (e.g., Markus, Uchida, Omoregie, Townsend, & Kitayama, 2006). Some cross-cultural research has indicated lower levels of trait inferences in collectivistic than individualistic cultures (Shimizu, 2017; but see Bott et al., 2021). For state inferences, there may be a reversed cultural difference. Last but not least, the temporary mindset and goals of an observer may constitute important moderating conditions, as has already been shown with respect to trait versus situation inferences. In our own exploratory attempts at identifying individual differences, we did not find any effects relating spontaneous state (and trait) inferences with implicit personality theories (Dweck et al., 1995) or construal level (Navon, 1977; Trope & Liberman, 2010; see online supplemental materials).

The process of person perception from behavior is very complex, and it is likely that a multitude of factors influence which inferences a specific perceiver draws from a specific behavior shown by an specific actor. Caution is advised to not over-generalize our current findings to person perception in general. Future research is needed to investigate which processes contribute to social inferences from behavior and to better understand the systematic behind aforementioned stimulus constraints and how target and perceiver effects may impact spontaneous state and trait inferences in deliberate and spontaneous impression formation from behavior.

In light of the multitude of spontaneous social inferences, we need to further develop our theorizing of impression formation from behavior to understand why and how we tend to overly attribute observed behaviors to peoples' dispositions. We are confident that the presented research constitutes an important first step in this direction.

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