The Influence of Object-Salience on Consistency of True and False Alibi Statements:

*When Liars’ Strive to Convince Backfires*

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THE INFLUENCE OF OBJECT-SALIENCE ON CONSISTENCY OF TRUE AND FALSE ALIBI STATEMENTS:

*WHEN LIARS’ STRIVE TO CONVINCE BACKFIRES*
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Summary

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Name of Supervisors: Pär-Anders Granhag (main supervisor) and Bruno Laeng (co-supervisor).  
Author Statement: The present thesis was an independent research project in which the author collected and analysed the data.

Background: How to correctly discriminate between honest and deceptive alibi statements holds great legal importance. Consistency as a cue for assessing veracity has received much attention within the field of deception detection; however the validity of the cue remains unclear for true-false alibi situations.  
Objectives: The aims of the present study was to investigate whether level of salience would moderate both the amount of information provided as well as consistency, and thus enhance the differences between pairs of liars and pairs of truth-tellers.  
Method: Pairs (rather than single suspects) were examined for within-group consistency, and a novel paradigm of a “Liar/Seen – Liar/NotSeen” was introduced. This paradigm was designed to reflect real life cases in which people, needing an alibi, ask a friend to falsely state that they were together at a specific place, at a critical point in time. Furthermore, salience was examined as a potential moderator and measured objectively using eye-tracking technology. Finally, the study introduced a novel specific measure of consistency through matches and mismatches. One hundred participants were tested.  
Results: As predicted, the analyses revealed that the level of salience influenced truth-tellers’ within-group consistency to a comparatively higher degree than liars’ within-group consistency. Specifically, there were clear differences between liars and truth-tellers regarding the occurrence of a mismatch. Close to all (except one) truth-telling pairs had at least one mismatch, whereas for lying pairs, the absence of mismatching details were as common as the occurrence of one. However, contrary to expectations there were no differences in amount of information told comparing the groups; neither measured as number of words nor number of details provided.  
Conclusion: The strong findings of salience moderating consistency might contribute towards improving our ability to discriminate between true and deceptive alibi statements.
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Introduction

The 29th of July 1985, a 36-year-old woman named Penny Beerntsen was out running when attacked by an unknown man, forced into a wooded area and sexually assaulted. Later, when confronted with the photo line-up, she identified Steven Avery as her attacker. At trial Avery presented 16 alibi witnesses. One of these was a clerk of a paint store that recalled Avery, accompanied by his wife and five children, buying paint. A checkout tape backed up Avery’s alibi, and showed that the purchase took place at 5:13 pm. That meant that Avery would have had to leave the scene of the attack, walk a mile to the nearest parking area to get to his car, drive home, load his family into the car, and drive 45 miles, in just over an hour. Despite this unlikely timeframe, Steven Avery was convicted of the rape and sentenced to 32 years in prison. Almost two decades later, by the help of the Wisconsin Innocence Project and improvements in DNA testing, Avery’s innocence was proved and he was released from prison on September 11, 2003. Unfortunately, Avery’s story is not unique. His, and similar stories, illustrate the importance of accurately discriminating between truthful and deceptive alibis.

The ability to correctly discriminate between honest and deceptive alibi statements holds great legal importance. Even though alibi research in general has received some attention in the last couple of years (Burke, Turtle, & Olson, 2007; Culhane & Hosch, 2004, 2012; Dysart & Strange, 2012; Olson & Charman, 2012), there are still a number of issues that need to be examined. One important example is the topic of alibi discrimination (Culhane et al., 2013). An alibi assessed as true may clear a person from charges, while an alibi assessed as deceptive may strengthen the case against the suspect. Thus, the lack of research focused on our ability to separate between truthful and fabricated alibi statements is a major challenge (Culhane et al., 2013).

Insofar as false alibis involve deceit, research on deception detection provides a fitting starting point for an examination of true and false alibis. Deception detection research shows that both laymen and presumed lie experts are poor at discriminating between truthful and deceptive statements (Bond & DePaulo, 2008; Clemens et al., 2010; Culhane et al., 2013; Granhag & Hartwig, 2008). It seems that this general finding also holds for people’s ability to distinguish between true and false alibis (Calcaño, Keen, Storey, Costello, & Aamodt, 2006 as cited in Culhane et al., 2013). However, there are rather few studies focusing on the discrimination between true and
false alibis. Still, the extant studies (Calcaño, Keen, Storey, Costello, & Aamodt, 2006 as cited in Culhane et al., 2013; Strange, Dysart, & Loftus, 2015) have reached the same conclusion as deception detection research: the accuracy of veracity judgements is no better than chance.

Moreover, deception detection research has identified consistency, either within- or between statements, as a common cue for assessing veracity. Hence, it is reasonable that the applicability of the consistency cue for discriminating between true or false alibi statements should be investigated. It is noteworthy that this cue has not been tested in this context before.

The aim of the present thesis was to extend previous research by examining the consistency cue in a true and false alibi-situation, as well as including the level of salience as a potential moderator. Specifically, I wanted to examine whether the level of object-salience could make the differences between liars and truth-tellers more apparent, and hence increase our ability to discriminate truth from deceit. That is; will the fact that information is of varying degree of prominence influence the consistency of pairs of liars and truth-tellers? Moreover, differences in verbal strategies were examined as a potential explanation.

**Deception Detection in Small Groups**

Most research on deception detection has focused on the behaviour of single deceivers, while ignoring the situation arising when examining two or more suspects (Driskell, Salas, & Driskell, 2012). This is surprising considering the applied value of such research (Vernham, Granhag, & Mac Giolla, 2016). Studies on groups allows for different interview approaches that enable examination and identification of unique cues to deceit, such as collective interviewing (i.e. interviewing of group members simultaneously, see Vernham & Vrij, 2015 for a review) and within-group consistency (Strömwall, Granhag, & Jonsson, 2003). Further, there are several settings in which investigators are required to interview more than one person to be able to determine whether they are telling the truth or not (Granhag, Mac Giolla, Strömwall, & Rangmar, 2013; Roos af Hjelmsäter, Öhman, Granhag, & Vrij, 2014). Critically, crimes that are committed by more than one suspect are common and on the rise (McGlovin, Sullivan, Piquero, & Bacon, 2008; Ouellet, Boivin, Leclerc, & Morselli, 2013; Van Mastrigt & Farrington, 2009). Moreover, co-offending is only one circumstance in which the police are required to investigate more than one person
(Vernham et al., 2016). Yet another example is a case were a suspect refers to an alibi witness (Dahl & Price, 2012).

Many alibi situations can be seen as unique cases of group deception. For example in cases involving an alibi witness, investigators are required to determine whether the alibi statement is true or false by evaluating the separate stories told by the suspect and the alibi witness. Hence, within-group consistency seems to be relevant for alibi situations (e.g. Mac Giolla & Granhag, 2015; Roos af Hjelmsäter et al., 2014; Vernham et al., 2016; Vrij, Mann, Leal, & Granhag, 2010) and is therefore the focus of this thesis. Despite its applied value, the number of studies examining groups is very limited. In fact, between 2003 and 2014 only 20 studies examining verbal group deception were published (Vernham et al., 2016). Thus, more research is needed on groups examining whether or not within-group consistency differs from the consistency results found in research on single suspects.

**Within-Group Consistency**

If the situation allows, people evaluating veracity often use the cue of consistency to try to discriminate between truth and deceit (Roos af Hjelmsäter et al., 2014). Consistency, however, can come in many different forms, including: *within-suspect consistency* (Granhag & Strömwall, 2001); *statement-evidence consistency* (Clemens et al., 2010; Hartwig, Granhag, & Strömwall, 2007); and *within-statement consistency* (Landström, Hjelmsäter, Roos, & Granhag, 2007). With regards to groups, the specific form of consistency most relevant is *within-group consistency* (Strömwall et al., 2003). This type of consistency is measured as the degree of overlap between statements provided by different members of a group. Hence it is relevant in for example alibi situations, in which several persons are questioned about the same story.

The general belief held by laymen and professionals is that consistency implies truth telling, whereas inconsistency implies lying (Granhag & Strömwall, 2000; Granhag, Strömwall, & Jonsson, 2003). However, there is little empirical evidence to support this assumption (Strange et al., 2015). On the contrary, research within the field of legal psychology has found consistency to be an unreliable cue to deceit, with liars being as – or even more – consistent in their statements than truth-tellers (e.g., Granhag et al., 2003; Wagenaar & Dalderop, 1994 as cited in Roos af Hjelmsäter et al., 2014).
Consistency is found to be an emphasised cue, also when it comes to alibi discrimination. Laypersons, police and presumed lie experts alike tend to believe that a suspect’s alibi, if truthful, should remain consistent over time (Burke et al., 2007; Culhane & Hosch, 2012; Dysart & Strange, 2012). Based on research on deception detection, it seems unlikely that the “consistency implies truth-telling and inconsistency implies lying”-assumption will hold any better in alibi situations. This is complemented by a recent study, focusing on the consistency between true alibi statements based on autobiographical memories (Strange et al., 2015). Participants were asked to imagine that they were suspected of a crime they did not commit, and that the police were asking them to provide an alibi for the time in question (a moment three weeks earlier). A week later, the same participants were asked to return to present their alibi statement for a second time. Strange and colleagues (2015) found that inconsistencies in honest alibi stories appear to be the norm rather than the exception. However, no previous studies have directly examined the within-group consistency between true and false alibi statements.

Why are Liars as Consistent as Truth Tellers?

A number of complementary explanations can account for why liars are able to achieve similar (or higher) within-group consistency levels as truth tellers. Granhag and Strömwall (1999) suggested the “repeat versus reconstruct” hypothesis as a possible explanation. The hypothesis was originally developed for single suspects who were interviewed more than once (i.e., between-statement consistency). Granhag and Strömwall hypothesised that liars know they need to keep track of their lies to avoid being exposed; hence they will carefully attempt to repeat the same story across interviews. Truth-tellers, on the contrary, rely on their memory of the event each time they are asked to provide a testimony. Thus, the hypothesis rests on the assumption that liars will try to repeat what they have planned, whereas truth-tellers will try to reconstruct what they actually experienced (Granhag et al., 2003). In general, memory is considered to be a reconstructive process (e.g. Baddeley, Eysenck, & Anderson, 2009; Loftus, 2003); hence, various types of inconsistencies should be expected across truth-tellers’ interviews. Granhag et al. (2003) argue that the repeat-strategy of liars will promote consistency, whereas the more recollective nature of truth-tellers’ memory might (to some extent) undermine consistency. Possibly, people’s poor discrimination performance might be the result of the assumption that
“consistency implies truth-telling”, whereas liars are in fact found to be as or even more consistent than truth-tellers (e.g., Granhag et al., 2003; Wagenaar & Dalderop, 1994 as cited in Roos af Hjelmsäter et al., 2014). The “repeat versus reconstruct” hypothesis has later been extended to group situations in order to account for within-group consistency (for more details, see Vredeveldt, van Koppen, & Granhag, 2014).

A related explanation concerns the verbal strategies applied by groups of liars and truth-tellers when trying to appear truthful. The literature shows that these verbal strategies differ (Granhag et al., 2013; Hartwig et al., 2007; Vrij et al., 2010). Specifically, Vrij et al. (2010) found that truth-tellers were mostly concerned with telling everything they remembered, whereas liars tried to prepare for possible questions and decided to be vague to avoid contradicting each other. These findings are in line with the “repeat versus reconstruct” hypothesis (Granhag & Strömwall, 2001), by suggesting that truth-tellers in fact are trying to recollect as much as possible whereas liars try to repeat the story they have planned. Vrij and colleagues argue that based on these differences in verbal strategies, the stories of truth-tellers are likely to be more detailed than the stories of liars. Liars restrict the amount and type of information they provide (e.g., by planning what to include and what to omit) to control the situation, whereas truth-tellers do not feel the same need to restrict their stories. Based on these differences it seems reasonable to assume that liars’ restrictive strategies will result in statement consistency – while the “tell everything” strategy embraced by truth-tellers will increase the risk of inconsistencies between statements. Thus, differences in terms of verbal strategies might influence the amount of information provided by suspects, which in turn might result in differences with respect to the level of consistency between groups of liars and truth-tellers. By providing less information, the chances of being consistent will increase.

**Salience as a Moderator**

The repeat vs. reconstruct hypothesis and research on counter-interrogation strategies can be used as a framework to explain the abovementioned findings on deception and consistency. An important next step to further understand the underlying processes of consistency involves an examination of other potentially influencing variables (i.e., potential moderators). That is, it is worthwhile examining what particulars that may influence consistency. With regards to within-group consistency, object-salience may be an important moderator. The concept of salience
refers to the state or condition of being prominent. According to The Oxford English Dictionary, salience is defined as the object or aspect that is “most noticeable or important” (2009). Perceptual salience, which is of particular interest in the present study, can be defined as the quality of a detail to be visually distinctive relatively to the details surrounding it (Humphrey & Underwood, 2008).

Within the field of memory research it is established that the strength of memories depends on the centrality of the details, with central or salient details being more easily retrieved than peripheral details that are less noticeable or prominent (Christianson, 1992; Heath & Erickson, 1998). It is argued that the reason for this is because what is central attracts more attention, and thus is better encoded and remembered than peripheral stimuli (Roos af Hjelmsäter et al., 2014). In addition, peripheral details are found to be more easily distorted (Roos af Hjelmsäter, Granhag, Strömwall, & Memon, 2008). This knowledge, combined with the knowledge of differences in verbal strategies, might further explain why liars manage to stay as (or even more) consistent than truth-tellers. That is, whereas liars choose to particularly restrict information they feel less sure about (i.e., peripheral details), truth-tellers are found to believe in a just world (Lerner, 1980), and not worry about their information being inconsistent. Hence, truth-tellers are expected to tell everything they remember regardless of degree of salience. Therefore, truth-tellers will provide relatively more of the information most prone to memory errors – which further increases the risk of being perceived as relatively inconsistent. Hence, details that are poorly remembered are naturally more likely to result in inconsistencies, compared to details that are very well remembered. Specifically, liars who work in small groups may ensure a high within-group consistency by explicitly plan to mention few (if any) details at a low level of salience (i.e., peripheral details) and omit the rest. In contrast, different members of a truth-telling group are likely to have encoded (and hence recall) different non-salient details, and thus the group are prone to within-group inconsistencies because all members still telling everything.

Research has also found that, due to attentional mechanisms, level of salience is essential for what we end up remembering (Roos af Hjelmsäter et al., 2014). In other words, as well as the quality of memories, salience will also influence what is remembered. In brief, highly salient details are recalled by most people. However, with less salient details, individual variation in what is attended to will influence what is remembered and subsequently recalled, thereby reducing consistency. This
influence of salience is not expected to influence liars’ consistency levels, because liars are expected to prepare the story to be told in an interview (Vrij et al., 2010). They could plan to mention a specific set of details and thus ensure a high degree of consistency regardless of the level of object-salience. For example, they could plan to mention a clown, a musician and a guitar case; while also planning not to mention which specific instruments the musician was playing or other people in the environment. In contrast, truth-tellers’ strategy of “telling everything” would most likely result in larger variations of details provided by members of a small group, particularly for less salient details. The reason for this is that the variation in attention allocation will be greater between individuals for details at a low level of object-salience.

To my knowledge, Roos af Hjelmsäter et al. (2014) published the only previous study that examined the potential connection between salience and consistency. Roos af Hjelmsäter and colleagues argue that when it comes to salient aspects it is reasonable to assume that truth-tellers can draw on their memory, which is fairly good. Hence, true statements are likely to be relatively consistent regarding highly salient details. On the contrary, less salient details (that attract less attention) are remembered less well (Roos af Hjelmsäter et al., 2014), and these details are therefore more likely to result in inconsistencies between honest statements. In other words, the degree of salience might moderate consistency between truthful statements, due to natural attention and memory effects (Roos af Hjelmsäter et al., 2014). Based on these assumptions, Roos af Hjelmsäter et al. (2014) examined the relationship between consistency and salience. Half of their participants experienced (truth-tellers) and half of them imagined (liars) an event, before they were asked to provide both a verbal and a spatial description of the event. Then consistency scores within the small groups were rated. Roos af Hjelmsäter and colleagues found a significant main effect of salience, with salient aspects being rated as more consistent than non-salient aspects. That is, they found differences in consistency within small groups to be dependent on salience.

Measuring Salience

A limitation of the study by Roos af Hjelmsäter et al. (2014), is their way of measuring salience. The authors used a subjective categorization procedure and simply regarded some factors as being more outstanding or prominent than other
factors. For example, Roos af Hjelmsäter and colleagues argued “as the man was the main focus of the event … aspects concerning the man … were defined as salient aspects” (p.183). Hence, they did not apply an objective method for defining salience. However, more empirical methods for determining salience can be found by turning to the field of computer vision. Within this field, the challenge of salient object detection (i.e., selecting the most visually salient object in a scene) has received a great deal of attention in the last couple of years (Borji, 2015). Since Liu et al. (2011) published “Learning to detect a salient object”, a large number of methods attempting to detect salience have been proposed (Borji, 2015).

The main criterion for judging how predictive a salience model is, are by examining correlations between eye fixations and the model (Borji, Sihite, & Itti, 2013). This implies an underlying assumption that eye fixation is “proof” of salience, and several studies do find a strong correlation between eye-fixations and salient objects (Borji, 2015; Borji et al., 2013; Li, Hou, Koch, Rehg, & Yuille, 2014; Parkhurst, Law, & Niebur, 2002). Moreover, fixations are found to more likely occur in positions of higher local salience value (Itti & Koch, 2000). Furthermore, it is argued that salience influence attention shifts manifested by the eye movements that would be drawn to the most salient aspects of a scene (Itti & Koch, 2000; Koch & Ullman, 1987). Hence one possible way to objectively measure and define salience is to base it on eye fixations. Such a definition was used by for example Borji (2015). Similar to Li et al. (2014), Borji (2015) argued that the object that attracts the majority of fixations is the most salient, and specifically he defined the most salient object as “the one with the highest fraction of fixations on it” (p.747).

The Present Study

The present study advanced previous research by examining within-group consistency in a true and false alibi scenario. Specifically, the study examined pairs of liars and truth tellers, where one liar “told the truth” to the other liar (and helped him/her with an alibi story, rather than two liars making up an alibi story together). This novel paradigm is meant to reflect real life cases where people, needing an alibi, ask a friend to pretend that they were together at a specific place, at a critical point in time. In such an alibi-situation, there will be one person telling the truth about were s/he was, but falsely adding the other person as present. The other person (that is in
need of an alibi) will have to rely on what the accomplice is telling him/her. To my knowledge, no such study – with one liar helping another liar – exists.

The study further examined salience as a potential moderator of within-group consistency. Importantly, salience was measured using eye-tracking technology as suggested by Borji (2015). This is a method that enabled us to analyse participants’ fixations across the picture, which in turn allowed for a more objective measure of object-salience (in comparison to the study by Roos af Hjelmsäter et al., 2014).

Finally, the current study employed a novel specific measure of consistency involving matches and mismatches. For most past research, a global measure of consistency is used, were the overall perceived consistency of two statements is rated on a Likert scale (e.g., from 1 to 7). This method was used in the present study, but in addition, matches and mismatches were counted. A *match* refers to one particular object or detail that is mentioned by both members in a pair, whereas a *mismatch* refers to one particular object or detail that is mentioned by one member in a pair but not the other. Both the frequency (counted as the total number of objects that were mentioned by both/one of the members in a pair) and occurrence (counted as one, as long as there were at least one) of matches and mismatches were calculated.

As such, the present study wanted to examine whether separating information based on different levels of object-salience (high, moderate and low) would influence the amount of information provided as well as consistency scores, and thereby make the differences between deceptive- and honest groups even more apparent.

Based on previous research, the following hypotheses were proposed: The first hypothesis stated that liars would provide less information than truth-tellers (Hypothesis 1a). This would be the case both with respect to statement length and level of detail provided during the interview. Previous research has argued that this is a valid assumption due to differences in terms of the verbal strategies used by liars and truth-tellers (Vrij et al., 2010). Moreover (and also due to differences in verbal strategy) an interaction effect was expected. The *amount* of information provided by lying and truth-telling pairs was expected to be dependent on the *type* of information; defined by level of salience (Hypothesis 1b). The rationale for this was that liars would be particularly restrictive regarding information they felt less sure about (i.e., peripheral information).
Furthermore, liars were expected to be as, or even more, consistent than truth-tellers (Hypothesis 2a). This hypothesis was based on the considerable amount of research that has found consistency to be an unreliable cue for assessing veracity (e.g., Culhane & Hosch, 2012; Granhag et al., 2003; Wagenaar & Dalderop as cited in Roos af Hjelmsäter et al., 2014; Strange et al., 2015). In addition, objects of a higher level of salience were expected to be perceived more consistent than objects at a lower level of salience (Hypothesis 2b). This assumption was based on the potential influence of salience on consistency found by Roos af Hjelmsäter et al. (2014). Moreover, liars were hypothesized to (due to their comparatively more restrictive verbal strategy) be particularly restrictive when it came to peripheral information, and thus being perceived as highly consistent regardless of level of salience. In contrast, truth-tellers were expected to “tell everything” without worrying about peripheral details possibly being poorly remembered, and were expected to be perceived less consistent the lower the degree of salience of the objects in question. In other words; an interaction effect of veracity and salience as measured by consistency was predicted (Hypothesis 2c).

Lastly, liars were hypothesized to provide matching information to a higher degree than truth-tellers (Hypothesis 3a); because liars (due to their restrictive strategy) were expected to plan to mention the same objects to appear convincing. In contrast, truth-tellers were expected to provide more mismatches than liars (Hypothesis 3b). Due to truth-tellers’ strategy of telling everything, and their believe that the truth will shine through (Gilovich, Savitsky, & Medvec, 1998), they were expected to mention every detail they remembered, and thus naturally more often having one member of a pair mentioning an object that the other member did not mention.
Method

The present study is a 2 (Veracity: liar vs. truth-teller) x 3 (Salience: high vs moderate vs. low) mixed design, with Veracity as the between-subjects variable, and Salience as the within-subjects variable. Participants were measured and rated regarding the amount of information provided (statement length and level of detail) and within-group consistency (including matches and mismatches).

Participants

One hundred participants (63 female and 37 male, age ranging from 18 to 54 years, \( M = 24.29 \) years, \( SD = 5.19 \)) took part in the experiment. Approximately 65% of the participants were students at various departments at the University of Oslo, the rest were recruited outside the university. All participants were recruited under the guise of a study examining how pictures of different scenes could influence problem solving and decision making. They were further told that there was a possibility of winning 500 NOK if they performed well. Eight of the participants were excluded from preliminary analyses of eye-tracking data (assessing the level of object-salience) due to poor calibration (i.e., deviations in visual angle acuity equal or above 1.0°) resulting in unsatisfactory accuracy levels of fixation. Nevertheless, these eight participants saw the target picture and conducted the experiment in the exact same way as all other participants (it was only their fixation measurements that were not accurate enough). Hence, all participants were included in the main analyses of statement length, level of detail and both global and specific measures of consistency.

Ethical Considerations

The study was approved by The Norwegian Social Science Data Services (NSD) before recruitment of participants began. All participants received, read and signed an informed consent prior to participation. They were additionally told verbally that their results would be anonymous and that they could withdraw from participation at any time.

Half of the participants (i.e., the truth-tellers) were not informed that their memory performance would be tested during the experiment. This was considered necessary to ensure a high ecological validity. All participants were debriefed and told the purpose of the study before leaving the experiment.
Stimuli and Apparatus

A single photograph of a well-known square in Oslo (“Egertorget”) was used as the target stimuli. The picture showed a musician playing several instruments simultaneously and a clown making balloons, in addition to other people and objects surrounding them (for picture, see Appendix 1). The picture was taken with a Canon EOS 600D camera, and Adobe Photoshop software was used to further improve the quality of the picture (e.g., luminance, sharpness, etc.). During encoding, participants passively viewed the target picture while eye tracked. The photograph was presented using Microsoft PowerPoint® and centred on a computer screen. The picture was presented for exactly 20 seconds, and eye data during this time period was collected using a non-invasive infrared eye-tracker (remote eye-tracking device, SMI – SensoMotoric Instrument®, Teltow, Germany). The gaze position was sampled at a rate of 60 Hz. Data recording was done using iView X Software (SMI, Teltow, Germany), and percent Fixation Time was extracted for each participant using BeGaze Software (SMI, BeGaze™). All participants were seated approximately 80 cm from the computer screen and completed a standard calibration procedure before they started the short eye tracking session. The interviews were audio recorded to enable transcription. A SONY IC recorder (ICD UX300) was used.

Procedure

Participants were recruited and arrived at the laboratory in pairs, before being randomly assigned to one of the two veracity conditions: either (1) “liars” or (2) “truth-tellers”.

Truth-Tellers

Truth-tellers (25 pairs; 50 truth tellers in total) were separately taken through a short eye-tracking session. They were instructed that a random picture would appear on the screen, and that some pre-conscious eye-measures would be done while they freely looked at the picture. The latter instruction was given as an explanation for why they were eye-tracked. They were then given a labyrinth task which was introduced as “a standard task for rating problem solving and the ability to focus”, and told that if they were able to solve the labyrinth in less than 5 minutes they would receive a ticket and be part of a draw for 500 NOK (approximately €54). In reality, this labyrinth task functioned as a filler task (for a picture of the labyrinth and instructions, see Appendix
2), however the participants that managed to complete the task within the timeframe did receive a ticket for the draw. After finishing the labyrinth task, truth-tellers were instructed to imagine the following scenario: Last Saturday, around noon, they had been out walking with the other pair member in the street of Karl Johan (the main street in Oslo, Norway). During this walk, they had stopped for a couple of minutes at Egertorget to watch something happening there – and that what they had seen at Egertorget was what they had earlier been shown on the computer screen during the eye-tracking. Further, they were told that at the exact time as they were standing at Egertorget (that is: Saturday, around noon), a robbery had taken place in another part of Oslo. They were informed that the police suspected them to be involved in this crime. Thus, they had been contacted by the police and asked where they were and what they were doing last Saturday around noon. To that question they had both answered that they had been standing at Egertorget at the time in question. The police still felt unsure of whether to believe this alibi story or not, so the participants were ordered in for questioning about what they remembered seeing at Egertorget to prove their alibi, and thus their innocence. Hence, their alibi was based on something that they had actually seen (i.e., the picture) and not something they only imagined (i.e. the rest of the story context). They were informed that their task was to convince the interviewer that they actually had been at Egertorget and that if they managed to be believed they would receive a ticket and be part of a draw for 500 NOK. All participants were then separately led to the interview. After being interviewed, all participants were asked to individually complete a post-interview questionnaire. They were told (verbally and in writing) that the experiment was finished, that their answers would not in any way influence the assessment of their statements as true or false, and were asked to answer the questions truthfully. After this questionnaire, all participants were debriefed and thanked for their participation.

**Liars**

Liars (25 pairs; 50 liars in total) were separated at the arrival at the lab, before receiving different instructions (one instruction for “Liars/Seen” and another for “Liars/NotSeen”).

**Liars/Seen** were verbally instructed to imagine that they had planned a robbery together with a friend. Their partner’s task/responsibility was to carry out the robbery, while their job was to provide an alibi for them both. Liars/Seen were further
instructed to imagine the same story context as the truth-tellers; namely that they had gone for a walk in Karl Johan last Saturday around noon and had stopped for a short period of time at Egertorget to watch something that happened there. Liars/Seen were then placed in front of the eye-tracker and told that what they had seen at Egertorget was about to appear on the computer screen. Finally, Liars/Seen were reminded that they were supposed to help their accomplice with an alibi based on this picture afterwards.

**Liars/NotSeen** were placed in a separate room and given written instructions of the same story. They were told that their job were to “conduct the robbery” (they did not actually carry out such an act), while their accomplice was to provide an alibi for them both. They were further told that they would soon be led to their accomplice to get instructions for the alibi.

When reunited at the lab, the experimenter told the lying pair (Liar/Seen and Liar/NotSeen) that the robbery had been successful. However, the police were suspicious to whether they had any involvement in the crime. Thus, the police had contacted them and asked where they had been and what they had been doing last Saturday around noon. To that question they were told that they had both replied that they were looking at something happening at Egertorget. The police still felt unsure of whether to believe this alibi or not, so the participants were informed that they would be taken in for separate questioning regarding what they had seen to prove their alibi and thus their innocence. They were informed that their task was to ensure that both of them were believed by the police. That is, they were unsuccessful if only Liar/Seen was believed but Liar/NotSeen was not. They were given five minutes to prepare themselves in whatever way they preferred, and informed that if they managed to both be believed they would each receive a ticket and be part of a draw for 500 NOK.

After their five minutes of preparation time, the liars received the same filler task as the truth-tellers (Labyrinth task, see Appendix 2), before being taken to the individual interview. Lastly they filled out the questionnaire and were debriefed about the purpose of the study.

The core differences between the procedures of liars and truth-tellers were which instructions were given and at what time, in addition to the memory task demands. Furthermore, the filler task (labyrinth) was presented *before* the interview instructions for the truth-tellers, while presented *after* the interview instructions for the liars. See Figure 1 for an illustration of differences in procedure.
Figure 1. Flow chart illustrating the differences in procedures between veracity conditions.
**Interviewers**

The interviews were conducted by the help of three voluntary assistants (two female and one male, mean age: 25), blind to the hypotheses and veracity conditions. The assistants did not get paid for their efforts. The three interviewers were first trained and then followed a pre-defined interview script. The interview was exactly the same for all participants across veracity condition. The assistants conducted interviews of both lying and truth-telling participants. Each interview lasted only a few minutes, and was audio recorded to enable transcription. For interview questions, see Appendix 3.

**Post-interview Questionnaire**

After the experiment was completed, all participants answered a post-interview questionnaire. This questionnaire was given to collect self-reported data to complement the eye-fixation data, and the data from the transcribed and coded interviews. Among other things, participants rated their motivation to be believed by the police and to what degree they had told everything during the interview vs being restrictive. The scales ranged from 1 (not at all motivated) to 7 (very motivated), and from 1 (told everything they could remember) to 4 (consciously being restrictive in what details they shared).

**Identification and Marking of the Objects in the Picture**

Structurally similar as Borji (2015), two assistants blind to the hypotheses of the experiment were asked to manually outline objects in the target picture. This was done to avoid subjective choices of which objects that were of interest (influenced by the hypotheses), and before conducting the preliminary area of interest (AOI) analyses to decide object salience. The assistants were (like Borji’s observers) instructed to accurately segment as many objects as possible, following three rules: a) discard reflection of objects (e.g., in mirrors/windows etc.), b) segment objects that are not separable as one (e.g., people in a crowd), and c) interpolate the boundary of occluded objects only if doing otherwise may result in one object being split in several parts. The assistants were also told that their outline should be accurate enough to make it perfectly clear what they included as a part of the object and not. Further, they were numbering the objects on the sheet and naming them on a separate list.
Before the assistants begun their identification and marking task, they received two pictures for practise, and were given the possibility to discuss differences after each of these. An object counted if it was identified by both assistants independently. This resulted in 22 objects, which were the basis for conducting the preliminary AOI-analyses (for a picture illustrating the AOIs, see Appendix 4).

**Preliminary analyses to determine salience**

In order to examine whether the level of salience influenced the amount of information provided and consistency (including matches and mismatches), preliminary analyses of the eye-tracking data were conducted to enable categorization of the objects to the high-, medium- or low level of salience (i.e., decide which of the 22 objects that would be assigned to which salience group).

A one-way repeated measures ANOVA was conducted to compare the percentage Fixation Time for all the 22 objects for both liars and truth-tellers. There was no significant interaction effect of Object and Veracity group (Wilks’ Lambda (21, 47) = 1.693, p = .067, \(\eta_p^2 = .431\)), meaning that there was no significant differences with respect to how long liars and truth-tellers fixated at the different objects. Thus, the mean percentage fixation time across veracity condition was the basis for ranking the objects (see Table 1 in Appendix 5 for all objects ordered based on mean percentage Fixation Times). Post Hoc comparisons (Bonferonni) revealed that the object with the highest percentage fixation time (the musician) had significantly higher percentage fixation time compared to all the other 21 objects. Based on this, and similar to how Borji (2015) defined salience, the musician was thus defined as the object of the highest level of salience. The musician was such a clear outlier compared to the clown and guitar case (the objects at second and third place, ordered on percentage fixation time) that is was easily categorized as the only object in the highest level of salience group by itself. The remaining 21 objects were split into two separate categories: moderate- and low degree of salience (see Appendix 5 for which objects were assigned to which group). This separation, however, was not that clear-cut. The split was done by calculating the mean percentage fixation time of the remaining 21 objects (\(M = 1.98\)). The objects with a percentage fixation time above this mean were allocated the moderate salience level,
while the objects with a percentage fixation time below this mean were allocated the low salience level.

**Statement Length, Level of Detail**

To examine whether the amount of information provided by liars and truth-tellers differed, the transcribed interviews were coded both with respect to the total amount of words and the number of objects provided in the interview. It is possible for a suspect to provide a high number of words, and still score rather low in terms of level of detail. Thus, the number of objects mentioned by the participant was counted in addition to the total amount of words provided. Both the total number of objects, as well as the number of objects within each level of salience group was counted to examine Hypothesis 1b.

**Coding of Consistency**

**Global Measure of Consistency**

The interviews were audiotaped and transcribed. Coding took place based on the transcripts. Two coders, blind to the hypotheses and veracity conditions, independently rated within group consistency. The coders were told that they would rate pairs of written statements on a 7-point consistency scale, ranging from 1 (not at all consistent) to 7 (completely consistent). Thus, the within-group consistency was evaluated by comparing the degree of overlap between the responses of the two persons in each pair. Separate ratings were made for all three levels of salience (high, moderate and low) as well as for the overall statement (in total four ratings per pair: 50 pairs x 4 ratings = 200 ratings). The first coder made consistency judgements for 100% of the statement pairs in all four groups (= 200 ratings), while the second coder independently coded a random 20% (=10 pairs) in each group. This coding procedure was the same as that used by Mac Giolla and Granhag (2015). The inter-rater reliability between the two coders for within-groups consistency was satisfactory for all four groups: Intraclass correlation coefficient (ICC) was .943 for the whole statement; .873 for the high level of salience; .968 for moderate level of salience; and .970 for low level of salience.
Specific Measure of Consistency - Match/Mismatch

In order to test whether the pattern of matches and mismatches differed between liars and truth-tellers, these were counted for each pair. Match Frequency was counted as the total number of objects in each salience group that were mentioned by both members of the pair. For example, if both participants mentioned the clown, the girl with the red scarf and the guitar case (all objects from the moderate salience category) the pair would get “3” on Match Frequency Moderate. Match Occurrence was a dichotomous coding where a score of 1 meant that at least one match had occurred in that salience group (regardless of the number of total matches) and a score of zero meant that no match had occurred in that salience group. Thus, in the example above Match Occurrence Moderate would be “1”. In the same way, Mismatch Frequency was counted as the total number of objects in each salience group that were mentioned by one member in a pair but not the other member (i.e. member A mentioned the trolley, while member B did not), while Mismatch Occurrence was counted as one if at least one mismatch occurred within a pair for a salience group.
Results

Motivation

The vast majority of the participants (90%) indicated that they were motivated to be believed by the interviewer (score of 5 or higher on the 7-point Likert scale). An independent-samples t-test was conducted to compare the motivation scores for liars and truth-tellers. There was a significant difference in motivation scores ($t(92.159) = 3.037, p = .003, d = 0.60$), with liars reported being more motivated ($M = 6.02, SD = 0.769$) than truth-tellers ($M = 5.48, SD = 0.995$). The magnitude of the differences in the means (mean difference = .54, 95% CI: .187 to .893) was medium to large according to Cohen’s guidelines (Cohen, 1992).

Subjective ratings

To explore whether self-reported level of detail provided was affected by Veracity, a one-way between-groups analysis of variance (ANOVA) was conducted. There was a statistically significant difference between the three groups (Truth-tellers, Liars/Seen and Liars/NotSeen): $F(2, 100) = 37.38, p < .001, \eta^2 = .43$. Post-hoc comparisons using Tukey HSD test indicated that Liar/Seen ($M = 2.85, SD = .78$) was significantly more restrictive than both Liars/NotSeen ($M = 1.61, SD = .69$) and Truth-tellers ($M = 1.47, SD = .61$).

Statement Length and Level of Detail

In order to test Hypothesis 1a, an independent-samples t-test was conducted to compare the length of the statement (total number of words provided) for liars and truth-tellers. It was found that liars provided less words ($M = 178.72, SD = 60.13$) than truth-tellers ($M = 207.84, SD = 94.28$). However, this difference failed to reach statistical significance, $t(98) = 1.85, p = .06, d = .37$.

In order to test Hypothesis 1b, 2 (Veracity: truth tellers vs. liars) x 3 (Salience: high vs. moderate vs. low) mixed ANOVA was conducted, with Veracity as the between-groups variable and Salience as the within-groups variable. The dependent variable was the number of objects mentioned. As showed in Figure 1, there was a main effect of Salience, Wilk’s Lambda = .03, $F(2, 47) = 878.03, p < .001, \eta^2_p = .97$, with both veracity groups showing a reduction in level of detail in the low- compared to moderate salience groups. However, there were neither a significant main effect of
Veracity $F(1, 48) = .106, p = .75$, $\eta^2_p = .002$, nor a significant interaction between Veracity and Salience as measured by level of detail, Wilk’s Lambda $= .97, F(2, 47) = .67, p = .52$, $\eta^2_p = .028$.

Figure 1. An illustration of the non-significant interaction effect between Veracity and Salience as measured by level of detail. The error bars represent a 95% confidence interval.

Within-group Consistency

In order to test Hypotheses 2a, 2b and 2c, a 2 (Veracity: truth tellers vs. liars) x 3 (Salience: high vs. moderate vs. low) mixed ANOVA was conducted, with Veracity as the between-group variable and Salience as the within-group variable. Consistency (i.e., the score on the scale from 1-7) was the dependent variable. In support of Hypothesis 2a there was a significant main effect of Veracity, with liars ($M = 5.4; SD = 0.72$) being perceived as more consistent than truth-tellers ($M = 3.1; SD = 0.89$), $F(1, 48) = 98.38, p < .001, \eta^2_p = .67$. In support of Hypothesis 2b there was a main effect of Salience, with highly salient aspects being perceived as more consistent than less salient aspects, $F(2, 96) = 28.32, p < .001, \eta^2_p = .37$. The analysis further revealed a significant interaction between Veracity and Salience, $F(2, 96) = 12.36, p < .001, \eta^2_p = .205$. A trend analysis found a significant linear trend for truth-tellers with respect to perceived consistency across the three levels of salience, $F(1, 24) = \ldots$
101.40, $p < .001$, $\eta^2_p = .809$, with lower levels of salience resulting in lower perceived consistency. This was not the case for liars $F (1, 24) = 2.45, p = .131$, $\eta^2_p = .093$. As predicted by Hypothesis 2c, truth-tellers were perceived as less consistent the lower the degree of salience, whereas this was not the case for liars (stayed nearly as consistent – see Figure 2).

The interaction effect between Veracity and Salience was examined further for simple effects by conducting three independent-samples t-tests. Due to multiple t-tests Bonferroni correction was performed ($p < .05$ divided by 3), resulting in a more conservative significance level of .017. The results revealed that liars were perceived as significantly more consistent than truth-tellers at all three levels: High salience, $t (48) = 4.86$, $p < .001$, $d = 1.37$; Moderate salience, $t (48) = 6.02$, $p < .001$, $d = 1.70$; and Low salience, $t (39.27) = 8.99$, $p < .001$, $d = 2.54$.

![Figure 2](image.png)

Figure 2. An illustration of the interaction effect of Veracity and Salience as measured by perceived consistency. The error bars represent a 95% confidence interval.

**Matches and Mismatches**

**Match Frequency and Occurrence**

In order to test Hypothesis 3a, a 2 (Veracity: liar vs truth-teller) x 2 (Salience: Moderate vs Low) mixed ANOVA was conducted to assess the impact of veracity condition on the frequency of matching objects at moderate and low levels of salience. There was a substantial main effect of Salience, Wilks’ Lambda = .37, $F (1,
48) = 83.47, \( p < .001, \eta^2_p = .64 \), with both groups showing a reduction in Match Frequency for lower level salient details. The main effect of Veracity condition was significant: \( F(1, 48) = 28.06, \ p < .001, \eta^2_p = .37 \), with liars (\( M = 2.86, SD = .82 \)) having a higher frequency of matches than truth-tellers (\( M = 1.74, SD = .66 \)). Furthermore, there was a significant interaction between Veracity and Salience, Wilks’ Lambda = .92, \( F(1, 48) = 4.38, \ p = .042, \eta^2_p = .08 \). The interaction effect between Veracity and Salience as measured by the frequency of matches was examined further for simple effects by conducting two independent-samples t-tests. Due to multiple t-tests Bonferroni correction was performed (\( p < .05 \) divided by 2), resulting in a more conservative significance level of .025. The results revealed that liars had a significantly higher frequency of matches than truth-tellers at the low level of salience (\( t(48) = 5.71, \ p < .001, d = 1.61 \)). For the moderate level of salience, the difference failed to reach the more conservative significance criterion (\( t(48) = 2.12, \ p < .039, d = 0.60 \)). Figure 3a demonstrates that truth tellers match frequency more sharply declined for the low level of salience – group in comparison to liars.

Further, a Chi-square test for independence (with Yates Continuity Correction) indicated a significant association between Veracity and Match Occurrence for low level of salience, \( \chi^2(1, n = 50) = 13.72, \ p < .001, phi = -.57 \).

![Graph](image)

**Figure 3 a and b.** To the left, Figure 3a illustrates the significant interaction effect between Veracity and Saliency as well as the main effects of both Salience and Veracity as measured by match frequency. To the right, Figure 3b illustrates the significant interaction effect between Veracity and Salience as well as the main
effects of veracity as measured by mismatch frequency. In both graphs, the error bars represent a 95% confidence interval.

Mismatch Frequency and Occurrence

In order to test Hypothesis 3b, a 2 (Veracity: liar vs truth-teller) x 2 (Salience: Moderate vs Low) mixed ANOVA was conducted to assess the impact of veracity condition on the frequency of mismatching objects at moderate and low level of salience. There was no significant main effect of Salience, Wilks’ Lambda = .95, $F(1, 48) = 2.60, p = .113, \eta^2_p = .051$. However, there was a substantial main effect of Veracity, $F(1, 48) = 119.30, p < .001, \eta^2_p = .71$, with liars ($M = .62, SD = .56$) showing a lower frequency of mismatches than truth-tellers ($M = 2.72, SD = .78$). In addition, there was a significant interaction between Veracity and Salience, Wilks’ Lambda = .91, $F(1, 48) = 4.76, p = .034, \eta^2_p = .09$. The interaction effect between Veracity and Salience, as measured by the frequency of mismatches, was examined further for simple effects by conducting two independent-samples t-tests. Due to multiple t-tests Bonferroni correction was performed ($p < .05$ divided by 2), resulting in a more conservative significance level of .025. The results revealed that liars had a significantly lower frequency of mismatches than truth-tellers, for both moderate– ($t(48) = 5.75, p < .001, d = 1.63$), and low level of salience ($t(40.81) = 8.98, p < .001, d = 2.54$). Figure 3b demonstrates that Salience had little effect on the frequency of liars’ mismatches. For truth tellers, however, mismatches increased for the low salience group compared to the moderate salience group.

Further, a Chi-square test for independence (with Yates Continuity Correction) indicated a significant association between Veracity and Mismatch Occurrence for both moderate level of salience: $\chi^2(1, n = 50) = 12.00, p = .001, phi = .54$, and low level of salience: $\chi^2(1, n = 50) = 18.67, p < .001, phi = .66$. 
Discussion

Overall, the results provide strong support for the idea that object-salience influence truth-tellers’ within-group consistency to a comparatively higher degree than liars’ within-group consistency. The five hypotheses (2a, 2b, 2c, 3a and 3b) related to this general prediction received support. Thus, salience seems to be a strong moderator of consistency. Differences in verbal strategies, as measured by statement length and level of detail, were presented as a possible explanation for the differences in consistency and the moderating effect of salience. However, the hypotheses regarding this did not receive support (1a and 1b).

The discussion will start by presenting the findings of consistency and the influence of salience. Then, the lack of support for statement length and level of detail as potential explanations will be discussed, followed by alternative explanations. Lastly, the advancements and potential limitations of the present study are discussed in addition to suggestions for future research and concluding remarks.

Influence of Salience on Within-Group Consistency

As mentioned above, all hypotheses regarding consistency and salience received strong support. First of all, liars were in general perceived as more consistent than truth-tellers. In line with previous research (e.g., Culhane & Hosch, 2012; Granhag et al., 2003; Strange et al., 2015; Wagenaar & Dalderop as cited in Roos af Hjelmsäter et al., 2014), this finding speaks against the commonly held assumption that consistency implies truth-telling and inconsistencies implies lying. Secondly, object-salience was found to influence the perceived consistency of truth-tellers, but not the consistency of liars. That is, the results revealed a strong interaction effect between salience and consistency, with truth-tellers being perceived less consistent the lower the level of salience, whereas this was not the case for liars.

Moreover, and also as predicted, the results revealed systematic differences between liars and truth-tellers when analysing the specific measure of consistency (i.e., patterns of matches and mismatches). Liars were in general found to have a significantly higher frequency of matches, whereas truth-tellers had a significantly higher frequency of mismatches. The Mismatch Occurrence measure revealed a very clear pattern. While an occurrence of a mismatch happened in less than half of the cases (48% for moderate-, and 40% low level of salience) for lying pairs, nearly all (except one; 96% for moderate-, and 100% for low level of salience) of the truth-
telling pairs had at least one mismatching detail. Hence, the largest discrepancy was found when comparing liars and truth-tellers on the specific consistency measure of mismatch occurrence for low object-salience.

Similar to Granhag et al. (2003), the present study provided both a global, more subjective measure of consistency—(i.e., the consistency scale from 1-7), as well as a more specific, objective measure of consistency (i.e., matches and mismatches). The separate analyses of both the global- and specific consistency measures yielded similar results, and supported the idea that liars are more consistent than truth-tellers, and that truth-tellers are being more influenced by salience than liars. When the interaction effect was further examined for simple effects, the differences between liars and truth-tellers were significant at all three levels of object salience, and the effects were substantial (as indicated by high values of Cohen's d; Cohen, 1992).

**Verbal Strategies, Statement Length and Level of Detail**

In the present study, differences in verbal strategies (found by e.g., Granhag et al., 2013; Hartwig et al., 2007; Vrij et al., 2010) were presented as a potential explanation for the differences in consistency and the moderating effect of salience. Such verbal strategies were measured both based on self-reports, as well as calculated by the number of words and details provided in the interview.

The results from self-reported data revealed that, in line with previous studies (Vrij et al., 2010), Liars/Seen reported to restrict their information in the interview significantly more compared to the Liars/NotSeen and truth-tellers. The fact that Liars/NotSeen reported not to restrict themselves was expected. A Liar/NotSeen was expected to apply a strategy of trying to tell everything that s/he was told by Liar/Seen, to ensure high consistency. Hence, the assumption of differences in verbal strategies was supported by self-reported measures. Nevertheless, when analysing the number of words and details provided by liars versus truth-tellers during the interview, the results suggested more similarities than differences. That is, liars were not found to provide significantly less information than truth-tellers, and level of salience did not influence liars to a higher degree than truth-tellers. Thus, there was no support for Hypotheses 1a and 1b.

One potential explanation for the lack of differences for amount of information might be the fact that a single picture was used as the target information. Such a picture is not as complex as a real life scenario (or e.g., a video-clip), hence
this obviously limited the total amount of information possible to remember. Therefore, in the same way as for truth-tellers, liars may have been able to remember and report “everything”. In a real life situation, there would have been an abundance of complex information (e.g., movements, sounds etc.) and minor details that a truth-teller potentially would have mentioned, whereas the liars probably would have avoided.

Since the differences in verbal strategies between liars and truth-tellers (as measured by statement length and details) were negligible, alternative explanations for the differences in within-group consistency – and the influence of salience – are necessary. A likely alternative explanation could be based on attentional- and memory mechanisms in general, and the related repeat versus reconstruct hypothesis. When analysing the differences in perceived consistency, the results revealed a linear trend for truth-tellers. That is, for truth-telling pairs, less salient objects were indeed being perceived as less consistent than objects of a higher salience level. In contrast, such a linear trend was not found for lying pairs. These results indicates that truth-tellers were in fact strongly influenced by attentional- and memory mechanisms (which is making the encoding and recall of peripheral information poorer), whereas this was not the case for liars.

Advancements of the Present Study

Similar to Roos af Hjelmsäter et al. (2014) the present study examined how salience might influence consistency, and possibly make the differences between statements provided by pairs of liars and truth-tellers more apparent. However, the present study further advanced the existing research in multiple ways.

First, a novel specific measure of consistency was introduced – in addition to the global consistency measure – that focused on the frequency and occurrence of matches and mismatches between specific details. Second, the present study extended previous research by introducing eye-tracking technology as a more objective approach to measure level of object-salience. Third, the study advanced previous research by applying a new research paradigm, with one liar “telling the truth” (i.e., one Liar/Seen and one Liar/NotSeen, rather than two persons making up a story together as done by e.g., Mac Giolla & Granhag, 2015; Roos af Hjelmsäter et al., 2014; Vrij et al., 2009). This paradigm might be particularly applicable in real life situations of true and false alibis. The unique type of a lying pair might also be a
potential explanation for the extremely large differences found between liars and truth-tellers on both the global and specific measures of consistency. It might be the case that such a pair obtains particularly high consistency, since Liars/NotSeen are completely reliant on what they are told by Liars/Seen. There is little to no reason for Liars/NotSeen to mention any other detail than what they are told by their accomplice (i.e., Liar/Seen). This, however, should not be seen as a limitation of the experimental paradigm since this type of alibi is likely to be common in real life.

Limitations and Future Directions

As always, there are some limitations of the present study – most of which relates to ecological validity – that deserves mentioning. First, differences in self-reported levels of motivation showed that liars were more motivated than truth tellers to be believed. This is a potential problem. Although both groups were motivated to be believed as evidenced by means above the mid-point of the scale, the differences in motivation cannot be ruled out as a potential explanation for the findings. That is, liars were more motivated to be believed and hence more determined to provide consistent statements. Nevertheless, it could also be argued that in real life, liars may be even more motivated to be believed than truth-tellers (because of the “just world fallacy” held by truth-tellers’; Lerner, 1980). Moreover, liars’ higher motivation would fit with the “attempted control” account of deception. That is, liars are attempting to control – not only their behaviour – but also their thoughts and feelings (Zuckerman, DePaulo & Rosenthal, 1981, as cited in DePaulo et al., 2003). Hence, liars increased motivation might reflect an increased attempted control, which in turn might have resulted in over-the-top consistency levels.

A second limitation of the present study is the fact that the target information, in which the participants later were asked to recall from, was a single photograph. This is arguably not very complex, compared to real life experiences (including movements, sounds etc.). Ideally, the participants would have experienced a real life event, however this would not have allowed for an objective measure of salience through the use of eye-tracking and fixations. An alternative would have been to eye-track participants viewing video clips, which in fact can be done. Future research should thus examine similar paradigms, while exchanging the single photograph for a video-clip.
A third potential limitation is the short time frame the liars were given to “stabilize” their stories (i.e., 5 minutes preparation time). For real life, it seems fair to assume that the liars would have had more time to plan their stories. Hence, if they had more time to plan, Liars/NotSeen might have had rehearsed and remembered everything Liars/Seen said and thus decrease the frequency of mismatches even more (i.e., the results might have been even stronger). On the other hand, the complexity of a real life situation may also have increased the odds for lying pairs providing a mismatch. Future research should thus examine the effect of differences in preparation time.

In addition to the abovementioned limitations related to ecological validity, there are also potential methodological limitations related to the objective measurement of salience. In general, there is a debate over how salience should be determined. In the present paper, level of salience was based on mere fixation time. Although previous research support that these two are highly correlated (Borji, 2015; Borji et al., 2013; Li et al., 2014), this is only one approach to evaluate salience. Hence, the use of fixation data to measure salience can be discussed. Some have argued that salience can explain little or none of the variance in realistic visual search and during natural tasks (Foulsham & Underwood, 2008). Specifically, Chen and Zelinsky (2006) argued that top-down guidance tends to dominate visual search, and that visual salient – but irrelevant – items rarely distract this. Nevertheless, in the current study liars knew their task of remembering for alibi purposes before the picture was shown to them. Hence they had “top-down guidance”. Truth-tellers, on the other hand, did not get these instructions. Rather, they were told to passively view the picture while some pre-conscious eye-measures were done. Despite this difference in task demands and goals while viewing the picture, the analyses showed no significant differences between liars and truth-tellers in percentage fixation time at the different objects in the picture. Thus, it seems like differences in top-down guidance did not influence what objects were looked at, and for how long.

As an alternative to percent fixation time, other measures extracted from the eye-tracker could have been used. For instance, some argue that the object that is looked at first might be an important cue to decide salience. In my case this was controlled for, and the average sequence of which the objects were looked at matched to a high degree the ranking based on fixation time (for Table 2, see Appendix 6).
Borji et al. (2013) argue that if humans agree on their response to salience judgements, this would suggest objectivity. Furthermore, if these explicit judgements also correlate highly with fixation, this would be an even stronger argument for rating the object salient. Borji et al. (2013) did indeed find a high correlation between explicit salience judgements and fixations, and Borji (2015) found that there was high agreement between fixations and what people reported to be the most salient objects. Thus, it seems reasonable that fixations could be used to indicate level of salience.

A second potential methodological limitation is related to the differences between liars’ and truth-tellers’ memory task demands. As mentioned above, half of the participants (i.e., the truth-tellers) were not informed that their memory performance would be tested during the experiment. Memory accuracy is evidently found to depend on whether encoding is incidental or intentional (Cycowicz & Friedman, 1999; Ferrara, Puff, Gioia, & Richards, 1978). Given that the study aspired to a high degree of generalizability to criminal cases involving alibi statements, truth-tellers could not be told that their memory would be tested. In real life scenarios, people usually do not expect that they will be questioned about a normal event before afterwards (when they are told that they need an alibi). Hence, not informing the truth-telling participants (i.e., incidental encoding) provides a higher ecological validity. On the contrary, liars who are planning to produce a false alibi would know that they should prepare for potential questioning, and thus the encoding of Liars/Seen would have been intentional. However, even though there were no significant differences in percentage fixation time between Liars/Seen and the truth-tellers, Liars/Seen might still have encoded the same information differently (e.g., more deeply, in more detail: not only the clown, but also the colours of the clothes etc.), and thus remember the objects differently. This is arguably a difference in memory task demands, which may affect the performance and thus to some extent explain the differences found between the veracity groups. Nevertheless, if these differences in task demands do reflect reality in a similar true and false alibi situation, this should not be considered a huge problem.
Concluding Remarks

The present study is to my knowledge the first experiment that attempts to empirically test level of salience in relation to consistency and alibi discrimination. The current study contributes to this emerging field by using eye-fixation as a more objective measure of object-salience. In applied settings it is found that lie catchers often assess veracity on the basis of consistency between multiple statements, sometimes derived from single suspects (interviewed repeatedly), and sometimes derived from multiple suspects. Nevertheless, a substantial amount of studies have found that observers are rather poor at discriminating between deceptive and truthful accounts (see Bond & DePaulo, 2006 for a review). The lack of research focused on our ability to separate between truthful and deceptive statements is considered a major challenge, and should be of great concern for all states who practices rule of law. Hence, it is important to develop and test techniques and methods that elicit cues which will enhance our ability to distinguish honesty from deceit. The current study examined object-salience as a possible moderator for within-group consistency, and found strong support for the idea that level of salience indeed influences the perceived consistency of truth-telling pairs to a higher degree than lying pairs. Moreover, it was found substantial differences when comparing liars and truth-tellers on the specific consistency measure of mismatches. Mismatching information did occur frequently for liars as well as truth-tellers; hence the occurrence of a mismatch may not be as informative in assessing veracity. However, the absence of a mismatch seems the most interesting. With only one exception, the absence of a mismatch did never occur for truth-telling pairs. In contrast, the absence of mismatching details was as common as the occurrence of mismatching details for lying pairs. That is, based on the current data, a pair without any mismatching details was almost certainly lying. Hence, the absence of mismatching details might be an indication of people lying. This finding could be of high applied value for the police. Moreover, due to the novel paradigms applicable value in real world alibi cases, these findings might have important implications for our ability to discriminate between true and deceptive alibi statements.
References


Dahl, L. C., & Price, H. L. (2012). “He couldn't have done it, he was with me!”: The impact of alibi witness age and relationship. *Applied Cognitive Psychology, 26*(3), 475-481. doi:10.1002/acp.2821


Appendices

Appendix 1 – Target Picture: Egertorget
Appendix 2 – Filler Task: Labyrinth

Participants were given a labyrinth-task, and told that this was a standard task for rating their ability to focus and solve problems. They were further told that if they were able to solve the task within a timeframe of 5 minutes, they would receive a ticket and be part of a draw for 500 NOK. They would be notified when they had 2.5 minutes-, and 30 seconds left.
Appendix 3 – Interview Questions

The interviewer started the interview by saying “I have been told that you and a friend claim to have been out walking in Karl Johan last Saturday, and that you stopped for a couple of minutes at Egertorget around noon. I will now ask you some questions about what you remember seeing there.” He or she continued by asking 4 open ended questions:

- “Why did you stop there?”
- “Can you tell me more about what you saw?”
- “It is really important to us to be sure that you and your friend actually were at Egertorget at that time, so that we can rule you out as suspects. Which other things did you notice that you can tell me about?”
- “Is there anything else you remember that you would like to add before we end this interview?”

These questions were asked to make sure that everyone got the opportunity to share as much information that they wanted to share.
Appendix 4 – Target Picture, with Areas of Interest
# Appendix 5 – Level of Salience Groups

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Level of Salience</th>
<th>Object</th>
<th>Mean Percent Fixation Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HIGH</td>
<td>Musician</td>
<td>16.13</td>
</tr>
<tr>
<td>2</td>
<td>MODERATE</td>
<td>Clown</td>
<td>7.64</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Guitar Case</td>
<td>6.84</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Balloons (carried by clown)</td>
<td>4.69</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Girl with red scarf</td>
<td>4.35</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Stuff in Guitar Case</td>
<td>3.62</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>People in the background (to the right)</td>
<td>3.49</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Trolley</td>
<td>2.90</td>
</tr>
<tr>
<td>9</td>
<td>LOW</td>
<td>Guitar</td>
<td>1.49</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>Drum</td>
<td>1.43</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>Trumpet</td>
<td>1.00</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>Fence</td>
<td>0.81</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>Child in pram</td>
<td>0.61</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>Pram</td>
<td>0.55</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>MAX-sign</td>
<td>0.45</td>
</tr>
<tr>
<td>16</td>
<td></td>
<td>Balloons (at the MAX entrance)</td>
<td>0.38</td>
</tr>
<tr>
<td>17</td>
<td></td>
<td>T-bane-sign</td>
<td>0.34</td>
</tr>
<tr>
<td>18</td>
<td></td>
<td>Garbage bin</td>
<td>0.33</td>
</tr>
<tr>
<td>19</td>
<td></td>
<td>Cymbal</td>
<td>0.25</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td>Girl by pram</td>
<td>0.23</td>
</tr>
<tr>
<td>21</td>
<td></td>
<td>Poster</td>
<td>0.1</td>
</tr>
<tr>
<td>22</td>
<td></td>
<td>Restaurant sign (Jaipur)</td>
<td>0.02</td>
</tr>
</tbody>
</table>
Appendix 6 – Objects Order by Fixation Time and Entry Time, Compared

Table 2

List of objects, ordered by:

<table>
<thead>
<tr>
<th>Mean Percent Fixation Time</th>
<th>Average Entry Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Musician</td>
<td>Musician</td>
</tr>
<tr>
<td>Clown</td>
<td>Clown</td>
</tr>
<tr>
<td>Guitar Case</td>
<td>Balloon Clown</td>
</tr>
<tr>
<td>Balloon Clown</td>
<td>Guitar Case</td>
</tr>
<tr>
<td>Girl with scarf</td>
<td>Drum</td>
</tr>
<tr>
<td>People background right</td>
<td>Girl with scarf</td>
</tr>
<tr>
<td>Stuff in Guitar case</td>
<td>fence</td>
</tr>
<tr>
<td>Trolley</td>
<td>Guitar</td>
</tr>
<tr>
<td>Drum</td>
<td>Trolley</td>
</tr>
<tr>
<td>Guitar</td>
<td>Stuff in Guitar case</td>
</tr>
<tr>
<td>Trumpet</td>
<td>People background right</td>
</tr>
<tr>
<td>fence</td>
<td>Cymbal</td>
</tr>
<tr>
<td>MAX-sign</td>
<td>Trumpet</td>
</tr>
<tr>
<td>Pram</td>
<td>MAX-sign</td>
</tr>
<tr>
<td>Child in pram</td>
<td>MAX balloons</td>
</tr>
<tr>
<td>MAX balloons</td>
<td>Child in pram</td>
</tr>
<tr>
<td>T-bane sign</td>
<td>Pram</td>
</tr>
<tr>
<td>Garbage bin</td>
<td>T-bane sign</td>
</tr>
<tr>
<td>Cymbal</td>
<td>Garbage bin</td>
</tr>
<tr>
<td>Girl by pram</td>
<td>Girl by pram</td>
</tr>
<tr>
<td>Poster</td>
<td>Poster</td>
</tr>
<tr>
<td>Restaurant sign (Jaipur)</td>
<td>Restaurant sign (Jaipur)</td>
</tr>
</tbody>
</table>
Endnote In situations when variances were unequal Welch’s t is reported instead of Student’s t.