



Perspective

Investigative fatigue: how sleep-circadian factors shape criminal investigations

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Abstract

Investigating criminal complaints and identifying culprits to be prosecuted in the court of law is an essential process for law-enforcement and public safety. However, law-enforcement investigators operate under very challenging conditions due to stressful environments, understaffing, and public scrutiny, which factors into investigative errors (e.g. uncleared cases). This paper argues that one contributing factor to investigative failures involves sleep and circadian disruption of investigators themselves, known to be prevalent among law-enforcement. By focusing on investigative interviewing, this analysis illustrates how sleep and circadian disruption could impact investigations by considering three broad phases of (1) preparation, (2) information elicitation, and (3) assessment and corroboration. These phases are organized in a framework that outlines theory-informed pathways in need of empirical attention, with special focus on effort and decision-making processes critical to investigations. While existing evidence is limited, preliminary findings support some elements of investigative fatigue. The paper concludes by placing investigative fatigue in a broader context of investigative work while providing recommendations for future research throughout.

This paper is part of the *Sleep and Circadian Health in the Justice System* Collection.

Key words: investigations; interrogation; interviewing; human intelligence; fatigue; sleep

Statement of Significance

While investigating criminal complaints or serving public safety, investigators routinely interview suspects, victims, and witnesses. Although doing critical work, investigators operate under very challenging conditions due to stressful environments, agency understaffing, and public scrutiny, which can contribute to various investigative errors (e.g. tunnel vision and confirmation biases). As a result, it is imperative to understand processes contributing to effective investigative interviewing and fair investigative outcomes. This paper argues that a neglected contributing factor to suboptimal investigative processes is sleep and circadian disruption of investigators themselves (i.e. investigative fatigue), known to be prevalent among law-enforcement. Critically, this analysis provides a theoretical framework on how sleep and circadian disruption may drive investigative fatigue, hypothesizes about underlying mediating pathways, and links investigative fatigue to broader investigative processes.

Ensuring public safety and combating crime relies on prevention and detection of criminal activity by law-enforcement personnel. To this end, police investigators routinely conduct criminal investigations where they must determine the nature of the criminal offense, preserve and collect evidence, identify potential suspects, generate a theory of crime, and ultimately establish an evidence base to prove the guilt or innocence of an accused person [1]. Criminal investigations are complex, lengthy, and unpredictable. Investigators must follow prescribed practices for identifying, collecting, recording, and preserving evidence [2]. Following a burglary, for example, the police officers, detectives, and forensic

personnel must preserve the crime scene, collect all the relevant evidence (e.g. fingerprints at point of forced entry and witness accounts), record obtained evidence (e.g. index photographs of missing valuables), and appropriately store perishable evidence (e.g. biological samples).

Investigative processes depend on investigative tasks which then inform investigative thinking [2]. Investigative tasks include actions and forensic procedures whose aim is to collect relevant information, including identification of physical evidence (e.g. fingerprints), documentation and preservation of evidence, and investigative interviewing of witnesses, victims, and suspects.

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Information gathered via investigative tasks then informs investigative thinking, namely the analysis of collected information which includes establishing a timeline of events, probing grounds to believe solicited accounts, and generating a theory of the crime. Once a theory (or theories) of the crime is established, it will guide further evidence collection and analysis. Ideally, a detective approaches investigation as a scientist, exploring evidence to inform plausible accounts of the crime, developing a theory that guides evidence search and suspect identification, and using evidence to confirm or disconfirm a theory. Investigations may also involve teams of individuals, including patrol officers, crime scene investigators, forensic technicians, and detectives who distribute both tasks and thinking, although it is very common for a single investigator to be responsible for conducting and completing cases [3].

Investigative Challenges

While their work is critical and widespread, investigative professionals operate under extremely challenging conditions. As mentioned earlier, investigations progress from evidence-gathering tasks, through information analysis, to theory development and evaluation, ultimately resulting in grounds to identify and arrest a suspect [1, 2]. Even a single case may involve interviews of multiple individuals, sometimes repeated, with the whole investigation spanning weeks to years. Criminal investigations in law-enforcement and security settings are further complicated by extremely stressful environments (e.g. an ongoing public threat), high-stakes placed on the investigative outcomes (e.g. finding a missing person), and little tolerance for errors (e.g. organizational and public pressure to solve the case and avoid wrongful arrests).

Reflecting the challenges just described, investigations do not always succeed in holding the culprit accountable or bringing closure to the victims. Investigative failures occur when a crime is either not solved or is “solved” incorrectly, resulting in a wrongful arrest or conviction [4]. Clearance rates of crimes (the proportion of handled cases where a suspect was ultimately charged) are frequently used as metrics of investigative success. In this vein, the proportion of *solved* crimes has been dropping for several decades, despite reductions in crime prevalence and advancements in forensic technology. For example, crime statistics from the Federal Bureau of Investigation indicate that the clearance rate for murder decreased from 93% in 1962 to 59% in 2016, with similar clearance drops for most other crimes [5]. The most recent Uniform Crime Reporting data suggest a continuation of this trend, with murder clearance rate further dropping from 60% in 2019 to 52% in 2022 [6]. Even if technically cleared, crime may not be actually solved; DNA-exonerations have confirmed numerous false convictions, often due to poor investigative or interrogation practices, estimated at 5% or more [7, 8].

While successfully concluding an investigation depends in large part on circumstances and luck (e.g. presence of witnesses or evidence), investigators’ efforts and strategies also play key roles in ensuring successful clearances [5, 9, 10]. In this vein, appropriate training and resources can improve investigative success. For example, recent efforts by the Boston Police Department increased homicide clearance rates by nearly 10%, implicating the role of additional personnel, improved evidence checking, and more rigorous interviewing [11]. Moreover, criminal investigations are important for justice beyond clearance rates. First, they act as a deterrent for future crimes, especially when investigating repeat offenders (which account for majority of crimes)

[5]. Second, successful investigations bring closure to victims and their families, while unsuccessful ones can anger communities. Ultimately, the conduct and outcomes of law-enforcement investigations shape public perceptions of procedural justice and are critical for public support of law-enforcement [12]. For example, even if an investigation does not result in a suspect being charged, public belief that investigators followed procedures and did everything that they could contribute to legitimacy of law-enforcement. Alternatively, failing to investigate or charging an innocent person undermines public trust in law-enforcement. Critically, achieving just outcomes relies on the quality of investigative thinking (critical decision-making) by detectives and investigators, in addition to successfully executing investigative tasks (e.g. evidence collection) [2].

To this end, there is increasing recognition that only focusing on evidence collection and organizational procedures will lead law-enforcement to “overlook a critical factor related to the essence of the detective function—investigative thinking. Police investigations are about solving crimes, and detectives need to be skilled in deductive, inductive, and abductive reasoning, not just in the operations of police bureaucratic processes” (p. 9) [5]. For example, a deconstruction of criminal investigative failures (e.g. wrongful convictions) commissioned by the US Department of Justice found that investigators’ personal factors were the most common causes of case failures, present in 61% of the cases (e.g. rush to judgment, confirmation bias) [4].

While there are numerous reasons for suboptimal investigative thinking and poor investigative outcomes, we suggest that *one contributing factor to failures during investigations is sleep and circadian disruption of investigators themselves*. To this end, we propose the term *Investigative Fatigue* to reflect psychological and behavioral consequences of sleep loss and circadian disruption that are manifested in how investigators execute investigative tasks and how they approach investigative thinking. While the impact of sleep loss on interrogation participants and confessions has drawn empirical attention [13–15], how sleep of investigators impacts the flow and quality of law-enforcement investigations has been neglected. This gap is surprising given the increasing recognition that sleep-related fatigue undermines the quality of policing outcomes; The Federal Bureau of Investigation has long recognized that “fatigue, overwork, and stress, all endemic in high-profile crime investigations... can create problems for police personnel” (p. 16) [16]. Our focus on sleep and fatigue also echoes increasing calls for recognition, identification, and mitigation of sleep-related fatigue in law-enforcement [17], as exemplified in a recent report recommending to the New York Police Department to make policies that recognize and mitigate the fatigue of their officers [18].

Overview

Next, we review evidence regarding the role of sleep-related fatigue in criminal investigations and chart the course for future research on this topic. First, we summarize the evidence on the prevalence of sleep and circadian disruption within law-enforcement and investigative communities. Second, we illustrate the potential consequences of sleep and circadian disruption on investigative processes by focusing on investigative interviewing and interrogation, an essential and ubiquitous component of investigations. By providing a theoretical framework that highlights knowledge gaps in need of attention, we hope to illustrate how sleep-circadian science can be applied toward

addressing investigative processes. Finally, we provide a broader view of the role of sleep-related fatigue in investigative work, highlighting questions in need of empirical attention throughout.

Sleep and Fatigue in Law-Enforcement

The pursuit of criminal justice and homeland security is a constant operation—“crime never sleeps” goes the adage. Present-day communities demand around-the-clock availability of safety and law-enforcement officers to spot, prevent, and investigate criminal activity. To meet these constant challenges, law-enforcement operations always rely on shift-work, with most police officers working a night shift at some point in their career. For example, results from the Buffalo Cardio-Metabolic Occupational Police Stress (BCOPS) evaluating health among police officers show that nearly half of them worked a night or afternoon shift, with many day shift officers switching to night shifts to cover missing personnel or meet high demand. Special agents working for Federal Bureau of Investigation must work a minimum of 50 hours a week and are on call 24 hours a day, 7 days per week [19]. Moreover, most police departments and government agencies have difficulty ensuring appropriate staffing and operate without needed personnel, which leads to longer or less desirable shift schedules [20]. Finally, investigators may be “held over” on duty following a major crime which further extends their shifts, while many officers work additional jobs that limit their time available for rest [21]. As a result, sleep and circadian disruption is pervasive among all levels of police investigators, especially on night shifts.

First, evidence suggests that a large proportion of police detectives and patrol officers are sleep-deprived or with sleep-related problems. Surveys reveal high rates of sleep disorders affecting more than 40% of police officers including insomnia, obstructive sleep apnea, and excessive daytime sleepiness [22]. Studies tracking sleep of police officers during the COVID-19 pandemic also reveal that about three-quarters had poor sleep quality, while about one-quarter reported excessive daytime sleepiness [23]. Officers on night shifts were especially likely to experience poor sleep quality and daytime sleepiness, and they were more likely to fall asleep driving home [23–25]. Rotating shifts are also typically associated with adverse cardio-metabolic and sleep outcomes [26]. In this vein, a meta-analysis indicated that 51% of officers across studies exhibited clinically significant sleep disturbances, especially when doing shift-work [27].

Second, the 24-hour nature of investigative work and criminal activity necessitates that investigators occasionally function during circadian misalignment, namely at night when circadian alerting is at a minimum with impairments in alertness and motivation [28]. For example, the most recent data from the FBI’s Uniform Crime Reporting Program (2022) show that nearly a third of crimes (e.g. 29% of crimes against persons) occur during nighttime (10 pm–6 am) [29]. This necessitates that investigators occasionally engage in investigative tasks after suffering at least some sleep loss and during nighttime low-points of the circadian alerting period (e.g. when interviewing potential witnesses). Similarly, survey and daily diary studies of police interviewing practices find that almost 20% of investigative interviews occur at night, suggesting suboptimal functioning during investigative activities at those times [30, 31].

In brief, the constant need for law-enforcement vigilance, the unpredictable and urgent nature of crime, and the lack of personnel all jointly contribute to a workforce of investigators who do not achieve sufficient sleep, experience sleepiness generally,

sometimes conduct critical tasks at night, or all three. These challenges contribute to high-rates of burnout and fatigue in police—irregular schedules, frequent night shifts, extended hours, and poor sleep in particular all predict higher levels of emotional exhaustion and burnout [32].

This brief review highlights that sleep-related fatigue is a common challenge among law-enforcement. As a result, multiple studies have examined how such fatigue may impact officers’ psychological well-being and physical health [24, 25, 33]. Given the high-stakes nature of policing, studies have also evaluated the impact of sleep disruption on critical policing tasks. For example, overnight sleep-deprivation was found to increase the likelihood of shooting unarmed targets within simulated use of force scenarios [34, 35], while in another analysis officers who curtailed sleep were more likely to draw public complaints [36]. However, to what extent sleep disruption impacts performance on investigative tasks or thinking is unclear.

To address this gap, in the following sections, we consider how sleep-related fatigue could impact investigative processes. Due to the complex, dynamic, and interactive nature of investigations, a comprehensive review of all the ways sleep-related decrements could impact them is beyond the scope of this analysis. Rather, we focus on *investigative interviewing* and interrogation as one critical investigative task vulnerable to investigator fatigue. Alongside this illustrative case, we also consider the more general impact of fatigue on motivation and decision-making that is likely to affect investigative thinking beyond interviewing itself. To frame this analysis, we first elaborate on interviewing and investigative processes.

A Focus on Investigative Interviewing

Investigations require information, and information often comes from human sources. Obtaining information from human participants via interviews is thus a ubiquitous process across criminal investigations. Each day, thousands of law-enforcement officers interview suspects, victims, and witnesses while investigating criminal complaints. Beyond law-enforcement, state-sanctioned investigators seek accounts about critical safety incidents, corporate investigators probe fraud, while intelligence officers debrief participants from home and abroad about sensitive national security information [37]. According to the College of Policing (UK), “Without the accounts of those who played a central role in the crime, or those who have witnessed an important aspect of the commission of a crime, other sources of material such as CCTV images, fingerprints, and forensic material, although extremely important, may have little value” [38]. For example, other information collected during investigations (e.g. electronic communications, physical evidence) is often valuable precisely because it points to new individuals who should be interviewed, while the interviews themselves guide evidence-search efforts. Investigative interviewing, when done effectively, also seeks to resolve any outstanding gaps and discrepancies within the investigation through the elicitation of reliable information [10, 39].

An investigative interview is defined as the systematic questioning of individuals for the purpose of soliciting detailed and accurate descriptions of an event [40, 41]. In practice, this includes a variety of interactions across distinct settings, including brief interviews routinely conducted by patrol officers following calls for service, systematic questioning of residents that takes place canvassing after crimes, and more extensive sit-down interviews of victims, witnesses, and suspect within controlled environments

(e.g. a police station). While interviews vary according to their goal or setting, investigative interviews generally focus on one of the two goals; to solicit information or to obtain a confession. Interviews of suspects typically fall in the second category, given that confessions obtained via interrogation can help secure convictions in court. What makes interviews even more challenging is that investigators must pay close attention to the motivations of the person they are interviewing, as well as consider why they are providing or not providing certain details in their account [39].

When employing *accusatorial* methods, interviews proceed as adversarial interrogations directed toward soliciting incriminating admissions or confessions from suspects who are typically resistant (e.g. interrogating a murder suspect about their presence at the murder scene). Such self-incriminating admissions can then be used at trial to obtain a conviction. During the 20th century, suspect interrogations were dominated by accusatorial, guilt-presumptive approaches aimed at securing confessions [41, 42]. Accusatorial approaches are based on a presumption of guilt and use social influence tactics (e.g. minimizing severity of the crime, personal culpability, or consequences) to secure a specific admission or confession through adherence. In the US justice system confessions are both sufficient to bring charges and viewed as compelling by lay jurors who sit in judgment, which motivates concerted efforts by law-enforcement to secure confessions from criminal suspects under investigation [43]. Suspect interrogations also pose a unique set of challenges, given legal frameworks that discourage suspects from engaging with law-enforcement (e.g. Miranda Waivers) [40].

However, accusatorial approaches can be so effective at inducing self-incriminating admissions as to produce *false* confessions, raising significant concerns that such techniques harm the innocent while letting the actual culprits go free [44–46]. For example, historically the most frequently taught interrogation techniques to law-enforcement are based on the “Reid Interrogation Technique,” developed by the Chicago Police Detective John Reid during 1950s as a way to elicit confessions without resorting to physical threats or strong inducements [47]. This technique relies on a preliminary assessment of credibility which either eliminates the individual from suspicion or suggests they should be treated as a potential suspect [48]. If labeled a suspect, the interrogation then proceeds with the sole aim of producing a confession, as the interrogator develops “themes” that make it easier for the individual to admit their involvement and more difficult to deny it (e.g. minimizing the consequences of crime, maximizing the perceived costs of concealment), with any and all denials by the suspect rejected [49]. While effective at increasing confessions from the guilty, this type of an approach can also induce false confessions when innocent individuals see no other way out of a distressing situation, or are deceived about evidence implicating them in the crime [50, 51].

In contrast, when using *information-gathering* methods, the interviews are focused on the gathering of verifiable account details through cooperation, while leveraging psychological processes underlying memory elicitation and rapport-building strategies. These methods aim to solicit a large quantity of rich and verifiable information from participants (be they suspect or not) that can speak to the events that occurred, but also inform the direction of investigation by corroboration with *other* intelligence or evidence (e.g. confirm an individual was present during a terrorist attack) [46, 52]. These approaches do not focus on guilt-presumptive questioning and aim to solicit verifiable information that can be independently evaluated. For example, an essential component of most information-gather approaches is

the Cognitive Interview [53, 54]. This method aims to motivate memory disclosures from participants via non-confrontational rapport-building strategies, while employing the use of mnemonics and context reinstatement to overcome memory limitations. Related contemporary approaches leverage science-based insights about psychological processes underlying memory elicitation and cooperation in order to prescribe ethical and effective interview methods that can be widely adopted across both forensic and intelligence-gathering sectors, while also being less likely to produce false admissions [55, 56].

The Investigative Phases

Preparation

A key part of any investigation is *preparation*, whose importance is especially acute when it comes to investigative interviewing. It is imperative that the investigators have concrete goals for the interview, be appraised of all available evidence relevant to that goal, and conduct significant background research on the participant so as to choose appropriate tactics for eliciting trust and assessing credibility of statements [57]. Regardless of the method a detective adopts during the interview or whether the participant is considered a suspect, interviewers generally aim to develop cooperation with the interview participant with the goal of eliciting disclosures which can then be evaluated for accuracy [39, 41]. To this end, interviewers need to develop rapport and trust with the interview participant so as to secure cooperation throughout the interview. Developing even a temporary relationship (“professional rapport” [58]) with the interview participant is critical for achieving cooperation and motivating participants to share what they know (i.e. reduce resistance). Common rapport-building tactics include a positive and professional demeanor, showing trust and respect, emphasizing identity similarities, using self-disclosures, and actively showing interest in the participant’s narrative [55, 58, 59]. This preparatory phase is critical even when using accusatorial methods with suspects, as it is important to motivate the suspect to engage with law-enforcement in order to conduct an interrogation and develop appropriate points of leverage [49]. Beyond a specific interview, preparation is key to the investigation as a whole because investigators need to organize their tasks and efforts across multiple interviews or evidentiary inquiries in order to systematically collect the most relevant evidence (e.g. statements or evidence about a suspect’s location at the time of the crime) [57].

Elicitation

Second, the investigator aims to *elicit information*, namely the most complete possible narrative from the participant, ideally by using unbiased memory elicitation techniques and strategic questioning. This phase is especially critical during information-gathering interviews of victims and witnesses who may have been traumatized or embarrassed. Active listening and rapport tactics appear critical for maximizing elicitation, as they maintain engagement of the participant and further facilitate established rapport [60]. Demonstrating empathy by showing concern and seeking to understand the participants’ point of view has also been shown to aid disclosures and mitigate resistance [60, 61].

Besides these interpersonal dynamics necessary to facilitate elicitation, appropriate questioning strategies are also critical to maximize the amount of accurate information provided by the participant. Evidence indicates that open-ended questions are

the least likely to bias memory reports, as the use of cognitive strategies such as mnemonic prompts (e.g. mental reconstruction of the experienced event) significantly increases the amount of correct information reported [53, 62]. In this vein, the aforementioned Cognitive Interview has proven more effective than many other techniques for improving elicitation, given it utilizes such rapport-building and memory principles that motivate more elaborate disclosures [62, 63]. In contrast, extensive empirical evidence shows that leading questions, suggestions, and hypotheticals can contaminate memory of events and participants' narratives [64–66]. As a result, accusatorial methods that provide undisclosed case information to the suspect, suggest potential crime scenarios, or imply theories of the crime, can all distort participants' memory and encourage false statements on the part of participants [40].

Credibility and Corroboration

Third, the interviewer must assess the *credibility* of accounts and *corroborate* evidence, including information provided by any individual [39, 67]. When assessing credibility of individual accounts, investigators look to determine whether a participant is lying or withholding information when providing narrative accounts of events in question, or when describing their beliefs and intentions. Credibility assessments of the participant involve appraising the fidelity of disclosed information based on appropriate access or recollection (e.g. did the person have a good view of the robbery), as well as spotting intentional deception (e.g. is the participant lying or withholding information). Despite the frequent reliance on non-verbal signals to detect deception by interview participants (e.g. gaze-aversion and anxiousness), evidence indicates such cues are not reliable indicators of deception [68–70]. Instead, verbal cues residing in the content of what is reported are more indicative of truthfulness, as genuine accounts are usually more detailed, coherent, and verifiable than deceptive accounts [71].

Investigators utilizing accusatorial approaches typically rely on an initial evaluation of credibility when facing potential suspects (e.g. the Behavior Analysis Interview), which then determines whether the individual will be treated as a suspect (and subjected to guilt-presumptive techniques aimed at eliciting a confession), or instead a witness to be interviewed using information-gathering techniques. As indicated, such preliminary evaluations of credibility have traditionally relied on non-verbal cues which are found to be unreliable and can be subjective (e.g. body posture, gaze direction) [72]. In practice, such presumed cues of deception often serve to confirm investigators' existing suspicions that a person is lying or withholding information, leading to confirmatory tactics that can eventually produce biased and unreliable statements, including false confessions [73]. Instead, scrutinizing coherence, richness, and plausibility of narrative accounts is known to yield more accurate deception detection, especially when combined with an evidence disclosure plan and questioning strategies not expected by the participant [39, 67].

However, credibility assessment is important only insofar as it generates investigative leads; deception is not evidence of guilt, and knowing someone is lying does not help close the case unless it helps generate further diagnostic evidence. Moreover, deception detection is extremely difficult, with even professional investigators performing only slightly better than chance [68, 72]. In this vein, regardless of the type or source of evidence, it is critical to determine its reliability and to corroborate any evidence via other

independent sources. Within forensic settings, reliability of evidence refers to the likelihood that a given piece of evidence (e.g. a fingerprint identification) indicates the corresponding “ground truth” regarding the event in question (e.g. the suspect's fingerprint), similar to the notion of validity in scientific discourse about the diagnostic value of measurement procedures [74]. When faced with evidence of uncertain reliability, investigators must rely on corroboration with independent sources of information (e.g. witness accounts). Such corroboration typically involves additional evidence gathering including both narrative accounts and physical evidence, which is effortful and time-consuming as it necessitates archival searches, following up on a large amount of information, and reevaluating evidence in hand [2, 35].

All of these efforts involve *investigative thinking*, and speak to a critical aspect of investigations that may be vulnerable to sleep-related fatigue. In the words of one seasoned law-enforcement investigator, “problems with physical evidence usually result from misinterpretation, not from the actual analysis” (p. 5) [16]. Ultimately, the detectives' most powerful tool is corroboration by independent evidence, which bolsters conclusions based on evidence in-hand and supports criminal charges in a court of law [39]. Thus, it is critical to address how sleep-related fatigue can impact investigative thinking and evidence evaluation throughout an investigation, given that complex, drawn-out tasks are known to be especially sensitive to negative effects of sleep-related fatigue [12].

While investigations and interrogations generally proceed along these phases, interviews are inherently recursive as questioning tactics may impact any established rapport (e.g. by shaming the participant) or bias memory recollection (e.g. by asking leading questions or disclosing evidence prematurely). Furthermore, disclosures by the participant can steer investigations in novel directions. For example, a self-incriminating statement can lead the investigators to consider that person as a suspect and shift the goal of the investigator toward soliciting a confession and adopting accusatorial methods. As a result, investigations are best understood as a cyclical and multi-prong process where the three phases outlined above repeat multiple times across a series of interactions [41, 75]. Critically, the complex and dynamic nature of investigations and interrogations reveals numerous points at which the investigator may adopt suboptimal strategies, make errors, or bypass critical intelligence-gathering opportunities [5]. It is precisely during these decision points or laborious, drawn-out tasks that sleep disruption may impact investigative actions. Next, we address how sleep-related fatigue may impact these phases of investigative activity.

Impact of Sleep-Circadian Disruption on Investigative Interviewing

As described earlier, investigative interviewers and interrogation professionals continually face challenging informational and social contexts requiring vigilance and complex decision-making, as they interact with different types of interview participants (e.g. debriefing a traumatized victim vs. interrogating a terrorist suspect) and have to continually update and reflect on case evidence [57]. This undoubtedly taxes interviewers' levels of vigilance, adaptability, perseverance, and self-control essential to the success of investigative interviews, as emphasized in existing guides to investigative interviewing [49, 57]. These tasks also must be accomplished under high levels of personal stress, fatigue, and public scrutiny.

Critically, these observations imply that sleep loss could undermine investigators' ability to prepare, elicit information, and adequately assess as well as corroborate the credibility of statements in evidence. This is important because understanding how sleep-wake processes impact investigative interviews can reveal important insights about modifiable factors that underlie efficacy and outcomes of real-world investigations. Furthermore, such understanding will speak to basic theoretical principles underlying the impact of sleep and circadian processes on consequential interpersonal behavior.

To this end, we illustrate suggested linkages between sleep-circadian disruption and the investigative interview process (Figure 1). This framework is meant to connect critical aspects of sleep-related fatigue to key phases of criminal investigations and to stimulate novel and untested hypotheses about how sleep and circadian factors impact investigative interviewing and investigative activities in general.

It is beyond the scope of this paper to provide a thorough review of how sleep-deprivation, circadian mistiming, and the resultant increases in stress and fatigue interact to impact all aspects of investigations or interrogations [76]; fully addressing the impact of any of these individually would require many pages. Any review is also constrained by the lack of direct evidence, given the relative paucity of research that has directly considered sleep and circadian factors in the context of interrogation or investigative

analysis. However, it is critical to jointly consider sleep and circadian factors given their mutual dependencies and established relevance for performance and social behavior (top of Figure 1). For example, during sleep restriction, neurocognitive deficits are exacerbated at times of low circadian alerting (i.e. night), while at peak times during the early evening, they may all but disappear [77]. As emphasized later on, sleep disruption undermines effort and impairs cognitive processing as well as emotion regulation, socioemotional consequences which by themselves are likely to impact performance and demeanor of investigators in ways that shape investigative interviewing. Under periods of stress, coping with sleep-deprivation is also more difficult, as each exacerbates the other [78, 79]. As a result, future studies examining the impact of sleep loss or circadian timing should be sensitive to concomitant changes in stress processes as they could play mediating roles [80].

Impact on Preparation and Rapport-Establishment

As noted earlier, when preparing for an investigative interview, the investigator aims to establish some form of rapport (a shared sense of mutual respect and coordination) with the participant. Even when interrogating a combative suspect known to have committed heinous crimes, some level

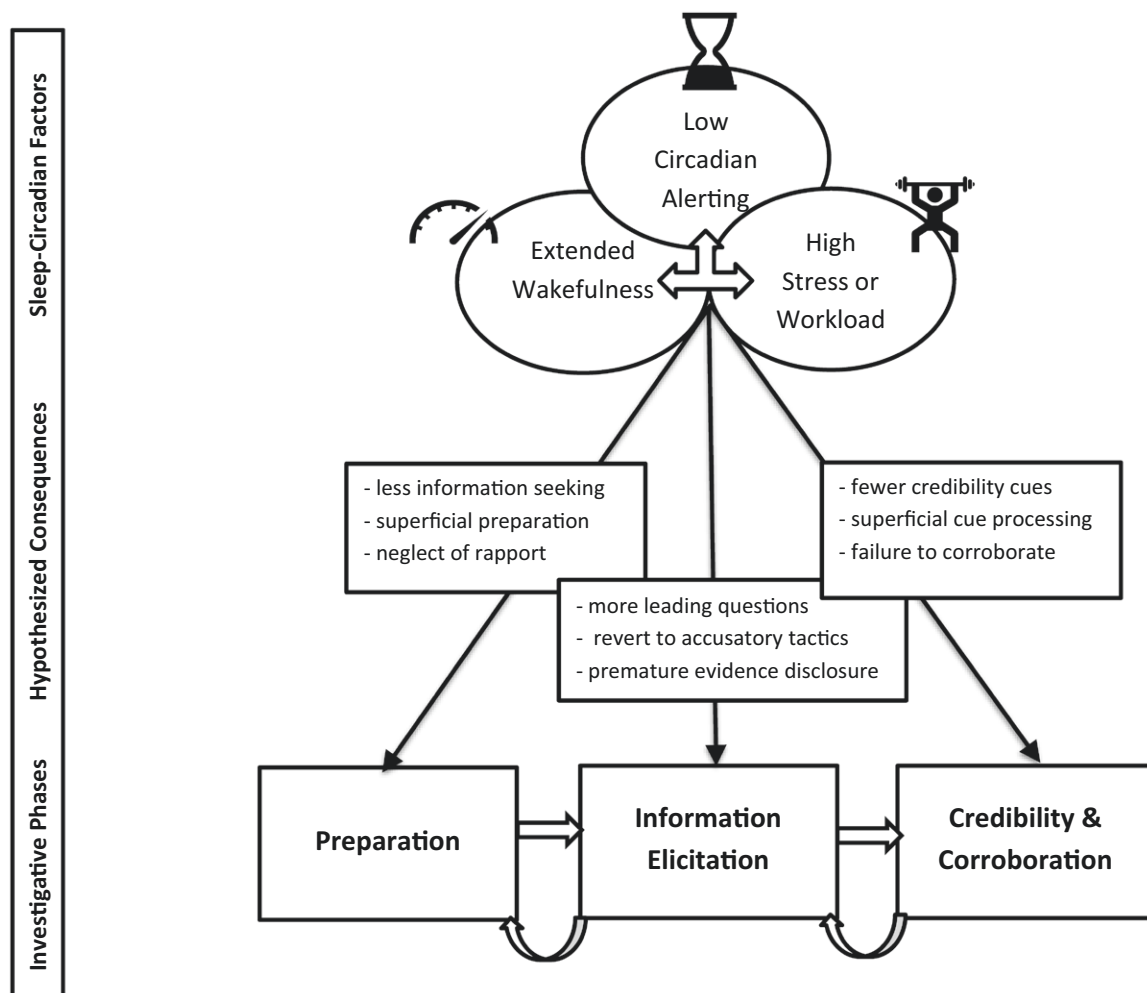


Figure 1. A framework linking sleep-circadian disruption to the investigative interview process.

of rapport is necessary to maintain the conversation and encourage disclosure by the participant. How might fatigue stemming from sleep loss, circadian misalignment, or their combination impact the interviewer's preparation for interacting with participants of investigation?

First, sleep disruption may undermine various preparatory tasks critical to planning and executing an investigative interview (e.g. background research on the participant). One pervasive general consequence of sleep loss is avoidance of effort. Tired individuals skip effortful tasks, choose easier options, or adopt easier but less effective performance strategies [12, 81, 82]. As a result, it is plausible that a tired investigator may curtail background research regarding crime elements or participant background, which would detract from executing an optimal interview strategy. For example, an adequate understanding of a participant's family situation and their significant relationships can aid investigators in drawing out personal similarities that enhance rapport, provide context for participants' activities at the time of the crime, and inform interrogative tactics.

Second, losing sleep and functioning at nighttime is known to create emotional disturbances, especially muting positive affect and enthusiasm, dovetailing concomitant experiences of tiredness. Furthermore, sleep disruption can increase negative affect like anxiety, depression, and anger, especially under conditions of high stress, provocation, or external demand [79, 83]. These consequences are likely to make it difficult for the investigator to maintain a pleasant and engaging demeanor throughout the interview, which could negatively impact establishing rapport.

Third, the increased stress and negative affect of sleep-circadian disruption, when combined with fatigue, may lead investigators to be impatient and regulate negative affect by again opting for easier, yet less-effective interview strategies, such as bypassing rapport development and proceeding directly to critical questions about the crime. Multiple experimental studies that examined performance under complex and changing conditions indicate that sleep-deprived individuals are poorer at monitoring their surroundings, perseverate with easier, yet riskier decision-making tactics, and are slower to adapt to new information [82, 84–86]. Finally, sleep loss undermines the ability to perspective take, which could lead interviewers to a misleading impression of how a participant is perceiving the interview situation, which could decrease the efficacy of preparation for any interviews [87].

While these consequences of sleep-circadian disruption are plausible and theoretically informed, they are at this point speculative as research has not directly examined them within investigative settings. To the best of our knowledge, there is only one published study that has evaluated interviewers' reports of actual investigative interviews as a function of their sleep-related fatigue. This investigation used actigraphy and biomathematical modeling to track sleep and alertness among a sample of law-enforcement officers [31]. Critically, on days that patrol officers and detectives were less alert, they reported being less able to secure rapport and cooperation with their (real-life) interview participants. Moving forward, it is important for future research to leverage basic insights about the impact of sleep on social behavior and interaction to examine these hypotheses within both experimental and field interrogation settings. For example, within experimental settings, studies that address how sleep loss impacts effortful preparation when faced with cognitive-demanding investigative activities can speak to the impact of fatigue in this context.

The Impact on Information Elicitation and Disclosure

Once the participant is willing to engage, the primary task of an interviewer is to elicit accurate and reliable information from the participant, including facts unknown to the investigator that may be relevant to the investigation (the "unknown unknowns" in the words of the former Secretary of Defense Donald Rumsfeld). Experimental studies evaluating approaches to eliciting information from memory indicate that cognitive approaches (e.g. Cognitive Interview) that employ open-ended questions, mnemonics, and context-reinstatement are more successful in yielding more (and more accurate) information than direct questioning or accusatorial demands [53, 54, 88].

However, these approaches require patience, time, and conscious effort to avoid leading questions or disclosure of cues to what investigators know [57, 89]. However, this extends the interview and requires further accommodations on the part of the investigator. As a result, a tired investigator may opt for suboptimal, yet easier and less time-consuming questioning strategies (e.g. direct questioning), rather than proceeding systematically with open-ended questions and using mnemonic approaches that usually extend the interview [52, 88]. These broad effects imply several consequences of fatigue for how interviewers elicit information (middle panel in Figure 1).

First, a fatigued interviewer may be more drawn to the use of leading questions (e.g. "did you see the gun in their hand?") rather than open-ended questions (e.g. "what did you see?") in order to save time and "get to the point." Leading questions are problematic because they provide cues about the interviewer's expectations, can taint participants' memory, and can discourage more detailed spontaneous disclosures [65, 90]. Rushing the interview could result in both less accurate and less detailed disclosures.

A second, related possibility for suspect interviews is that a fatigued interviewer falls back on adversarial and accusatorial tactics to elicit a confession or desired information as quickly as possible ("get to the point"). Especially when facing a resistant suspect who deflects difficult questions or provokes the investigator, a tired investigator may lose patience, interrupt, and shift to accusatorial tactics such as insisting there is evidence of guilt (even if not) and repeatedly demanding that the participant confess regardless of denials or corroborating evidence [46]. For example, interrogators' use of "themes" about how and why the crime was committed (e.g. maybe you only hit them once) will inevitably provide information to the participant they can integrate into a (false) narrative [7, 51]. Consistent with the premise that insufficient sleep may undermine composure of investigators, one study showed that professional investigators report more difficulties with maintaining their focus and emotional composure during actual interviews on days when they were more sleepy and less alert [31].

In this vein, sleep-related fatigue may encourage those interviewing suspects to "dump evidence"—that is, to quickly disclose evidence of potential guilt, including false evidence or evidence bluffs, so as to pressure the suspect to confess [39, 91]. Interrogators may also employ false evidence (e.g. "we have your DNA") to pressure suspects to confess, which can contribute to false confessions [92]. While disclosing evidence prematurely may also undermine accurate credibility assessment (see below), it may increase resistance and reduce participants' motivation to cooperate [47]. This may be particularly problematic in homeland security and intelligence-gathering settings, where interviews of

criminal suspects target ongoing or future threats, rather than admissions of wrongdoings [37].

As was the case with the role of sleep disruption for rapport-establishment, there is a paucity of direct evidence regarding the impact of investigator fatigue on approaches of information elicitation or their effectiveness. One exception is the study by Krizan et al. [31] that examined how daily fatigue of real-life investigators predicts report of actual field interviews—findings suggested that on days officers slept better they reported encountering less resistance from participants and higher utility of obtained information. Future research can address this by associating sleep-related fatigue among law-enforcement with their reports of strategies and approaches used during investigations. Conversely, experimental analogs should examine how individuals approach information elicitation (e.g. choice of questions) when under fatigue.

The Impact on Credibility Assessment and Corroboration

A key goal for any investigative interview is assessing the credibility of information provided by the interview participant [93, 94]. Specifically, investigators must determine whether suspects, witnesses, or victims are lying or withholding information when providing narrative accounts of events in question, or when describing their beliefs and intentions [95]. Achieving these goals is undoubtedly difficult as it demands the assessors' optimal sensory acuity, cognitive flexibility, and interpersonal insight. However, the extensive sleep difficulties experienced by professional investigators outlined earlier may make these tasks more difficult and thus prone to error (right-most panel in Figure 1).

First, one set of potential consequences for the accuracy of credibility assessment is implied by the hypothesized negative influence of sleep-related fatigue on the amount of information elicited. Specifically, people are more accurate at detecting deception when there is a large amount of verifiable verbal information that can then be scrutinized for plausibility (i.e. how likely or realistic is the participants' narrative), coherence (i.e. how logical are the described event sequences), and correspondence with known evidence (i.e. how well do claims fit with independently known facts) [69, 70, 94, 96]. However, these facets will be more difficult to evaluate if only a brief, information-poor narrative is elicited. In other words, the interviewers will have to base their judgments on a more limited set of information, which is likely to undermine deception detection accuracy, as well as limit the opportunities to corroborate participants' statements with independent sources of information.

Second, an overly fatigued interviewer is likely to struggle with noticing and making sense of relevant cues to credibility. While non-verbal cues to deception are not very reliable, participants' demeanor and behavior do provide an important context for evaluating their statements (e.g. whether a particular topic raises a participant's discomfort and thus points to a relevant line of inquiry), and para-verbal features such as tone and pace of speech can aid in evaluating statement truthfulness [97]. Extensive research shows that sleep-deprivation and circadian mistiming significantly impair vigilance of one's surroundings, social awareness, and information processing [28, 86, 98, 99]. As a result, a fatigued interviewer may miss important verbal or non-verbal cues to truthfulness or deception, over-weighting only a few (potentially misleading) cues due to limited cognitive

capacity (e.g. it is easier to scan for fidgeting than mentally reconstruct a lengthy narrative).

Finally, sleep-related fatigue may lead to premature conclusions regarding participants' truthfulness when evaluating credibility. Given that sleep loss leads to the conservation of effort and the adoption of easier strategies [81], interrogators may be more likely to seize on early cues to deception or rely on preexisting impressions regarding the participants' credibility. It is well established that investigators can easily fall into "tunnel vision" where they only seek confirming evidence consistent with their preliminary conclusions, neglecting exculpatory or contradictory evidence in need of corroboration [100, 101]. In this vein, individuals may rely more on their stereotypes and preexisting beliefs when operating during periods of low circadian alerting [98, 102].

Put together, these hypothesized consequences suggest that fatigued investigators may be less accurate when discriminating true from false accounts elicited from interview participants. While these possibilities also await empirical scrutiny, one unpublished study provided preliminary evidence consistent with these proposals. In this research, a group of law-enforcement officers evaluated video-recorded alibis from participants who truthfully or falsely described their activities from the prior night. Critically, officers who were less objectively alert (as measured by the Psychomotor Vigilance Test) were less accurate in sorting false from true accounts, due to poorer detection of false statements [103]. In general, future work should examine both the motivations and manner in which investigators with more versus less fatigue approach credibility assessment and corroboration.

Sleep-Related Fatigue in the Broader Context of Investigative Work

As outlined in this paper, sleep-circadian disruption is prevalent in investigative communities, and there are strong theoretical bases to expect that it could undermine various phases of the investigative interview process. This cursory review has focused on psychosocial and cognitive mechanisms that are plausible mediating factors between sleep-circadian disruption and implementation of investigative interviews. While most of the links await direct empirical scrutiny, there is at least preliminary evidence for some [31].

Making Sense of the Evidence

As just outlined, sleep disruption and investigators' fatigue may impact critical investigative interviewing tasks, leading to a focus on establishing adherence over actual cooperation, failures to explore the participants' perspective or relevant knowledge, and less motivation to resolve participant resistance. Critically, sleep and circadian disruption could impact how investigators approach making sense of the evidence they have and how they use it throughout the investigation. Tired investigators may disclose evidence prematurely when dealing with a highly resistant participant (e.g. disclosing to them that a witness placed them at the scene of the crime as a way to counter that suspect's resistance). This effectively precludes a key corroboration opportunity, as soliciting a more detailed narrative from the participant could speak to whether they are truthful in the first place. Alternatively, seizing on a witness statement that confirms investigators' suspicions without adequate vetting of the witness and searching for corroborating witnesses could lead to a faulty conclusion that

curtails further investigation. Such “streamlined” approaches are often adopted by individuals when under fatigue.

Thus, fatigued investigators should be more likely to fail to corroborate the details of any participant admissions or confession. There is often the false presumption among law enforcement investigators that once a confession is obtained, the investigation is complete and ready to be submitted to the prosecutor’s office for charging. In the timeline of an investigation, this is a critical tipping point [100]. As observed by the second author throughout decades of investigative experience, an investigator who is not with fatigue will likely take the time to corroborate details obtained from a participant’s admissions or confession and be able to substantiate the accuracy of the evidence incriminating the participant. This will then enhance the integrity of the entire investigation. On the other hand, a fatigued investigator should be more likely to cut corners after obtaining an admission or confession and fail to corroborate any information obtained, incorrectly assuming that the confession is all that is needed.

Finally, sleep-related fatigue is likely to generally undermine the fidelity of investigative thinking critical to successfully resolving investigations. Sleep-deprived individuals have problems with remembering recent events as they struggle to maintain information in working memory, akin to a “temporary amnesia” [104]. Similarly, lost sleep could undermine insight and creative ideas [105, 106], which is an important component of investigative thinking as it supports inventive theorizing and consideration of neglected avenues to pursue.

Investigative Teams and Timelines

Investigative interviews do not occur in isolation—they are occasionally conducted in teams including multiple detectives, note-takers, or interpreters, especially in homeland security settings [57]. Furthermore, any person of interest may be interviewed multiple times as an investigation unfolds, especially if they are later identified as a suspect [10], and multiple participants may be asked similar questions. The influence of sleep-circadian disruption may thus also be sensitive to these dynamic aspects of investigations.

For example, sleep-deprivation may impact team performance differently depending on the type of task. If the competencies or responsibilities of investigative team members are very specialized and not substitutable (e.g. only one officer is trained to interview children), then one sleep-deprived member may have a significant influence on the overall performance (or the investigative outcomes) of the team [107]. This suggests that division of labor may help to mitigate the accumulating effects of fatigue.

Any influence of sleep-related fatigue may also be exacerbated during the initial days of an investigation (the “first 48” hours), given the urgency to collect participant and suspect statements, pursue investigative leads, collect physical evidence, or identify ongoing threats [108]. In the event of a major crime, entire homicide teams may be immediately deployed to the scene, often in the middle of the night, with protracted interview and scene analysis duties. Detectives in charge may be “held over” after their shifts if there is a need to investigate an incident. Such practices may amplify cumulative fatigue in investigative teams and leave little reserve to handle additional cases. In a protracted investigation, an investigator may have more time to prepare and execute interviews, potentially muting fatigue effects.

Coda

This review highlighted how prevalent sleep and circadian disruption among professional investigators may impact investigative processes, with a focus on interviews which are a critical component of investigations conducted in the service of criminal justice and public safety. While direct evidence for the hypotheses presented throughout is so far lacking, the strong theoretical bases underlying the proposed framework encourage further empirical scrutiny. At this point, it is unknown whether homeostatic, circadian, or stress-related factors are most important—given their inter-dependence; however, they need to be considered in tandem, and their individual contributions ultimately evaluated. For example, there is increasing recognition of “compassion fatigue” among police officers and forensic investigators. This refers to the cumulative exposure to traumatic events (directly or vicariously) that “numb” investigators to the suffering or experience of others, or alternatively induce rumination and preoccupation which undermines sleep and leads to exhaustion, both of which could influence investigative interviewing [109, 110]. Given the key role that investigative activities play in securing justice, our central argument was that understanding how sleep and fatigue impact investigative tasks and thinking is deserving of more attention. Hopefully, the framework presented can encourage and guide future work on this topic.

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