Towards an integrative design-oriented theory of sleep-onset and insomnolence
from which a new cognitive treatment for insomnolence
(serial diverse kinesthetic imagining) is proposed

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A. IDO: Integrative Design-Oriented Approach Required

Understanding human sleep onset and propensity (somnolence and **insomnolence**) requires an **IDO approach**.
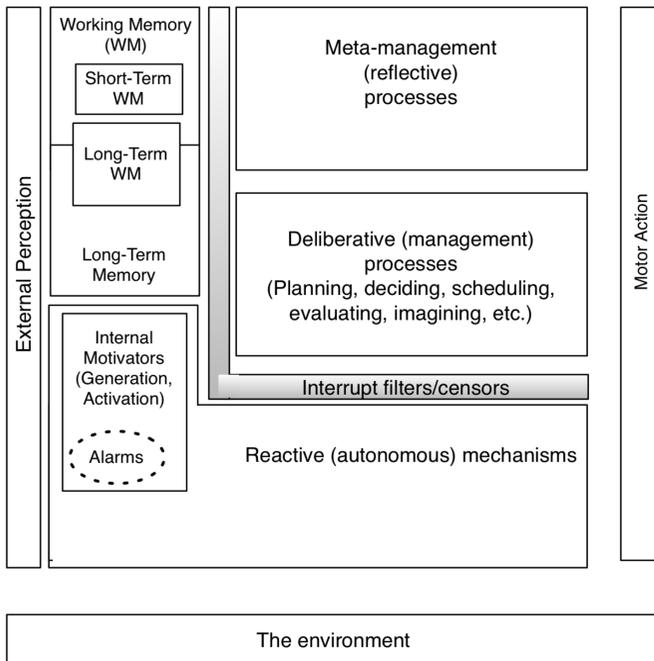
An IDO Manifesto

* **AI** is the general science of intelligence and competence
* **Design stance**: AI (Niches, requirements, design, implementations, evaluation/analyses, iterate)
* **Explain competence**: (J.R. McCarthy; A. Sloman) : **autonomous agency** (Beaudoin, 1994).
* **interdisciplinary**: (AI, philosophy, psychology, linguistics, neuroscience, anthropology, etc.)
* **information-processing** (IP) theories;
* Explain **integration** (**interaction, blending**) of major IP functions: "Cognitive", motivational, affective, executive, ancillary…
* Explore **IP Architectures**. Research teams require AI/software architects.
* **Comparative**: Analyze design-space and trade-offs.
* Provisional commitment to theory: Use of key terms (e.g., "arousal", "attention") requires provisional commitment to IDO theoretical concepts for interpreting them.
* Acknowledge IDO shortcomings of one's scientific communications.

See Sloman (1993); Beaudoin (1994); Muthukrishna & Henrich (2019); Beaudoin et al 2017.

B. CogXAff: Towards an IDO model based on H-CogAff (Sloman, 2003) and LIDA

Key integrative concepts and claims

Figure: H-CogAff Architecture: An architecture *to transform into CogXAff*

H-CogAff though very aligned with AI of IDO requires more consideration of psychological and neuroscience research. Thus the need for *CogXAff*, which we have been developing.

* **Perturbance**: insistence motivators influencing management processes despite meta-management.
* **Perturbance** accounts for (affectively laden) repetitive thought and emotions *à la* Herbert Simon.
* Motivational control of cognition.
* **Alarms:** global inputs, global effects, underlies stress response, tension, etc.
* Human meta-management is limited
* IP and neural architecture of consciousness: Donald (2001), LIDA; Shanahan (e.g., coherence, connectome)

C. Issues with many insomnia theories

* Insomnia is a psychiatric term. Insomnolence is an IDO psychological concept of difficulty falling asleep.
* Explicit or **implicit** dependence on "arousal" and "activity".
* "**Arousal**" in a problematically polymorphic concept. (e.g., circular explanation). Shows need for philosophy (conceptual analysis) in IDO. "Arousal" also undermined by Kay & Buysse (2017). Term used without commitment to a theory of arousal; theories of arousal themselves are weak.
* **Not IDO** (long list of criteria.)
* **Repetitive thought** (Watkins, 2008): atheoretical; not IDO
* No commitment to emotion theories (themselves mostly not IDO).

D. SIP: SOMNOLENT INFORMATION PROCESSING THEORY

Evolutionary challenges: deliberate influence on sleep is essential, yet for adaptive reasons this influence is relatively indirect (cf Anderson's adaptive theory of memory and Beaudoin's heuristic relevance-signaling hypothesis). Yet cortical states are relatively opaque to ARAS and hypothalamus. (A dog cannot read her master's mind).

SIP's Postulates

1. **Temporal processes** (C, H: Borbély, 2016) regulate sleep timing, with underlying sleep state controls (opponent processes, "switching", etc.) due to the adaptive necessity of sleep.
2. **N1-like** information-processing **is (*inherently* and by association) pro-somnolent**. (This means N1 involves a positive IP feedback loop.)
3. **Perturbance** is **insomnolent**
4. **Alarms** are **insomnolent**
5. Some **perceptual states** affect sleep propensity: e.g., sensing supineness, rocking or skin temperature.

Distinctive Implications:
· These are IDO postulates, drawing on IDO (hence proudly theoretical) concepts.
· Mental activity is not necessarily insomnolent (contra Perlis's, neurocognitive model).
· Attention and intention to sleep is not necessarily insomnolent (contra Espie's PI model, 2006).
· Concept of arousal is not required (contra Harvey's cognitive model).
· potential for deliberate mentation techniques that are pro-somnolent and counter-insomnolent, i.e., "super-somnolent", such as forms of serial diverse imagining (eg., SDKI).
* Many more…

E. SDKI: Serial diverse kinesthetic imagining
An IDO deliberate mentation ("cognitive") technique
derived from SIP expected to promote sleep onset.

Beaudoin previously defined and explored SDI ("the cognitive shuffle"). Here we derive SDK I.
N1 is unique, involving a transition in consciousness where coherence and sense-making wane; with oneiragogia and hypnagogia (mental imagery) (cf. Windt, Nielsen). The imagery is often **kinesthetic**. Hence, by virtue of Postulate 2, a technique that involves serially imagining diverse actions, or repeated actions in diverse setting should be pro-somnolent (generating a somnolent illusion then sense that one is falling asleep). E.g., imagining oneself opening and closing different drawers in different rooms in different buildings, while subvocalizing "pull", "push" (and possibly visualizing contents of drawers). This should increase the likelihood of spontaneous oneiragogia.
This mentally engaging yet 'easy' activity ties up the connectome, all of Baddely's working memory buffers, interfering with management processes that would otherwise sustain perturbance+alarms (counter-insomnolence).
Rocking sensations promote sleep, perhaps by virtue of N1 like cycles (slower frequency than sigma). Repeated actions are N1-like that way. This might also engage mechanisms involved in postulate 1; hence ulike other technniques this may counter jet lag. For these and other reasons SDKI should be counter-insomnolent by virtue of postulates 3-4; and tap into 5.

F. FUTURE RESEARCH

· Develop CogXAff with LIDA and other "cognitive" architectures (e.g., Sigma) in autonomous agent scenarios, drawing on promising integrative theories (e.g., Moors, 2017; Donald's theory).
· Explore brain bases of insistence and perturbance (following up on Kay & Buysse, 2017).
· SIP paper and companion paper (IDO assessment of emotion theories; and perturbance as missing concept)
* Revisit emotion, stress and "arousal" literatures in terms of alarms (an IDO interpretation of Selye's "alarm reaction").
· Empirical tests and explorations of postulates, SDI, SDKI.
· SIP contradicts many insomnia theories, thus critical experiments should be pursued, while drawing on strengths.
· Explore brain basis of insistence and perturbance (salience network).
· Much more, as this represents a paradigm shift in insomnia and emotion research (and beyond)

G. References, abstract and ancillary information

Available from http://summit.sfu.ca/item/18922