For several years now, frames in the style of Barsalou (1992) have been widely used in many branches of cognitive science. Frames are recursive attribute value structures, i.e. they represent properties as a combination of a function, e.g. means of locomotion, and an appropriate value, e.g. legs. Constraints can be used to express the fact that values of different attributes are related, e.g. wings as means of locomotion support flying as mode of locomotion. While applying frames, the authors independently developed a combination of frames and probabilistic modelling for their specific research purposes. The talk explores the general notion of stochastic frames and discusses three applications of stochastic frames: modification, prototype theory and lexical disambiguation.

**Defining stochastic frames**

The functionality of attributes makes it possible to make their range a probability distribution over values rather than a particular value, yielding a form of stochastic frame. *Leg length*, for example, yields a bell-shaped probability distribution on length, which particular figures depend on whose legs one talks about, e.g. cats’ or persons’. Within this framework, it is possible to express, refine and extend Barsalou’s initial idea of constraints (relations between the values of different attributes) as probabilistic constraints, e.g., informational links between values represented using conditional probabilities. For example, updating the value for a profession attribute with *basketball player*, may propagate information throughout the person’s frame leading to updates of other values (plausibly, an increased estimation of height, for instance). More generally, by switching to joint probability distributions over different nodes one gets a grasp on the full picture of relational constraints between the values of different nodes.

**Applications**

We argue for the benefits of applying stochastic frames in three areas:

a) **Adjectival modification**

Frame theory can explain how modifiers act on a particular value. Stochastic frame theory can furthermore represent the intrinsic blurriness associated with vague, gradable adjectives (a property shared with other probabilistic approaches e.g., Lassiter 2011, Egré 2017), and, due to constraints, can shift the probability distribution of other values as well. For example, a predication of *bald* can increase the probability of being male. Note that previous models like the selective modification model by Smith et al. (1988) don’t represent such constraints. Stochastic frames can also provide structured representations of comparison classes yielding a compositional analysis for complex APs such as *tall for a basketball player* derived from a composition of *[[tall]]* with a basketball player frame.

b) **Prototype theory**

The prototype theory of concepts, e.g. Rosch & Mervis (1975), explains the empirically confirmed typicality gradient of common-sense categories with the proximity of category members to a category’s so-called prototype. Different
specifications of prototypes have been discussed. With stochastic prototype frames we propose a quantification of the prototype in terms of attribute values’ probabilities to be found in categories. We will show how a comparison of the probability distributions of values, both of the category as a whole and of its category members, provides us with a measure of typicality based on subjective probabilities.

c) Lexical disambiguation
Stochastic frames can also represent constraints between thematic roles thus giving us a handle on lexical disambiguation (cf. Zeevat et al. 2017). For example, that, for the verb break, an instrument PP (e.g., with a hammer) necessitates the provision of an agent (e.g., Sam) and blocks the provision of an inanimate causer. This, we argue, can explain the contrast between, With a hammer, Sam broke the window, and #With a hammer, a stone broke the window. We can thus illustrate ambiguous verbal concepts by using probabilities to represent distributions over thematic role signatures.

In each application, we argue that combining probability theory with frames yields the ability to represent tendentious belief, constraints between values and plausibility reasoning with them. We also argue that the stochastic enrichment of frames is warranted by the need to represent gradability, informational update, contingency and underspecification that applications (a)-(c) require. The specific required structure varies considerably with the specific application, however. This raises the question what, if any, is the correct notion of stochastic frame that would fit to all of our and other possible applications.

General problems of stochastic frames
Finally, we consider the challenges that arise for stochastic frames. First, we consider whether they can be sufficiently constrained, given that there are potentially infinitely many stochastic frames around any given classical frame. The second foundational question that is addressed is the question of the origin of the stochastic information associated with a stochastic frame and the closely related problem how different subjects can share sufficiently similar stochastic frames – which seems to be a prerequisite for successful communication. Various roads are sketched that may lead to a solution.