Research Statement

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I am currently an Assistant Professor of Chemistry at the University of Nebraska – Lincoln (UNL), where my group is working the chemical design of novel two-dimensional (2D) materials and heterostructures for applications in electronics, photovoltaics, sensors and energy storage. I received my training in materials science, which is often described as an interdisciplinary field at the interface of chemistry, physics and engineering. With such background, I am equally interested in the synthesis of new materials as well as their characterization and implementation in different applications, and I really like research projects where my students have exposure to ideas from different fields of natural science. This concept can be naturally applied to the research on emerging 2D materials, such as graphene, transition metal chalcogenides, and many others. First of all, there is a great need for new synthetic techniques for 2D materials with properties tailored for specific applications, which requires students working on the synthesis of 2D materials to have a deep knowledge of chemistry. These materials have a plethora of interesting properties and characteristics, which necessitates students' exposure to a large number of materials characterization techniques. Finally, 2D materials are often discussed with regard to a broad spectrum of potential applications, which is why many projects on 2D materials are logically concluded by a demonstration of a prototype of a functional device, be it a field-effect transistor, a sensor, a solar cell or a supercapacitor. Such multifaceted professional preparation should help students in their future careers. Because of the highly interdisciplinary nature of our research, we have established numerous collaborations with chemists, physicists, materials scientists and engineers on campus, in the US and internationally. Shown below are several examples of specific research projects.

(1) Solution bottom-up synthesis of graphene nanoribbons.

Since 2004, graphene, a one-atom-thick planar sheet of carbon atoms, has received a great deal of attention due to its remarkable physical properties and potential applications. However, graphene cannot be directly used in logic applications because it does not have an energy bandgap. Therefore, control of graphene's electronic properties is an important fundamental and applied problem.

According to theoretical studies, narrow graphene nanoribbons (GNRs) with atomically precise armchair edges and widths (*w*) less than 2 nm should have a bandgap comparable to that in silicon. However, bulk synthesis of GNRs with such characteristics remained a great challenge for many years. Research groups around the world tried different top-down fabrication approaches to "carve" narrow GNRs from larger blocks of sp^2 carbon materials, such as graphite, graphene or carbon nanotubes. The resulting GNRs were tested in device studies, but since they had disordered edges and widths > 10 nm, they did not exhibit the desired semiconductor properties. Instead of carving GNRs from graphene using top-down approaches it is also possible to construct narrow atomically precise GNRs from smaller molecules via bottom-up techniques. In 2010, Müllen and Fasel groups (Cai *et al.*, *Nature 466*, 470, 2010) demonstrated that narrow GNRs that are only a few benzene rings wide and have atomically smooth armchair edges can be synthesized by surface-assisted coupling of molecular precursors on Au(111) into linear polyphenylenes followed by cyclodehydrogenation. Motivated by this milestone work, I decided to work on developing an alternative solution-based approach for atomically precise GNRs in bulk quantities, as the surface-assisted synthesis of GNRs cannot be scaled up, and the ribbons produced on conductive substrates, such as Au(111),

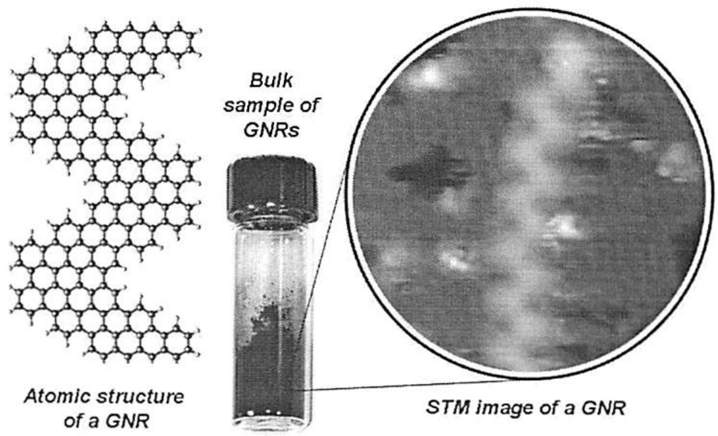

Figure 1. Solution-synthesized atomically precise GNRs.

cannot be directly used for electronic transport measurements.

Generally speaking, the goal of this research is to develop an approach that would combine the best of both worlds, *i.e.* top-down and bottom-up approaches. Such approach should yield high-quality narrow GNRs with atomic precision that was previously achieved by the bottom-up surface-assisted synthesis, and yet the resulting GNRs should be produced in large quantities and easily processable form that would enable convenient device fabrication and electrical measurements. Recently, we have demonstrated a solution-based bottom-up approach that meets these requirements. It is based on Yamamoto coupling of pre-synthesized molecular precursors followed by cyclodehydrogenation via Scholl reaction. Figure 1 shows a vial with GNR powder, in which the nanoribbons have a precisely defined atomic structure, as evidenced by the scanning tunneling microscopy (STM) image (Figure 1). Further synthetic and characterization details can be found in our paper (Vo *et al.*, *Nature Comm. 5*, 3189, 2014) that is enclosed as a representative article. For the sake of fairness, I should point out that we are not the first group that attempted to synthesize atomically precise GNRs in solution – Müllen's group in particular was very active in this area for many years. However, our paper in Nature Communications became the first (and so far the only) study where solution-synthesized GNRs were imaged at such a high resolution as in Fig. 1. Direct visualization of GNRs at high resolution ultimately proved their high structural quality, while comparable studies often rely on indirect techniques for structural characterization, such as NMR and Raman spectroscopy. The high-resolution STM imaging became possible, in part, due to the fact the GNRs were synthesized without solubilizing side groups.

The ability to produce sub-2-nm-wide atomically precise GNRs opens numerous opportunities that will be explored by my group in the nearest future. For the future electronics applications it is important to demonstrate that the solution-synthesized GNRs could be doped with heteroatoms, such as nitrogen and boron, to modify their electronic properties (similarly to how silicon could be doped with N or B to achieve n- or p-type conductivity, respectively). We have published the first study on the bottom-up solution synthesis of N-doped chevron-like GNRs (Vo *et al.*, *Chem Comm, 50*, 4172, 2014; another representative paper), and we will continue to explore the possibility of chemical doping of GNRs in the future studies. We also found that N-doped GNRs tend to self-assemble into two-dimensional (2D) and three-dimensional (3D) structures (Vo et al., Nano Lett. (2015) DOI:10.1021/acs.nanolett.5b01723), which means that nitrogen doping could be a useful tool to not only change electronic properties of GNRs, but also promote their packing into 2D and 3D assemblies, which opens a new route to engineer new carbon-based materials. Also, since we now have access to GNRs with semiconductor properties, it is tempting to utilize them for device studies. Our preliminary measurements show that the GNRs shown in Figure 1 are electrically conductive in a bulk form (Vo *et al.*, *Faraday Discuss.*, *173*, 105, 2014), so our future studies will be focused on the electrical measurements of individual GNRs. In the long term, these studies should reveal the potential of atomically precise GNRs with semiconductor properties for applications in electronics, optoelectronics and photovoltaics.

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(2) Heterostructures of two-dimensional and ferroelectric materials for electronic applications.

Nonvolatile ferroelectric memories, based on electrically switchable polarization, have been in mass production for over 20 years with a market size estimated to be in the hundreds of millions of dollars per year. However, several challenges, such as scaling issues, high operating voltages, relatively slow speed and structural degradation, limit further development of this technology and call for fundamental advances in materials science and device engineering. In this project, we study heterostructures comprising ferroelectric perovskites and two-dimensional (2D) electronic materials, such as graphene and transition metal chalcogenides (TMCs). A combination of 2D and ferroelectric materials results in heterostructures with promising electronic and memory properties. Polarization reversal can be employed to modulate (1) the perpendicular-to-plane tunneling conductance across the ferroelectric barrier (Figure 2a), and (2) the in-plane transport in a conducting channel of a field-effect transistor (FET) device (Figure 2b).

An example of a vertical structure with a perpendicular-to-plane tunneling conductance across the ferroelectric layer is shown in Figure 2a. By transferring graphene in different solvents on the surface of the ultrathin ferroelectric $BaTiO_3$ (BTO) film, we found that an interfacial ammonia layer leads to strong polarization retention and increases the resistance disparity between "on" and "off" states by almost three orders of magnitude. Using graphene as an electrode in ferroelectric tunneling junctions reveals a new potential for graphene as a functional material. The easiness with which graphene can be transferred from a solution to a ferroelectric surface opens a possibility of using a wide variety of molecular substances for interface engineering to the further improvement of ferroelectric tunnel junctions. This work, which was performed in collaboration with Prof. Alexei Gruverman at UNL, has been published in Nature Communications (Lu *et al., Nature Comm.* 5, 5518, 2014).

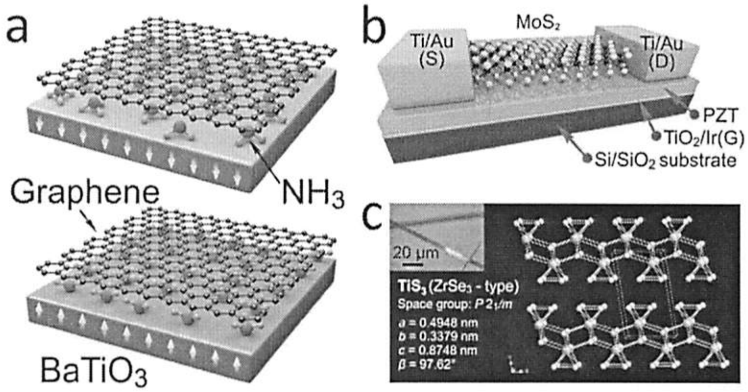

Figure 2. (a) Ferroelectric tunneling junction with ammonia molecules trapped at the graphene/BTO interface. Top and bottom panels show orientation of ammonia molecules depending on the polarization direction in BTO. (b) MoS_2 ferroelectric field-effect transistor with PZT as a gate dielectric. (c) Crystal structure of titanium trisulfide (TiS_3); the inset shows an optical photograph of a TiS_3 single crystal.

More recently, we studied the effect of the ferroelectric polarization reversal on the in-plane electron transport in a 2D material. We fabricated and tested electronic and memory properties of field-effect transistors (FETs) based on monolayer or few-layer molybdenum disulfide (MoS_2) on a lead zirconium titanate ($Pb(Zr,Ti)O_3$, PZT) substrate that was used as a gate dielectric. We demonstrated that these devices have a large hysteresis of electronic transport and promising memory properties. MoS_2-PZT memories have a number of advantages and unique features compared to their graphene-based counterparts as well as commercial ferroelectric random-access memories (FeRAMs), such as nondestructive data readout, low operation voltage, wide memory window and the possibility to write and erase them both electrically and optically. This unique dual optoelectrical operation of these memories can simplify the device architecture and offer additional practical functionalities, such as an instant optical erase of large data arrays that is unavailable for many conventional memories. A paper reporting these findings was recently published in ACS Nano (Lipatov *et al., ACS Nano* 9, 8089, 2015).

In addition to graphene and MoS_2 we are also exploring other materials that could be used in combination with ferroelectric substrates in the future studies. While a large number of recent experimental works have focused on TMCs with MX_2 composition (M = Mo, W; X is a chalcogen), such as MoS_2, $MoSe_2$, WS_2 and WSe_2, the TMC family is very rich and contains many other layered materials with interesting properties that received limited attention from the researchers. Recently we have demonstrated that titanium trisulfide (TiS_3; Figure 2c) is a competitive electronic material in the family of 2D TMCs that can be considered for emerging device applications. Several-mm-long TiS_3 whiskers can be conveniently grown by the direct reaction of titanium and sulfur, and then exfoliated using the adhesive tape approach; the resulting few-layer TiS_3 flakes can then be used for device fabrication. The TiS_3 FETs showed an n-type electronic transport with room-temperature field-effect mobilities of 18-24 $cm^2V^{-1}s^{-1}$. We demonstrated that TiS_3 is compatible with the conventional atomic layer deposition (ALD) procedure for Al_2O_3. ALD of alumina on TiS_3 FETs resulted in mobility increase up to 43 $cm^2V^{-1}s^{-1}$, and much improved subthreshold swing characteristics. It is very likely that there is a lot of room for improvement of TiS_3 FETs, since theory predicts TiS_3 to have an electron mobility of up to 10,000 $cm^2V^{-1}s^{-1}$ (Dai and Zeng, *Angew. Chem. Int. Ed. 54*, 7572, 2015). Optimization of TiS_3 FETs and fabrication of TiS_3 devices on ferroelectric substrates will be a subject of our future studies. Our first results on TiS_3 FETs have been recently published in Nanoscale (Lipatov *et al., Nanoscale 7*, 12291, 2015). This study should also attract attention to other TMCs with MX_3 composition.

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mediated modulation of electronic properties of hybrid ferroelectric-based heterostructures" ($490.5K, 06/01/2015-05/31/2018).

(3) Three-dimensional graphene nanostructures

Graphene's remarkable physical properties are strongly dependent on how the graphene sheet is shaped. As was discussed previously, graphene sheets could be carved to form narrow graphene nanoribbons (GNRs) that could be either metallic or semiconductive depending on their width and edge structure. Carbon nanotubes (CNTs), a one-dimensional carbon allotrope, could be considered as rolled-up sheets of graphene. Similarly to GNRs, CNTs could be either semiconductor or metallic depending on their diameter and chirality, *i.e.* the angle at which the graphene sheet is rolled. These two examples show that carving, twisting and rolling graphene sheets could be powerful tools to achieve graphene-based structures with new properties. This idea was extensively explored theoretically, as numerous three-dimensional (3D) graphene-based materials with intriguing properties have been proposed. These materials include periodic 3D structures comprising graphene sheets interconnected by nanotubes ("pillared graphene"), hybrid graphene-CNT structures and 3D graphene frameworks among others; many of these materials are discussed in the recent review paper (A. Ivanovskii, *Russ. Chem. Rev., 81*, 571, 2012). However, synthesis of such 3D graphene-based periodic structures remains a great challenge.

During my PhD studies I worked on colloidal photonic crystals and was exposed to the idea of making periodic porous structures by templating. In this approach, an original template, which could be, for example, a colloidal crystal made of polymer or silica spheres, is infiltrated with a material of choice, and then the template material is selectively removed. The resulting scaffolds that are made of the original material of choice can be considered as inverse replicas of the original colloidal crystals and are often called 'inverse opals'. In previous studies, inverse opals made of metals, nonmetals, semiconductors, polymers and other materials were successfully demonstrated. In this project we are trying to demonstrate that a modified templating approach can also be applied to the synthesis of high-quality graphene scaffolds with tunable structural parameters and physical properties.

We take advantage of the recently advanced method for the synthesis of graphene by chemical vapor deposition (CVD) on metal substrates, whereby centimeter-scale sheets of high quality graphene can be readily grown over the surface of a catalyst metal. Although the typical CVD procedure involves growth of graphene over the surface of a flat metal foil, the CVD method could be a powerful tool to grow complex 3D graphene-based periodic structures on properly structured substrates. Top panel in Figure 3 illustrates how an arbitrarily-shaped 3D metallic object (a) could serve as a backbone to grow and support a 3D graphene structure (b). Due to the complex shape and curvature the graphene coating is likely to possess structural defects that may enable etching away the metal template (c). In the

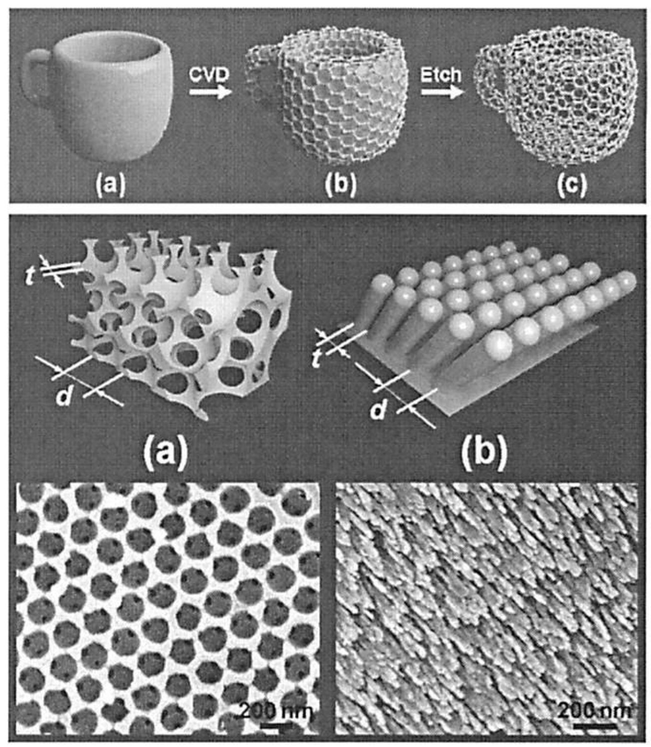


Figure 3. Synthesis of three-dimensional graphene nanostructures. □□□□□□□□: General scheme of growing arbitrarily shaped graphene nanostructures: graphene is grown on a metal nanostructure (a) by CVD to form a graphene-coated metal nanostructure (b) followed by the subsequent etching of the metal leaving a free-standing graphene nanostructure (c). □□□□□□ □□□□□: Metal nanostructures used in this project to grow graphene by CVD: (a) inverse opals and (b) slanted nanopillars. Top row panels show 3D schemes of these nanostructures; bottom row panels show representative SEM images of nickel inverse opals and nickel and cobalt slanted nanopillars, respectively, used in this project.

original study (P.M. Wilson *et al., J. Mater. Chem. C, 2,* 1879, 2014) we demonstrated this growth concept using two different types of metal nanostructures (see bottom panel in Figure 3): (a) nickel inverse opals grown by electrodeposition and (b) nickel slanted columnar thin film (SCTF) arrays grown by glancing angle deposition (GLAD) technique.

We systematically studied the roles of different parameters, such as the composition, morphology and crystallinity of a nanostructured metal, as well as the CVD growth temperature and different carbon sources to grow graphene on metal nanostructures and at the same time preserve their integrity. In particular, we showed that nanostructures with large crystalline domains can withstand high temperature CVD, whereas polycrystalline nanostructures, such as nanopillars grown by GLAD, suffer damage even at the low growth temperature of 500°C. In case of such thermally sensitive nanostructures, a careful selection of a highly reactive carbon source that could form graphene at lower temperatures becomes crucial. Furthermore, the selection of a metal is also important, as cobalt nanostructures are shown to be more resistant to thermal damage than their nickel counterparts. Finally, we successfully demonstrated that the nanostructured metal templates could be removed to form free-standing graphene-based inverse opals and hollow graphene nanopillars (P.M. Wilson *et al., J. Mater. Chem. C, 2,* 1879, 2014).

These original results can open a path toward the synthesis of other 3D graphene nanostructures, some of which are currently exploring. We also recently found that nanostructured graphene coatings can have some technologically relevant properties. For example, they can be used for the thermal protection of delicate metal nanostructures. Cobalt slanted nanopillars that we used in the original studies are known to melt at temperatures much lower than the melting point of bulk cobalt because of their nanoscopic dimensions. After graphitic coatings were conformally grown over the surfaces of Co nanopillars by CVD, the resulting carbon-coated Co nanostructures retained their morphology at elevated temperatures which would damage the uncoated structures. Similar thermal stabilization effect is also demonstrated for carbon-coated Ti nanopillars. The results of this study may be extended to other metallic and possibly even non-metallic nanostructures that need to preserve their morphology at elevated temperatures in a broad range of applications (P.M. Wilson *et al., ACS Appl. Mater. Interf. 7,* 2987, 2015).

Outlook

In addition to these three projects, my group also works on the development of highly selective graphene-based chemical sensors (Lipatov et al., Nanoscale 5, 5426, 2013; Lipatov et al., Appl. Phys. Lett. 104, 013114, 2014), electropolymerization of dielectrics on graphene for top-gated FETs (Lipatov et al., Chem. Mater. 27, 157, 2015) and other materials problems. Overall, my group at UNL has already published 16 papers in high-profile journals and 1 book chapter.

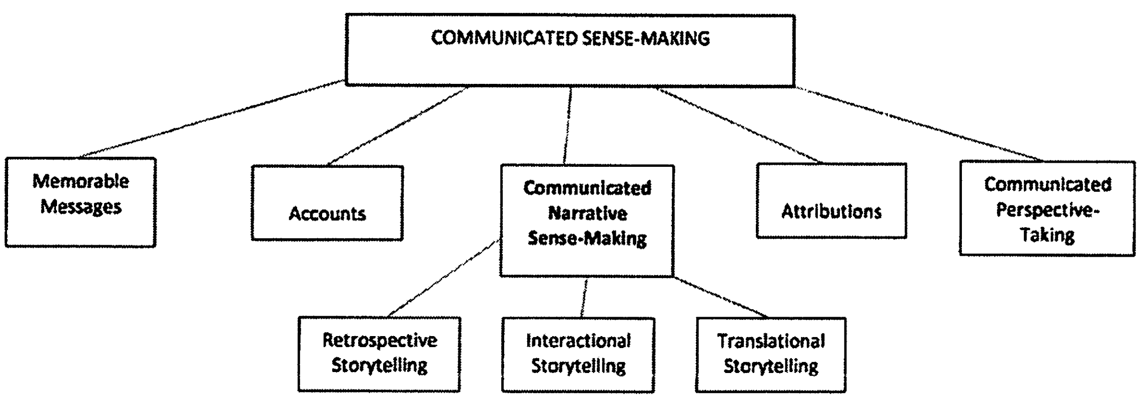
While we will continue working on the above projects, I hope that in the future the synthetic and device expertise that is being developed in my group will converge for solving even more difficult problems. The ultimate goal of this research is to demonstrate atomically precise functional electronic devices, such as, for example, single-GNR devices on "active" (possibly, ferroelectric) substrates. It may take several years to achieve this goal, but we will work hard to make it happen.

Research Focus, Philosophy, and Goals

My research is driven by a desire to understand the connection between the quality of communication and the quality of life. I have dedicated my career to examining the ways in which communication practices affect and reflect mental, physical, and relational health. Narratives and storytelling processes in the family are at the heart of my innovative interdisciplinary research on health and well-being. *The overarching purpose of my research program is to study the ways in which narratives, storytelling, and related forms of communicated sense-making can help individuals and families understand, negotiate, and improve communication and coping within the context of difficulty and illness.* I seek to implement interdisciplinary, narrative-based interventions to improve caregiving, communication, and psychosocial well-being for families and care providers.

The constructs pertinent to my program of research are detailed in my recent chapter in the *Sage Handbook of Family Communication* (Koenig Kellas & Kranstuber Horstman, 2015) and presented in Figure 1 below. As illustrated, Communicated Sense-Making – or the ways in which people communicate to make sense of their lives – provides the umbrella that captures my work on concepts typically conceptualized and studied as psychological constructs. Importantly, I focus on sense-making as a communicative, rather than wholly cognitive, process because much of our understanding emerges within and as a product of our everyday talk. Thus, my research agenda seeks to uncover the ways in which interpersonal and family communication, such as memorable messages, accounts, attributions, narratives, storytelling, and communicated perspective-taking are important to our well-being.

Figure 1. Theory and Model of CNSM (from Koenig Kellas & Kranstuber Horstman, 2015)



My research on these constructs informs theory and practice in areas such as parenting, healthcare provision, and the maintenance of relationships. For example, my research on **memorable messages** shows implications for how mothers' communication affects and reflects the ways daughters view romantic relationships in adulthood (Koenig Kellas, 2010), and how patients, family caregivers, and practitioners make sense of hope in the context of cancer and palliative care (Koenig Kellas, Castle et al., in progress). We have also identified links between what parents say about sex and adolescents' sexual risk-taking (Holman & Koenig Kellas, in press; in progress), highlighting the importance of memorable messages and stories in the process of family socialization.

I have also studied how people communicate to make sense with others outside their family by studying **accounting** practices. For example, my research on lesbian mothers' accounts in response to challenges to their family identity (Koenig Kellas & Suter, 2012) was published in *Communication Monographs* (5-year Impact Factor: 3.67, 2012 acceptance rate: 12%) and received the National Communication

Association (NCA) LGBTQA Monograph of the Year Award (see Appendix 2, Research Awards). From these results, we produced a brochure to inform others on the practices that our participants cited as (in)effective. Other CSM research focuses on **attributions** for family difficulty such as the often-contentious mother-in-law/daughter-in-law relationship (Rittenour & Koenig Kellas, 2015) and parents' and adult children's attributions for familial estrangement (Carr, Holman, Abetz, & Koenig Kellas, in press). These projects highlight the importance of **communicated perspective-taking**, another element central to my program of research that demonstrates the ways in which people communicate their understanding of others can have significant consequences for individual, marital, and family health (see Koenig Kellas et al., 2010; Koenig Kellas, 2005; Koenig Kellas, Carr, et al., under review; Trees & Koenig Kellas, 2009).

At the heart of communicated sense-making is storytelling, or what we have developed as a new theory of **communicated narrative sense-making** (CNSM) (Koenig Kellas & Kranstuber Horstman, 2015). The theory examines the content and process of storytelling in relation to health constructs (e.g., individual mental and physical health, relational satisfaction, coping) to showcase the many ways storytelling affects and reflects well-being. Because stories are central to teaching values, helping people construct identity, and making sense of/coping with difficulty, my goal is to examine the significance of storytelling in our lives and move toward interventions. This goal and the progression of my scholarship are reflected in CNSM's three foci. **Retrospective storytelling** refers to family storytelling individuals recall as important to socialization, meaning, and health. For example, I have examined the ways family stories socialize and impact the values and behaviors of adult stepchildren (Koenig Kellas, Baxter et al., 2014), adolescents (Holman & Koenig Kellas, in press), adult adoptees (Kranstuber & Koenig Kellas, 2011), and emerging adults (Thompson, Koenig Kellas et al., 2009). **Interactional storytelling** refers to the communicative processes that animate the sense-making of participants in joint storytelling episodes. This interactional sense-making (ISM) research shows links between the ways families collaborate to make sense and well-being (Koenig Kellas, 2005; Koenig Kellas et al., 2010; Trees & Koenig Kellas, 2009). Finally, **translational storytelling** refers to the ways narrative theorizing and research inform efforts to improve well-being as illustrated in my current work on narrative interventions in the context of cancer, palliative care and assisted living care (see Appendix 2, ACS and Enhance CAS Grant Proposals).

Achievements, Significance, and Impact

I have built a national reputation for research on narratives and storytelling in the family and am regarded as a leader in the discipline of communication on narrative scholarship as evidenced by the many chapters I have been invited to author in foundational communication handbooks, for example in *The Routledge Handbook of Family Communication* (Koenig Kellas & Trees, 2009), *The Sage Handbook of Family Communication* (Koenig Kellas & Kranstuber Horstman, 2015), *The Dark Side of Close Relationships II* (Koenig Kellas, Willer, & Kranstuber Horstman, 2010), and *Engaging Theories in Interpersonal Communication: Multiple Perspectives* (Koenig Kellas, 2008, 2015), to name a few. I was invited to edit a special issue of the *Journal of Family Communication* on family storytelling (2010) which, based on its impact, was published as an edited book (Koenig Kellas, 2013a) by Routledge with a revised introduction (Koenig Kellas, 2013b) and two additional articles/chapters. I have been invited to speak on my research in leading communication programs (e.g., University of Iowa, Arizona State University) and in the professional community (e.g., Bryan Health Bio-Ethics Conference), and have been spotlighted on panels of prominent narrative scholars at NCA (see Appendix 2, Research Presentations). My reputation in the field has also recently resulted in the invitation to apply for journal editorships, including the *Journal of Family Communication*, *Western Journal of Communication*, and *Communication Reports* (see Appendix 3, Editorships). Although I did not apply based on timing conflicts, I recently accepted the invitation to serve as an Associate Editor (responsible for the review process and editorial decisions) for the international, interdisciplinary *Journal of Social and Personal Relationships* (see Appendix 3). Finally, as detailed below, I have received three national awards and eight Top Paper or Top Four Paper awards (see Appendix 2, Research Awards). The following outlines the significance and impact of five noteworthy scholarly achievements.

1. Communicated Narrative Sense-Making (CNSM) Theory. The development of the CNSM theory (Koenig Kellas & Kranstuber Horstman, 2015) is an achievement that synthesizes my research and provides a heuristic and translational theory for future research. Unlike most extant interdisciplinary research on narrative, my research and CNSM is positioned primarily in the post-positivist paradigm, arguing for and examining quantitatively the empirical links between the content and process of narratives and storytelling and the psychosocial well-being of individuals and families. Because most research on narratives stems from a interpretive tradition, grounded in qualitative methods, this contribution is significant as it provides mechanisms to empirically test the theoretically supported but often overlooked links among storytelling and health. The translational storytelling heuristic in CNSM is particularly relevant to my current research, which brings together the humanistic practice of narrative medicine and empirically supported CNSM research to create interventions designed to improve the well-being of cancer patients, family caregivers, and health care providers. In an American Cancer Society grant application, I have proposed an intervention based on CNSM, narrative medicine, and narrative therapy designed to aid communicated perspective-taking and coping in the context of cancer and palliative care (see Appendix 2, Grant Proposals). This work also guides my latest project on the benefits of telling stories for the health of assisted living facility (ALF) residents. In a UNL *Enhance CAS* grant-funded study, I will be conducting an experiment this fall including self-report and physiological (i.e., cortisol and alpha amylase) data on the health effects of telling significant life stories (see Appendix 2). Both the ALF and cancer/palliative care studies, framed within the translational storytelling proposal of CNSM theory, represent the current and future trajectory of *Narrative Nebraska*—my research lab at UNL whose goal is to improve family lives through storytelling interventions and translation.

2. Interactional Sense-Making. I co-developed the Interactional Sense-Making (ISM) rating system for analyzing joint storytelling among families (Koenig Kellas & Trees, 2005) and empirically linked ISM with individual and relational health. Although narratives and storytelling have consistently been theorized to help people cope with difficulty, little research has identified the communication behaviors that facilitated interpersonal sense-making when close relational partners told stories to make sense of difficulty, stress, trauma, and illness. This was a critical gap because (a) people tell stories to and with others, making the communication process significant to understanding how people cope with stress, and (b) providing empirical evidence for effective communication behaviors can inform interventions. We identified four sets of behaviors—engagement, turn-taking, perspective-taking, and coherence—that facilitate sense-making among families telling stories about stress and difficulty and have empirically linked those behaviors with increases in family satisfaction and functioning, feelings of being supported in the family, and decreases in husbands' mental health symptoms and perceived stress. This rating system and body of research is recognized as foundational, leading research on family storytelling in the field of communication. Two papers from this body of research have won national awards, including the *Journal of Family Communication* 2010 Article of the Year Award (Koenig Kellas et al., 2010) and the NCA Family Communication Division 2010 Distinguished Article Award (Koenig Kellas, 2005) (see Appendix 2, Research Awards). Moreover, the ISM research is used in others' research within and outside the discipline. Two of the articles from this line of research are in the *Journal of Family Communication's* Top 10 (Koenig Kellas & Trees, 2006) and Top 20 (Koenig Kellas et al., 2010) most cited articles in the last three years.

3. ***Communicated Perspective-Taking.*** Over the last several years, I have conducted research to identify the behavioral properties and health benefits of Communicated Perspective-Taking (CPT). In my ISM research, I found consistently that perspective-taking emerged as the strongest ISM predictor of individual and family health. Based on this, I conducted a series of studies to understand the behavioral properties of CPT in joint storytelling interactions and beyond. To inform translational storytelling research, we needed to understand better the behaviors people identified when they witnessed the communication of perspective-taking. I conducted a study in which married couples jointly told a story of marital difficulty and identified the degree to which they felt their spouse attended to, understood, and confirmed their perspective and the behaviors that influenced their ratings. Those behaviors included agreement, attentiveness, relevant contribution, coordination, positive tone, and freedom in storytelling (Koenig Kellas et al., 2013). I have since developed a quantitative measure (Koenig Kellas, Kranstuber Horstman et al., 2014) and an observational rating system of CPT, empirically linking husbands' CPT with wives' marital satisfaction in conversations about conflict (Koenig Kellas, Carr et al., revision invited). These findings and CPT are foundational to the interventions I am in the process of developing and testing in healthcare contexts (see Appendix 2, Grant Proposals).

4. ***Training in and Application of Narrative Medicine.*** Over the last few years, I have expanded my work on family communication, narratives, and perspective-taking by adding a health communication and narrative medicine emphasis. Narrative medicine (www.narrativemedicine.org) involves an interdisciplinary orientation to health care that encourages the development of narrative competencies and the ability to attend to, absorb, and interpret patient stories through close reading, writing, and communication. Based on my work on CNSM, ISM, and CPT and my growing interest in narrative and health, I sought training in narrative medicine as a clinical and applied method for training medical practitioners, families, and patients to engage in empathy, understanding, and compassion (i.e., perspective-taking). I completed both the introductory (Fall 2011) and advanced (Spring 2012) workshops in New York at Columbia University's College of Physicians and Surgeons' Program in Narrative Medicine. This training has facilitated the integration of my research on family storytelling and CPT with narrative medicine principles and practices (as described in the section on current and future research below) (see Appendix 2, Interdisciplinary Research Development).

5. ***Extending the Expressive Writing Paradigm.*** Finally, I have published extensions to the Expressive Writing Paradigm (EWP: Frattarolli, 2006) by empirically supporting the health benefits of writing and telling stories *in and about interpersonal communication*. The EWP was pioneered by psychologist James Pennebaker. The general experimental design involves writing about a significant personal trauma in a timed exercise over the course of three days. Mental and physical health are measured in pre-tests, at the conclusion of each writing exercise, and in a post-study survey a month later. The findings overwhelmingly suggest that *writing about trauma* has sustained benefits on individual well-being. Based on the benefits of this process, the goal of developing communicative coping interventions, and our previous research, I extended the EWP to examine whether interpersonal *communication* (i.e., telling a friend the story of a difficulty using adapted EWP methods) would have health benefits similar to writing. Findings show decreases in negative affect and mental health symptoms thereby supporting the health benefits of *telling* stories of difficulty over time. Findings also showed, however, that without training, storytellers' perceptions of their friends' communication behaviors declined over time. This suggests the need to teach and model good listening, a focus of our current work that synthesizes CPT and narrative medicine. A second study involved individuals writing *about* interpersonal communication difficulty. Subjects were assigned to conditions directing them to write about conflict from their own or their romantic partners' perspective or to a control group. Findings demonstrate the benefits of writing about communication, particularly for those writing from the partners' perspective. Collectively, this

research extends the EWP by highlighting the benefits of EWP methods in and about interpersonal communication and provides evidence for the design of the interventions proposed in my current and future work. This research has been well-received: The study on friends' storytelling was published as the lead article in *Health Communication* (5-year Impact Factor: 1.686; Acceptance rate: 13%) (see Koenig Kellas, Kranstuber Horstman et al., 2014), and the study on CPT and relational conflict received a Top Four Paper Award from the Interpersonal Communication Division of NCA (to be presented in 2015) (see Koenig Kellas, Flood Grady, & Allen, 2015; Appendix 2, Research Awards).

Current and Future Research

In my current work, I have turned toward the translational and applied potential of narratives, shifting my focus toward health communication as it intersects with family communication in the context of healthcare. My research, teaching, and community outreach focus on cancer, palliative care, and end-of-life communication. I have established a working relationship with local palliative (Palliative Care Services of Nebraska), oncology (Southeast Nebraska Cancer Center; Bryan Health), and assisted living facilities (e.g., Tabitha) care providers to facilitate further development of this area of research (see Appendix 2, Research & Community Partnerships). I have also become active in the healthcare community. As the 2014 speaker at the Bryan Health Bio-Ethics conference, whose previous speakers are nationally and internationally known experts, I highlighted narrative approaches to health communication. In 2015, I facilitated three of NET Nebraska's (local PBS/NPR) community panel discussions with practitioners, survivors, and caregivers on "How to Talk to your Doctor" in line with NET's preview of the PBS documentary, *Cancer: The Emperor of All Maladies* (see Appendix 2, Research Presentations). I have established an interdisciplinary collaboration with Dr. Marlene Z. Cohen, Associate Dean for Research at the College of Nursing at the University of Nebraska Medical Center, whose extensive background in oncology and palliative care research complements my expertise on family communication and narratives (see Appendix 2, Research & Community Partnerships). We undertook an interview study on hope, communication, and relational challenges faced by family caregivers, patients, and medical providers in cancer and palliative care and have manuscripts in progress on the storied trajectories of hope and cancer (Koenig Kellas, Castle et al., in progress) and the complex variety of communication and relational challenges faced by different constituents (e.g., patients, caregivers, providers) in the context of cancer care (Koenig Kellas, Cohen et al., in progress). I am the PI on a grant application that Cohen and I submitted to the American Cancer Society on a narrative palliative care intervention that will be delivered in an oncology clinic. It recently received an "Excellent" score with strong encouragement to resubmit from the program officer (see proposal and reviews in Appendix 2, Grant Proposals). Once completed, this pilot intervention will position us for additional large scale funding (e.g., NIH). We have three projects planned for the assisted living facility study for which we plan to apply for funding (e.g., NIA) once our pilot project is complete. I am also collaborating with Maureen Keeley, Professor at Texas State University, on an invited book proposal for Columbia University Press' End of Life Care series.

My current research is innovative, fundable, and has implications for further narrative theorizing; patient, provider, and caregiver well-being; and disciplinary and interdisciplinary recognition. I am a founding member of UNL's interdisciplinary Translational Research Initiative, a faculty-led effort to build a center for translational research science at UNL (see Appendix 2, Interdisciplinary Research Development). Our team recently received a Big Idea Grant from the UNL Office of Research and Economic Development to study best practices in translational science for application at UNL (see Appendix 2, Grant Proposals). My goal is to build a translational research program in narratives and storytelling through *Narrative Nebraska* and continue to apply our findings to the experiences, significant needs, and quality of life of patients, survivors, family caregivers, and health care providers.