5.1

The four components of the haptic experience design process are browsing, sketching, refining, and sharing. Browsing refers to looking at existing designs in haptics or other domains. Haptic designers sometimes keep a personal collection of materials or items for inspiration. Browsing often helps designers come up with a wide range of ideas. The most important aspect of sketching is creating many rough ideas quickly. In visual interaction design, paper prototyping is commonly used for sketching. In haptics, sketching often is done with scrap materials that can be hand-actuated. Refining one or more haptic sketches into one polished sensation or interaction takes a lot of effort and requires hapticians to pay attention to the feel, timing, and semantics of the haptic sensation on its own as well as in relation to the other sensory modalities. Sharing the haptic sensations and interactions with users and other designers is an integral part of the design process that helps with selecting sketches and polishing them into a usable and enjoyable solution.

5.2

Surgical training: complementary, secondary, synchronized

haptics mainly plays a complementary role in this use case because it can provide information about the softness of the tissue, bones, and tumors which may be visually indiscernible. It also helps the users know about the amount of force they apply to the virtual tissue. Haptics is secondary modality as the task can still be completed only with visual information. To be useful, haptic feedback must be synchronized with visual information.

Entertainment for blind or low vision (BLV) users: Complementary, primary, synchronized

For BLV users, haptics and audio modalities provide complementary information. With haptic sensations, the user can know where they are in relation to the opponents and other objects and whether they are hitting an object. Information about the location of the user is not provided through the audio modality. Haptics is the primary modality for BLV users in this case, because playing such an interactive game without haptics will be impossible or very challenging. Finally, for a good user experience, haptics and audio output must be synchronized.

Emotion communication with a robotic companion: Reinforcing, primary, synchronized

The main form of haptic feedback in this example is breathing pattern of the haptic creature. Other forms of haptic sensations are the feel of the fuzzy fur on the robot. Both types of haptic signal are reinforcing since the breathing and fur can be seen and felt. Haptics is likely the primary modality of emotion communication and a past with haptic creature showed that holding the haptic creature on your lap can calm users down [ref] which probably would not happen by only watching haptic creature. The visual, haptic, or any auditory effects are synchronized by the design.

5.3

Surgical training: Model-based rendering is used most often where the geometrical model of anatomical structures and their stiffness is used to determine the force feedback using a simple or more sophisticated

spring and damper model. Data-driven haptic rendering can be very effective following a similar approach to rendering textures or rendering tool acceleration during real surgery as shown in Chapter 0. Pre-designed haptic effects can also be used for notifications, warnings, or guidance.

Entertainment for blind or low vision (BLV) users:

Model-based rendering is used most often where graphical models of the objects are used with physical models of springs and dampers to render various object properties. Pre-designed haptic effects (e.g., a celebratory haptic icon for scoring a goal) can be added for more excitement and better user experience.

Emotion communication with a robotic companion

The breathing pattern could be pre-designed and played back. One may use a data-driven approach by recording and modeling breathing pattern of cats and/or dogs and rendering it in real time based on the amount of movement or state of the robotic companion.

5.4

For ideas, you can browse proceedings of ACM UIST, ACM CHI, and IEEE World Haptics Conference. Note that a good design process involves all four stages of browsing or exploring existing designs, sketching a wide range of ideas, refining to one or a few ideas by sharing it with colleagues and users. The process should be iterative where you go back to browsing, sketching, and sharing as you refine your design.