

EN

**Taking diversity in research  
projects into account.**

*How to make it work*

**A Handbook for  
Researchers in Technology  
and Natural Sciences**

# ***Who should use this handbook?***

**This handbook is relevant to all those whose research**

- refers to humans or living matter,
- is intended for users who differ in a variety of aspects, such as gender, culture, education or age.

***The handbook provides key questions for your research.***

It illustrates how you can identify and integrate possible relevant aspects of diversity into your research project – for example by defining new variables, developing methods and incorporating them into your publications.

You will find concrete examples from various scientific disciplines and receive suggestions on how you can put together and support your team.

***Why is diversity relevant in research projects?***

If you consider diversity aspects in your research project, then new research and innovation potentials open up for you (Hewlett 2013, European Commission 2013, Schiebinger 2014, Page 2008, Schiebinger & Schraudner 2011). This is possible in all phases of a research project and can lead to new research questions, more inclusive and secure results or new funding options. More and more national and international funding schemes require the systematic integration of gender and diversity perspectives in research projects (e.g. HORIZON 2020).

If research and technical development respond in this way to new challenges and diverse requirements, developments with economic opportunities that are tailored to needs and target groups will emerge (Bath 2015).

***What is diversity?***

Diversity stands for the natural difference of all things and the conscious perception of differences and similarities. Some of these differences and similarities are congenital and difficult to change, e.g. gender, ethnic origin, sexual orientation, physical characteristics, age. Some differences are acquired, such as skills, knowledge, technical understanding. Other differences are context-dependent, such as mobility needs in the home or work environment, social and economic background, lifestyle, family care responsibilities, expectations of a technical product.

For details and further definitions on sexes, gender and intersectionality, see p. 36-37 at the end of this brochure.



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## Taking diversity in research projects into account.

### *How to make it work*

The handbook offers suggestions for all those whose research relates to people or living matter or is intended for target groups who differ in many aspects (such as education, age, ethnicity, gender, etc.). In six chapters, key questions are used to stimulate the identification and integration of possible diversity aspects in order to achieve more innovative research results — for example by defining new variables or developing methods and incorporating them into publications.







#### **The handbook invites readers to use it:**

There are free note fields and a poster as a working document to visualize ideas and to illustrate an own project. 18 concrete examples from technology and natural sciences are additionally available online. References to literature, explanations and definitions of terms complete the handbook. The handbook is bilingual (German/English).

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## In each area, *you will find:*

- **guiding questions** for your research project or your research team,
- free areas for your **notes**,
- **suggestions and examples** which are available online as additional information [[www.tugraz.at/go/diversitaet](http://www.tugraz.at/go/diversitaet)] and can also be downloaded directly via QR codes in accordance with the individual subject areas.

## In addition, *the brochure contains*

- **a poster** as a working document for your team, to visualise ideas and to illustrate your project,
- **definitions** and **further references** at the end of the brochure.

**An interactive online version has been made available for you at the TU Graz TeachCenter.** [<https://tc.tugraz.at/main/go/diversitaet-forschung>]

## Examples

You can use the QR codes and go links to find examples for the subject areas. These examples each contain:

- short general explanations for a block of questions,
- a concrete example from a technical or scientific discipline,
- related references.

**We will be happy to provide you with further information, respond to specific concerns and advise you in a personal conversation.**

## *Contacts at TU Graz:*

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Technology & Society Unit TU Graz



# 1 Focus



## What is the focus of your research project?

Your research findings may be relevant for many different groups of people.

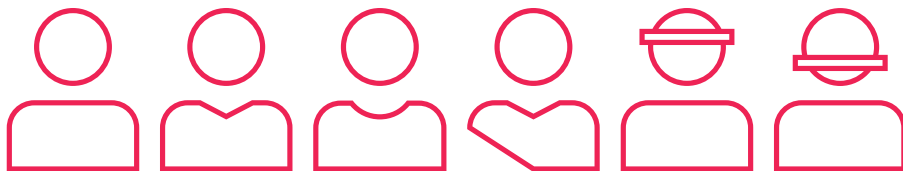
### Does your research relate to animals, tissue or cell material?

(For example, gender and age can already be taken into account for cells in order to gain new insights.)

### Does your research relate to people...?

- ...as subjects of research?
- ... as stakeholders, i.e. as individuals who are interested in your research or are affected by your research (e.g. in the development of technical equipment)?

**Example 1.1 Publications and reports:**  
Are your graphics readable for all target groups?



## Who will use and apply your research findings? Who is otherwise affected by your research?

- What do the groups of people have in common?
- Where do they differ?
- Which stakeholders should be considered and involved?

**Example 1.2 Software development:**  
Who does the service reach via the smartphone?

## What different needs do these groups of people have?

- Can the variable "gender" sufficiently explain the phenomenon that interests you?
- What other aspects could provide more precise insights into the previously defined different needs?

**Example 1.3 "Empathy Map" method:**  
How can groups of people be analysed?

Here you can find all the examples mentioned in this section online:  
[www.tugraz.at/go/hbf/focus](http://www.tugraz.at/go/hbf/focus)



## 2 Literature



### *What insights into diversity aspects can be gained from the relevant literature?*

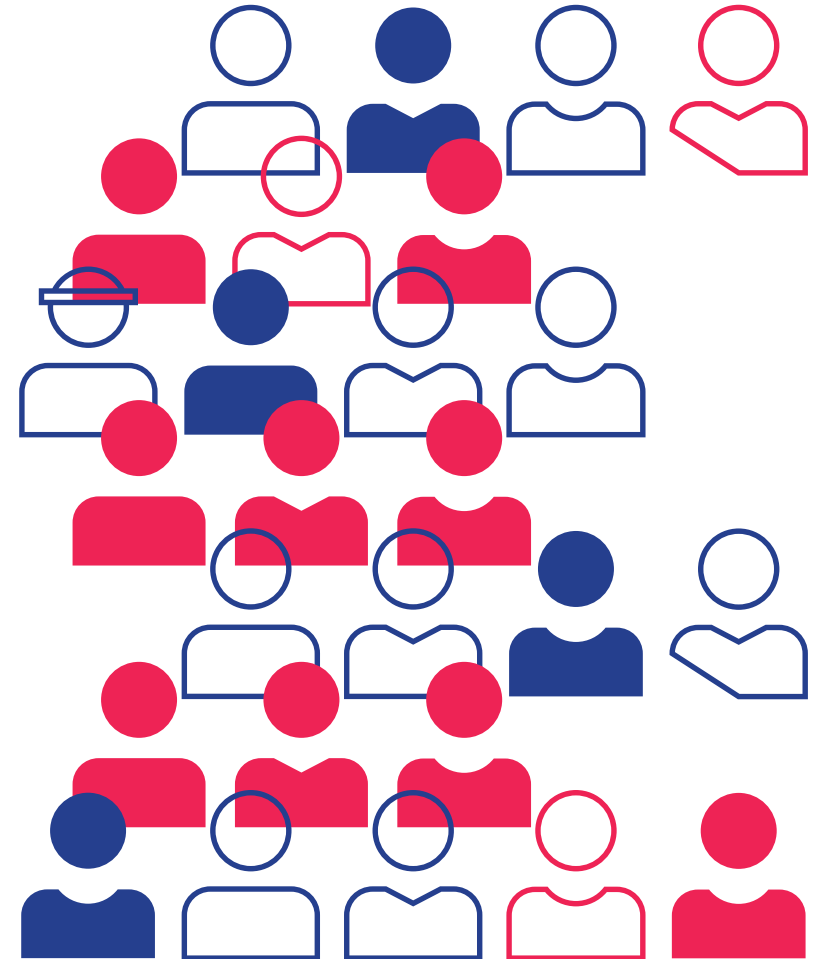
*Previous research may already have taken diversity aspects into account. A literature analysis also reveals gaps in existing research.*

### *Which aspects of diversity have been examined to date and with what results?*

- Which aspects of diversity have been examined to date and with what results?
- Which **variables** were used? How were they defined or operationalised?
- What information does the data provide? What are the **assumptions** underlying the interpretation?
- Were **correlations (intersections)** between different aspects of diversity addressed?
- Which terms or variables might be relevant?
- What was not considered, but could be of interest for your research?

#### **Example 2.1 Machine learning:**

What are relevant variables for face recognition?



### *Which methodologies can be found in the literature?*

- In which methodological steps are diversity aspects integrated and analysed?
- Which methodology would allow a better representation of the dimensions that interest you?

#### **Example 2.2 Machine learning:**

What is to be questioned in the "Word Embedding" method?

# 2 Literature



## *What are the most important research gaps?*

- Is there a research gap regarding the "gender" variable?
- If yes, then "gender" should be given priority in your research project.
- If not, you should focus on other aspects of diversity, but keep "gender" as an analysis category.
- What research gaps in terms of other aspects of diversity have been identified that might be relevant as intersectional variables?
- How do these gaps in research relate to the diversity aspects already identified?

## **Example 2.3 Automotive engineering:**

What has not yet been considered in the crash test?

*Here you can find all the examples mentioned in this section online:  
[www.tugraz.at/go/hbf/literature](http://www.tugraz.at/go/hbf/literature)*



Lined writing area with horizontal dashed lines and small blue arrowheads pointing right.

## *Avoid stereotypes*

**Differentiation according to gender is often helpful, but this is not always the case. Special attention is needed to avoid falling into the trap of stereotyping.**

- Software development, for example, has led to the gender swapping approach for personas (i.e. fictitious individuals with concrete characteristics or usage behaviour that symbolise groups of users): If the gender of a persona is swapped, gender aspects as well as stereotypes can be specifically uncovered and reflected upon (cf. Marsden 2014, Turner & Turner 2011).
- In the interest of user-oriented and usage-oriented vehicle development, the needs and requirements of everyday life should be taken into account. These are not necessarily gender-specific: an old man with problems getting in, a father of a family and a businessman can have completely different demands on a car. Mobility needs and requirements for transport systems and vehicles depend more on variables such as the following, than on gender (cf. Bath 2015):

- Age, height, weight
- Care responsibilities (e.g. for children, elderly, sick or disabled people)
- Need for accessibility and storage space (e.g. use of a wheelchair, pram, excessive luggage)
- Individual security needs
- Employment (full-time, part-time, working hours — e.g. shift work vs. office hours, nine to five vs. business hours)
- Place of residence; length of distances travelled

### Literature

Bath, Corinna (eds.) (2015).

Gender, Technik und Mobilität. Innovative, soziotechnische Lösungen für gesellschaftliche, wissenschaftliche und wirtschaftliche Herausforderungen. Technische Universität Braunschweig, Maria-Goeppert-Mayer-Professur für Gender, Technik und Mobilität. <https://www.tu-braunschweig.de/index.php?eID=dumpFile&t=f&f=84793&token=473da4057d98ba748f783350531a84c42bba3279>

Marsden, Nicola (2014).

Gender Uselt. HCI, usability and UX from a gender perspective. Guidelines for practice. [https://www.gender-wissen-informatik.de/content/download/199/file/Gender-UselT\\_20141105\\_final.pdf](https://www.gender-wissen-informatik.de/content/download/199/file/Gender-UselT_20141105_final.pdf)

Turner, Phil & Turner, Susan (2011).

Is stereotyping inevitable when designing with personas? Design Studies Vol. 32, Issue 1, January 2011:30–44. <https://doi.org/10.1016/j.destud.2010.06.002>

# 3 Concepts and models



## How are diversity aspects taken into account in different concepts and models?

A critical analysis shows whether a theoretical framework is suitable for your project or whether adjustments are necessary.

To what extent do the theoretical concepts and models that come into question for your research project take diversity aspects into account?

- Are diversity aspects **explicitly** part of the theoretical concept?
- Are the concepts or models possibly based on **implicit** assumptions regarding diversity and gender variables (e.g. stereotypes, generalisations, fictitious correlations)?

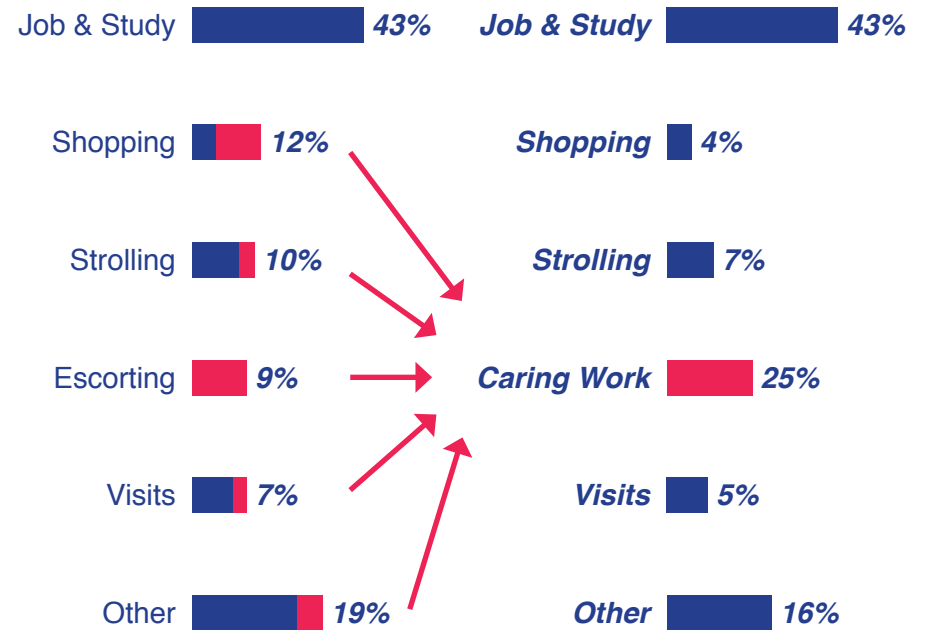
### Example 3.1 Statistics and mobility:

Which model takes the diversity of paths into account?

## Path purposes in mobility statistics – The "mobility of care" concept

### Traditional

### "Mobility of Care" – Care Work as a separate category



Graphic based on: Gendered Innovations – Public Transportation 2019:

<https://genderedinnovations.stanford.edu/case-studies/transportation.html#tabs-2>

# 3 Concepts and models



*In what contexts has the theoretical framework been developed and applied to date?*

- Which researchers apply the concept (gender/discipline/context)?
- Are the same definitions and terms used within the theoretical framework?

**Example 3.2 Gamification:**  
Who plays which video games?

*Is the corresponding theoretical framework suitable for integrating diversity aspects into your research, taking into account the guiding questions mentioned above?*

- If not, is it possible to adapt the theoretical concept so that it better meets your requirements?
- Which other theories and models could better meet your needs?

**Example 3.3 Building technology:**  
Is the simulation model suitable for determining energy efficiency?

A large area of horizontal dotted lines for taking notes, spanning the right side of the page.

*Here you can find all the examples mentioned in this section online:  
[www.tugraz.at/go/hbf/conceptandmodels](http://www.tugraz.at/go/hbf/conceptandmodels)*



## *I-METHODOLOGY*

**The term "I-Methodology" was coined in design and refers to the (unconscious) tendency of designers to develop products for users whose interests, abilities and needs resemble their own (cf. European Commission 2013).**

- Since the proportion of men among engineers and designers is high, this can lead to a "male standard", even if there is an attempt to design for everybody. For example, most video games are designed for boys and men, and in the field of artificial intelligence, early speech recognition systems recognised only male voices because the technology had been adapted accordingly (cf. Bath 2009).

- Own experiences, assumptions and values are the basis from which we try to understand others. There is a risk of a "fundamental design error", which, for example, may mean that the problems, needs and skills of people who are not familiar with technology are not sufficiently taken into account in technical development. A well-mixed research team (see also "Research Team", p. 24), awareness of diversity aspects and a fundamental willingness to reflect, and above all the involvement of the diverse users and affected parties can be very helpful in this context.

### Literature

Bath, Corinna (2009).

Searching for methodology: Feminist technology design in computer science. 9 p.

[http://www.informatik.uni-bremen.de/soteg/gict2009/proceedings/GICT2009\\_Bath-geloesch.pdf](http://www.informatik.uni-bremen.de/soteg/gict2009/proceedings/GICT2009_Bath-geloesch.pdf)

European Commission (2013).

Gendered Innovations. How Gender Analysis Contributes to Research. Report of the Expert Group

"Innovation through Gender" Report. [http://ec.europa.eu/research/science-society/document\\_library/](http://ec.europa.eu/research/science-society/document_library/pdf_06/gendered_innovations.pdf)

[pdf\\_06/gendered\\_innovations.pdf](http://ec.europa.eu/research/science-society/document_library/pdf_06/gendered_innovations.pdf)

# 4 Research design



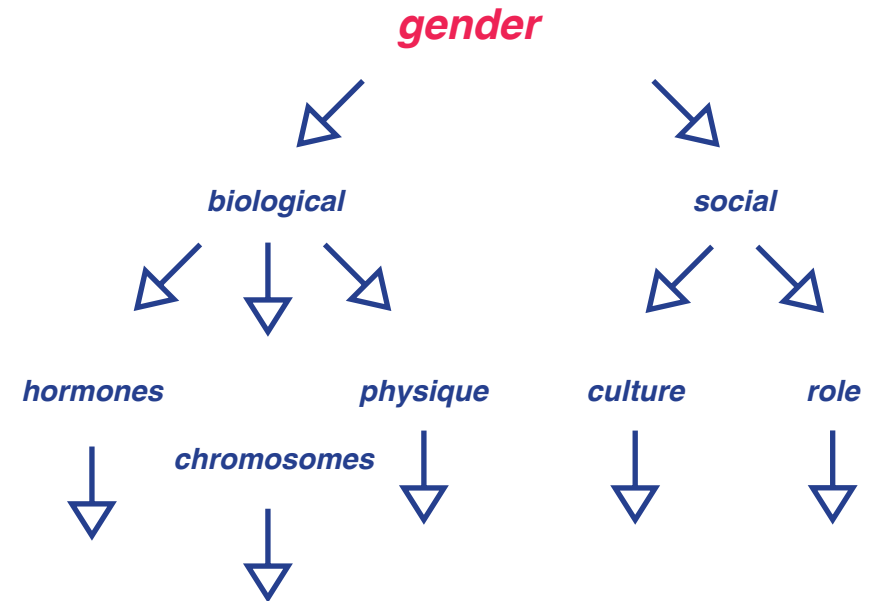
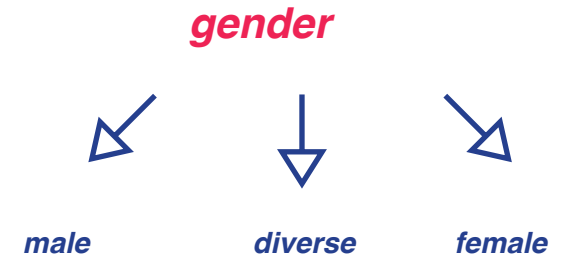
**Which research design delivers new, innovative findings?**

*A well-developed methodology allows you to identify all the relevant variables and to collect the necessary data.*

**How can you operationalise the diversity aspects that are of interest to you?**

- What variables do you use to examine diversity aspects?
- Do you focus on a specific group (e.g. gender, specific age cohort, specific usage context of a technology) or are you planning a comparative study?

**Example 4.1 Automated driving:**  
Research design as a result of discourse





# 4 Research design



## *Does the chosen methodology provide an adequate database for your research questions?*

- Are test plans, questionnaires, surveys, focus groups designed to take the potentially relevant aspects of diversity into account?
- Are the previously identified diversity variables and possible links to other variables taken into account in the data analysis?

### **■ Example 4.2 Assistance technologies:**

What database is required for the development of nursing robots?

## *Does the chosen methodology provide an adequate database for your research questions?*

- Are test plans, questionnaires, surveys, focus groups designed to take the potentially relevant aspects of diversity into account?
- Are the previously identified diversity variables and possible links to other variables taken into account in the data analysis?

### **■ Example 4.2 Assistance technologies:**

What database is required for the development of nursing robots?

## *How are the perspectives of the potential user groups integrated?*

- Does the research team reflect the diversity of the target groups or research subjects in such a way that their perspectives are taken into account?
- Do you intend to use participatory methods to involve those who will later use and apply your research results?

### **■ Example 4.3 Civil engineering:**

Civil engineering: Who are the water supply experts?

## *How should the study population be adapted to achieve the desired objectives?*

- What is known about the distribution of diversity characteristics in the overall population?
- Should the distribution of diversity characteristics in the sample correspond to the total population?

### **■ Example 4.4 Software development:**

Whose knowledge is decisive?

*Here you can find all the examples mentioned in this section online:*  
[www.tugraz.at/go/hbf/researchdesign](http://www.tugraz.at/go/hbf/researchdesign)



## *Usability tests and the participatory design approach*

**Usability tests and the participatory design approach are two methods for involving users in different phases of the research and development process (cf. Buchmüller, Bath & Henze 2018; Gendered Innovations – Participatory Research and Design 2019):**

- Usability tests tend to involve users in the final phase of a project and focus mainly on the technical infrastructure in order to identify functional/technical adaptation requirements, e.g. measurement of driving behaviour in driving simulators, followed by a structured inquiry of the test persons about their experiences and impressions in interaction with the system; tests of websites, software, technical devices.

- In a participatory design approach, the affected individuals and users are involved in the development process right from the start — from the definition of research objectives through the collection and evaluation of data to usability. This approach has been tested mainly in software development. For example, users are encouraged to become aware of their daily routines and behaviour, to think about their needs and requirements and to express them explicitly. They visualise ideas and develop solutions in discussions with researchers and technicians.

### Literature

Buchmüller, Sandra; Bath, Corinna; Henze, Roman (2018).

To whom does the driver's seat belong in the future? A case of negotiation between gender studies and automotive engineering. In Proceedings of 4th Gender&IT conference, Heilbronn, Germany (GenderIT'18). ACM, New York, NY, USA, 10 pages. Doi: 10.1145/3196839.3196866

Gendered Innovations – Participatory Research and Design (2019).

<http://genderedinnovations.stanford.edu/methods/participatory.html>

# 5 Results



## Is a different interpretation of the results conceivable?

A critical evaluation of your findings avoids distortions and explanations that can easily be questioned. It is also important for the purpose of planning the future use of your findings.

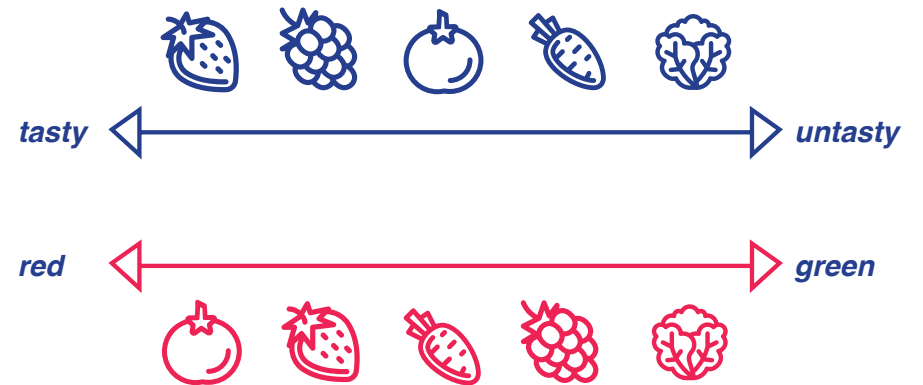
### What insights does your data provide?

- What are the **significant differences in diversity** and effects?
- Which differences and effects between different groups are **not significant**?
- Which hypotheses cannot be confirmed?
- What do the different investigated groups have in **common**?
- Which diversity characteristics that were **not investigated** could contribute to the interpretation of the results?

#### Example 5.1 Machine learning:

Which data sets were used to train algorithms?

Depending on the criteria you use (and the ones you don't), results might be different



Graphics inspired by: Randall Munroe (2019). xkcd –

A webcomic of romance, sarcasm, math, and language: <https://xkcd.com/388>

### What different conclusions are conceivable?

- To what extent do the obtained results and their applications have different implications for **specific groups** (e.g. women and men, age groups ...)?
- Which conclusions **regarding diversity and gender aspects** can be drawn **for further research projects**?

#### Example 5.2 Medical technology:

Are gender, weight or height relevant?

Here you can find all the examples mentioned in this section online:  
[www.tugraz.at/go/hbf/results](http://www.tugraz.at/go/hbf/results)



# 6 Research team



## What is the composition of the research team?

*In order to achieve excellent results, it is crucial to have team members with a variety of skills and competences. Working conditions and processes can contribute significantly to cooperation and foster excellent performance.*

### *Have you identified the expertise required to address the diversity aspects of your research project?*

- Do members of your team or partner organisations have the necessary expertise?
- If not, who could provide diversity and gender expertise (e.g. colleagues known through publications, recommended experts)? If you involve external expertise: How is knowledge transfer ensured in the project?

**Example 6.1 Speech recognition:**  
Does “gender swapping” lead to better results?

### *Does the composition of the team in terms of men and women correspond to the potential of your research area?*

- What reference values and benchmarks can you use to assess the potential in your research area?
- How can you specifically recruit women (or men) for your team?

**Example 6.2 Reference values:**  
What specialist potentials are there in different disciplines?

### *Which processes and structures promote individual motivation and sustainable results?*

- Are processes designed in such a way that everyone can contribute equally and learn from each other?
- How are decisions made?
- Are resources for individual career planning provided, regardless of gender, age, culture, etc.?

**Example 6.3 Mentoring:**  
Who gets what support?

*Here you can find all the examples mentioned in this section online:  
[www.tugraz.at/go/hbf/researchteam](http://www.tugraz.at/go/hbf/researchteam)*



Relevant analytical  
dimensions and definitions  
see also:

**Terms in relation to diversity**  
*at the TU Graz at TU4U:*

<b>Diversity</b>	36
<b>Biological sex</b>	37
<b>Gender (social gender)</b>	37
<b>Intersectionality</b>	38

*Also see*  
*terms in relation to diversity*  
*at the TU Graz at TU4U:*  
[tu4u.tugraz.at/go/vielfaltsbegriffe](https://tu4u.tugraz.at/go/vielfaltsbegriffe)



## **Diversity**

- **Diversity** stands on the one hand for variety and on the other for the conscious perception of differences and similarities. The most important factors here are a respectful attitude towards differences and a positive view of the potential that this diversity inherits. Taking into account different dimensions and characteristics, humans are the subject of research or users of the research results. Some of these characteristics are inherent (e.g. gender, ethnic origin, sexual orientation, physical characteristics, age), some are acquired (e.g. skills, knowledge, understanding of technology) and others are contextual (e.g. different mobility needs in the home or work environment, social and economic background, work and living environment, lifestyle, care responsibilities, requirements/expectations for a technical product). Categories based on these properties are referred to as **diversity dimensions** and can serve as a guide. The (relatively) unchangeable dimensions of age, disability, ethnicity, gender, religion or belief and sexual orientation are regarded as basic dimensions. These dimensions are also legally protected against discrimination in Austria (above all in the working world, and to some extent in other areas of life). Protection against discrimination in these dimensions is also anchored at European level. Categorisations, however, also entail the danger of forming exactly those prejudices one would wish to overcome by making attributions again on the basis of the dimensions or categories. Fixed categories will to a certain extent automatically hide other categories. It is important to justify the selection of diversity dimensions and to consider possible interactions and combinations (see also intersectionality).

## **Biological sex**

- The **biological sex** refers to biological characteristics and features (chromosomes, hormones, gonads, genitals) of a person. Concrete characteristics include sexual organs, chromosomes, hormones, shape and size of the breast, body hair, ability to give birth, fertility and body size. Individually different expressions of these characteristics are possible, whereby certain combinations of characteristics are categorised as "female" or "male". However, this is not always biologically "unambiguous" — there are people who have both male and female sex characteristics (intersexual people). Irrespective of these physical characteristics, a person's own feelings can also deviate from (social) classification (gender identity). In this context, the terms "third gender or third sex" are also used to express the diversity of gender identities. This makes the binary notion that there are only two sexes — and that each person can be assigned to exactly one of them — too simplistic. In research, gender can be a useful analytical and explanatory variable in many contexts. However, it should be noted that it may overlap with other biological diversity characteristics that have a higher explanatory significance (e.g. age, height or weight, hormone status).

## **Gender (social gender)**

- The term **gender (social gender)** refers to the socially established differences between the sexes. Societies, cultures and families associate a distinct appearance and specific competences, behaviours and attitudes with the biological gender of a person (gender roles or gender norms). These learned expectations and attributed roles lead to further differences in people's lives and opportunities, e.g. by influencing the perception of talent, career choice, income or experience and dealing with technology. Gender is therefore not a variable per se, but a combination of different, temporally changing aspects and social categories.

## ***Intersectionality***

- **Intersectionality** refers to the overlaps and interaction of two or more aspects of diversity in a person. It is often referred to as a combination of gender with social milieu, lifestyle, ethnicity, migration background, sexual orientation, nationality, age, religion, disability, etc. These overlaps contribute to specific experiences of discrimination or disadvantages for certain individuals, but also to privileges for others. For example, women with a migration background experience different forms of discrimination than men with a migration background. Older white men, on the other hand, are represented in positions of social and political power with particular frequency. From an intersectional perspective, therefore, individual dimensions of diversity do not stand side by side in isolation. Rather, they are interwoven, work simultaneously, influence each other depending on the context (e.g. reinforcing or weakening) and must also be examined accordingly. For example, differences between men and women in subgroups can be uncovered and results and needs of users can be explained.

## ***Which assumptions should be avoided?***

- **All women or all men are the same (e.g. in attitudes, preferences, needs, knowledge).**
- **Women and men are completely different.**
- **Observable differences between women and men are exclusively biologically determined.**
- **Observable differences between women and men are the same across different cultures or socio-economic realities.**

([genderedinnovations.stanford.edu/terms/sex.html](https://genderedinnovations.stanford.edu/terms/sex.html))

Ainsworth, Claire (2015).

Sex redefined; Nature News Feature. Nature 518:288–291; doi:10.1038/518288a.  
<http://www.nature.com/news/sex-redefined-1.16943>

Bath, Corinna (ed.) (2015).

Gender, Technik und Mobilität. Innovative, soziotechnische Lösungen für gesellschaftliche, wissenschaftliche und wirtschaftliche Herausforderungen. Technische Universität Braunschweig, Maria-Goeppert-Mayer-Professur für Gender, Technik und Mobilität. <https://www.tu-braunschweig.de/index.php?eID=dumpFile&t=f&f=84793&token=473da4057d98ba748f783350531a84c42bba3279>

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Toolkit Gender in EU-funded research. <https://op.europa.eu/en/publication-detail/-/publication/c17a4eba-49ab-40f1-bb7b-bb6faaf8dec8>

Europäische Kommission (2013).

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