Mybias: A web-based Tool to Overcome Designers' Biases in Heterogeneous Design Teams

MATTIOLI Francesca[*]; FERRARIS Silvia Deborah; FERRARO Venere; and RAMPINO Lucia Rosa Elena

Politecnico di Milano
* Corresponding author e-mail: francesca1.mattioli@mail.polimi.it
doi: 10.21606/drs.2018.445

Cross-cultural and interdisciplinary collaborations are increasing in all sectors, from companies to universities. As a consequence, design teams are becoming more and more heterogeneous; it thus becomes fundamental to improve teamwork for heterogeneous teams. Designer's interpretation ability is a fundamental skill, but it might be strictly connected to the designer's personal experience and can, therefore, be strongly biased. Are design students aware of this? If not, how can they be supported to manage diversity? In this paper, we first introduce our research that is aimed at better understanding the role of biases in the design process and in heterogeneous teams. We afterward present the development of a web-based tool designed to improve design teams' dynamics by making students more aware of their biases from the beginning of the design process. The results of the tool testing on 79 students of two different classes of a Design Studio Course are presented and discussed.

design tool, heterogeneous teams, biases, mutual understanding

1   Introduction

In today globalized and complex world, cross-cultural and interdisciplinary collaborations are increasing in companies, universities, and institutions. Design is also moving in this direction, both in the area of education and profession. Design teams are becoming increasingly heterogeneous; it thus becomes fundamental to inquire about how to improve teamwork for these teams.

Indeed, while common thought patterns and a better chance to understand each other exist amongst people sharing the same cultural background, heterogeneous groups of people are characterized by a high variety of viewpoints and, therefore, have complex dynamics that lead to major misunderstandings.

Being a group of design researchers of an international university, we teach in a multidisciplinary and multicultural environment and, therefore, have first-hand experiences of the effect of diversity

in teamwork. As educators, we observed that the high variety of different viewpoints that defines the profiles of our postgraduate students can impact their teamwork to a point that require support.

In this paper, we present the tool we are now developing and testing to overcome biases in heterogeneous teamwork. The first testing activity was carried out in a Master of Science course, where students come from all continents and from different fields of expertise.

We acknowledged that, when the team members share many cultural patterns, it is quite easy to accept some assumptions for granted. It is natural to think that "*everybody in the team knows what this means or what this is*", but it is quite inaccurate to assume that some ideas are universally understandable. However, this natural attitude becomes problematic when the team is highly heterogeneous because personal meanings can differ considerably among team members. If not well managed, this lack of understanding can be frustrating. On the other hand, it can also be an effective way to experience the subjectivity of interpretations. Indeed, each designer necessarily filters what she observes (context, user, interactions) through a personal point of view and most of the time, designers have their preconceptions about design objects. As a result, teams' heterogeneity can be considered either as positive or negative for the design process because from one side it leads to a varied range of ideas, but it also leads to many misunderstandings.

All these considerations brought us to the following question: how can we ask students to "*think outside the box*" if they do not know in which box they are thinking in? Each person's mind-set is built on personal biases and first-hand experiences.

We verified the need to effectively manage cultural differences during the design process to enhance teamwork. We observed that design students do not exactly know where the limit of their interpretation of reality lies until they are confronted with a completely different one. Designers' interpretation ability is a fundamental skill, but it might be strictly connected to the designer's personal experience and therefore strongly biased. Are the design students aware of this? If not, how can we support them?

In this paper we introduce our research regarding biases managing in design education. This research started in 2016 and led the team to develop a web-based tool to overcome designers' biases. The research output described in this paper refers to the making of a latest prototype, tested in the current academic years started September 2017 in two parallel design studio courses.

2 Literature review

While setting the basis of our research, we investigated three areas of interest, from the more general to the more specific, all strictly connected with the issue of managing a design team. Firstly, a general overview on decision-making will be presented. Then, teamwork practice in the design field will be briefly discussed. Finally, the issues related to biases in heterogeneous design teams are presented.

2.1 *Decision-making: is teamwork effective to overcome biases?*

To make good decisions has always been by far one of the most important goals of the organizations; human behaviours within the decision-making process are therefore a crucial topic in the field of teamwork science. Consequently, in the early days of this field, researchers tried to describe cognitive processes behind the individuals' ability to make choices (Larrick, 2016).

Heuristic processes, which could be defined as a shortcut to memory, are identified as the main drivers of individuals' decision-making (Kahneman, 2011). In other words, the human brain usually relies on memory when it comes to making decisions. Even though heuristic processes frequently work well in everyday life, they can however lead to wrong assumptions when decision-making concern unusual problems. Moreover, the lack of awareness of the heuristic processes leads to the tendency of people to ground decision on a biased set of evidence (Larrick, 2016), which are called cognitive biases. Cognitive biases are defined as "the deviation of rationality in judgment, whereby

situations may be represented in a subjective way" (Haselton, Nettle, & Murray, 2005). The extensive literature about cognitive biases in the fields of cognitive psychology and strategic management suggest that cognitive simplification and biases play a crucial role in strategic decision making.

The existence of cognitive biases explains the rising importance of teams in organizational management as well, because a group of people can have access to a higher variety of experiences and therefore to a wider range of data (Kahneman, 2011). In his review, Larrik (2016) suggests that the heterogeneous composition of the team improves the decisional process because of two principles. The first is that of error reduction, because the introduction of multiple viewpoints produces different errors that statistically balance each other. The second is the principle of knowledge aggregation; diverse people will bring up different knowledge which will allow a better understanding of a given decision (Larrick, 2016). For these reasons, in the recent decades teams have become the strategy of choice when organizations are confronted with complex and difficult tasks (Salas, Cooke, & Rosen, 2008). The team can be defined as a social entity in which two or more individuals socially interact (Kozlowski & Ilgen, 2016) and the decision-making can be defined as one of the main results of team's social processes (Larrick, 2016).

It is interesting to understand the socio-cognitive processes through which the team builds a shared conception of an issue. The shared cognition is built thanks to communication among team members and the crucial attitude to reach this goal is mutuality, which means that the team is in an environment where all members can potentially contribute and be listened to by others (Barron, 2000). In other words, each viewpoint brings value to the shared cognition building process. Hence this process is enhanced if all the members are willing to build a mutual understanding. Mutually shared cognition is developed when an agreement is reached around the co-constructed understandings (Van den Bossche, Gijselaers, Segers, & Kirschner, 2016).

In our research, it is assumed that processes to build mutual understanding and share cognition should be implemented from the very beginning of the team activities. This aspect is identified as a booster for teamwork efficiency because it leads to more respectful dynamics.

2.2 Teamwork and Design

Design can be described as a "social process of interaction and negotiation between different participants who each bring to bear their own 'object world'" (Cross, 2011). By using these words, Cross highlights the subjectivity of the design process which needs the participants' interaction and negotiation to succeed. Since design teams' dynamics are gathering a massive importance within design research, many socio-cognitive and behavioural processes related to design thinking have been analysed. Two of them raised our interest among the others: design-by-analogy and design fixations.

Design-by-analogy is highlighted as one of the most important processes that regulate designers' thinking. Designers tend to make analogies during idea generation, which means that they use their experiences to find solutions to actual issues. This process seems to improve creativity (Toh & Miller, 2015), but still there is a lack of understanding about how much those analogies are accessible in heterogeneous teams (Christensen & Ball, 2016).

The second fundamental aspect of designers' behaviour is design fixations.

> *Design fixation is a state in which someone engaged in a design task undertakes a restricted exploration of the design space due to an unconscious bias resulting from prior experiences, knowledge or assumptions. (Crilly & Cardoso, 2017, p. 6)*

Fixation is neither defined as something good or bad for the design process, but it seems to be unavoidable (Crilly & Cardoso, 2017). Moreover, it is described as an unconscious behaviour which is always present (Cardoso, Badke-Schaub, & Eris, 2016).

Both design fixations and design-by-analogy could be interpreted as the result of previous designer's experiences. These two socio-cognitive processes suggested us that the problem-solution framing within the design process could be highly influenced by self-constructed preconceptions. As much as cognitive biases are unavoidable factors in decision making, the pre-conceptual ideas, that we call in this research "biases", seem to be present and relevant in design teams' dynamics.

Indeed, according to Krippendorff (2005) the way designers understand the world is not different from the way in which other people are influenced by their subjectivity. Designers should develop the skill of understanding of others' understanding. We do advocate that this skill could be implemented first with co-workers, leading at the same time to the construction of the shared cognition and mutual understanding among team members. This practice could also improve an efficient communication in the team, which is highlighted as fundamental in design collective processes as well (Wardak, 2016).

However, the design teamwork research often focused on the observation of teams during the decision-making moments. Referring to the Double Diamond mapping of the design process made by the Design Council, decision-making mainly takes place in the convergent parts of the scheme (Design Council, 2007).

What is the role of divergent thinking in decision-making? This first stage of design thinking lays the basis for idea generation, because the designer is exposed to stimulus that later will possibly have a role in the analogical reasoning (Mougenot, Bouchard, Aoussat, & Westerman, 2008). Designer's subjective experience is a fundamental element during the discovery research (Mougenot, et al., 2008). We think that this leads to the unavoidable fact that designers' cognition acts like a filter during divergent thinking, while designer observes and tries to deeply understand the design issues. Divergent thinking is therefore necessary to shape the ground where decision-making takes place, it is thus a crucial phase for the team to build shared cognition because designers could have different perspectives and biases while observing users and contexts. It is therefore important for them to be aware about the subjectivity of their interpretations.

2.3   Heterogeneous design teams: the challenge for the future.

During the last decades, design studies moved from analysing the individuals to analysing homogeneous teams (D'souza, 2016). Recently, the interest is shifting on heterogeneous design teams, especially because interdisciplinary collaborations increased. Some principles to foster interdisciplinary teamwork could be summarised as (Maciver et al., 2016, p. 14-15):

- *Fostering appreciation and unifying activities*

- *Recognising, acknowledging and embracing difference in approach*

- *Challenging of assumptions*

- *Synthesising ideas via alternative forms of communication*

Indeed, the role of individual variation in background knowledge is vitally important for attaining a full understanding of the biases of team members, which influences the effectiveness of teamwork (Christensen & Ball, 2016). Consequently, research on knowledge-sharing in interdisciplinary teams has also arisen in the design field. The knowledge-sharing literature demonstrated that a potential for design teamwork exists in the exchange and integration of previously unshared domain knowledge (Christensen & Ball, 2016).

Nevertheless, Maciver et al. (2016) principles can also be effective in other kind of teams, for instance in cross-cultural and demographically diverse teams. Indeed, the internet and the globalization has transformed our world into an international marketplace. Even though teamwork science paid very little attention to culture in its early times (Zeynep & Gelfand, 2012), increasing globalization pushed the field to an era where culture research is becoming an emergent field of scholarly inquiry (Larrick, 2016; Salas, Cooke, & Rosen, 2008). Several design tools have been

developed to manage divergent thinking to understand users coming from different backgrounds and contexts (i.e. IDEO.org, 2015). Nevertheless, cross-cultural research in the design field seems to be quite exclusively related to designer-user interaction (i.e. Plocher, Rau, & Choong, 2012) and is rarely discussed during design teamwork itself.

Some authors underlined the importance of cross-cultural collaborations in designer's education (i.e. Hoyos, Scharoun, & Poplin, 2015; Peña, Conesa, Hassan, & Ballester, 2009). The interest in this topic is rising since academic studies are becoming increasingly international. However, from the team members' point of view, most research does not provide practical insights aimed at solving the issues related to cross-cultural design teamwork in education. In her article Audra Buck-Coleman (2010) presents a cross-cultural workshop organized with students of graphic design coming from different universities across the world. The identified need was to inform the students on how traits such as religion, socioeconomic class and other differences can impact visual messages (Buck-Coleman, 2010). Therefore, the workshop deliberately challenges students to evaluate their beliefs, recognize the limitations of their knowledge to understand how preconceptions manifest in their design work.

In our case study - an interdisciplinary master course attended by students from different Countries - it was difficult to define if the observed personal biases were caused by different disciplinary backgrounds or different cultures. Therefore, we defined heterogeneous team as one characterized by a wide range of different biases and by a lower initial shared cognition.

Moreover, since the design activity performed by the students' team were intended to mimic professional practice (with a brief issued by a company), we agreed on the theory that the reflective practice about biases their selves could solve the identified issue.

> *It is argued that reflective practice can help practitioners to understand their own experience and knowledge, in turn assisting them as their expertise develops over their careers [...]. Furthermore, in certain situations, effective reflective methods need to allow a person to reflect on the influence of others as well as themselves in the decision-making process. (Gribbin, Aftab, Young, & Park, 2016, p. 12).*

The repertory grid technique proposed by Gribbin et al. (2016) for designers is another example of a tool aimed at making design practitioners and student more aware of their tacit knowledge and biases, which is also our issue concerning heterogeneous teams. In particular, it is intended to uncover implicit personal constructs through building polar definitions of certain topics using exclusively words.

3   Designing a tool to share biases in heterogeneous teams

We decided to design a tool for designers aimed at reducing the negative effects of personal biases on teamwork dynamics. Since the wide variety of biases is the most important characteristic of heterogeneous teams, the tool should help designers to understand another designer's viewpoint from the very beginning of the design process.

The idea was to create a way to represent personal biases. Through this representation, designers should reach a greater awareness of their own biases and, at the same time, they have a chance to understand the mental models of their teammates. In this way, the tool can actively improve mutual understanding in design teams by sharing personal biases about the design object.

Before developing the tool, we searched for already existing ones. We acknowledged that most of the tools for teamwork are designed for the convergent phases, while the tools for the divergent phases are mainly related to designer-user interaction (i.e. IDEO.org, 2015). This lack of tools aimed at improving designer-designer's interaction during the inspiration phase reflects the attitude, already observed in literature, to allocate the shared cognition building process after the divergent phase. We furthermore reviewed some interesting research related to this issue. Most of this research gave us useful insights, but they referred to *ad hoc* workshop activities (i.e. Buck-Coleman,

2010). Other research presented interesting tools related to the reflective practice, for instance the already mentioned repertory grid technique (Gribbin et al., 2016). Nevertheless, this technique, which completely relies on words contraposition, also appeared inappropriate; indeed, since designers frequently communicate by using images, we believed that the tool should have been based on diverse communication modes.

This aspect of the tool and its other expected characteristics are presented and justified. Beside the communication modes, we also supposed that a web-based tool would have been the best solution to represent personal biases and to train students to reflective practice. However, we found a lack of web-based design tools for designers aimed at building mutual understanding regarding designer's tacit knowledge (Bernal, Haymaker e Eastman 2015).

To sum up, none of the tools we found seemed to fit our goal. Since our specific case-studies were two Design Studio Courses based on learning-by-doing, we needed an applied tool for the students to manage such diversity. We therefore looked for a repeatable activity, easy and fast, to be proposed to the teams at the beginning of the Design Studio project teamwork. The tool should be aimed at improving team dynamics by making students more aware of their biases from the beginning of the design process.

3.1   Fundamental characteristics of the tool

As anticipated, we defined some fundamental characteristics for the tool based on some assumptions deduced by our observation of the students and from the literature review. We will briefly introduce them because the characteristics definition was a fundamental step for the definition of the design tool.

3.1.1   Light cognitive load

According to cognitive psychology, we can define the cognitive load as the total amount of mental effort being used to accomplish a certain task. The tool aimed at recreating an everyday interaction which did not represent a heavy cognitive load. We wanted students to be relaxed while doing the activity, because we expected that an unstressed atmosphere among participants would have fostered the mutual understanding building process.

Also, observing the interaction between students in heterogeneous teams, we noticed that when they want to express an idea, they first try to use the English language. If they do not know some words, they take out their laptops or mobile phones and look for translations. They also rely on gestures to empathize what they are saying. To reinforce their references, they usually look for images on the Internet or they pick some stored images on their devices and social networks. This technology-based and internet-based interaction appeared to be faster and more effective.

The core of meaning-making process within design collaborations relies on the correlations between words, images and gestures (Wardak, 2016). We therefore assumed that all those communication modes should have been present in the tool, because they are necessary during the meaning-making process and because they ensure a right cognitive load.

3.1.2   Communication using images

Images are a powerful design communication mode and they are intensively used during the whole design thinking process. We hence supposed that participants should necessarily use some pictures to describe their biases.

Mougenot at al. (2008) observed designers during images selection of the discovery phase and they found that web browsing allows a wider range of inspirational pictures and consequently a greater range of outputs. Then they observed how refining keywords is crucial to find the correct images, especially when designers want to express abstract or feeling-related concepts. For example, to represent "Competition" a participant looked for Footwear first, then Footwear + Sport, then Footwear + Sport + Design (Mougenot et al., 2008). They finally observed that "today computational

tools could allow more effective control, such that individual differences in information gathering strategy can be more effectively pursued" (Mougenot et al., 2008).

We consequently thought that the picture selection of the tool should have been internet-based to guarantee the widest range of images. Participants should be free to refine their research keywords until they find the right pictures. Therefore, an internet-based activity also ensured a high flexibility of sources, which is needed to show a wide range of subjective ideas.

3.1.3 Communication using a common language
The use of words is also important and the correlation between pictures and words is another sense-making factor. Keywords and storytelling are fundamental to make the images-words correlation explicit. Storytelling is very important because it leads to building deep connections between participants and talks and gestures are a fundamental step to building shared understanding (Wardak, 2016).

The course we refer to is in English, which is identified as the international business language (Harvard Business School Publishing, 2017) and the international academic language (Jenkins, 2014). Many other international organizations and companies tend to assume English as the language chosen for cross-cultural collaborations. This usually happens even if no one in the team is an English native speaker.

Language is a critical issue in heterogeneous collaborations since the team communicates using a certain language with different proficiency levels. This implies that each person will have different skills in expressing and sharing subjective ideas. Moreover, according to each different mother tongue, the translation could be easier or harder. Indeed, it is fundamental to consider the notion of linguistic distance, which refers to the relative difference between two languages. According to the models of the origins of languages, 'language trees', to explain the historical relations between 'families' or 'groups' of languages being structurally relatively similar, the structural closeness of languages can significantly vary (Lauring & Selmer, 2010). Regardless of individual fluency, it is thus more difficult to express a concept for people with a higher linguistic distance from English.

The tool should indeed be designed for multiple users who can be either non-native speakers or native speakers. Since the objective is to build mutual understanding, it is important to give the team members time to think about words to use and to let them explain *"what they mean with those words"*.

3.1.4 Standard format
We agreed on the need for a standard format which implies a defined quantity of information that must be used to describe the bias. The standard format has some important consequences on the activity. Firstly, everybody knows the format which leads to better understanding of others during the sharing phase.

Moreover, everybody has the same space to express subjective ideas. Indeed, personal attitudes can influence team dynamics and these attitudes can vary according to individuals' characters. We should guarantee equality among all the team member's biases and, of course, among team fellows.

Finally, the selection process reveals differences and common points. To select the most relevant aspect to describe an idea is a great exercise to show how differently people can create connections. This tool's feature is the one that contributes the most to understand the subjectivity of thought.

4 Mybias: a web-based tool to share designers' biases.

4.1 Aim
The aim was to create an effective bias sharing tool. Indeed, we believe that during their academic path, design students should develop positive behaviour during teamwork, especially when they face a high variety of biases. These include:

1. To be aware that own personal interpretation is biased
2. To respect the team fellows' viewpoints
3. To understand the team fellows' viewpoints

Thus, the tool enables to share personal viewpoints in a safe environment. This is a key step in heterogeneous teams to build mutual understanding because it leads to acceptance and respect of differences.

Mybias is a web-based activity for design teams where users can represent their biases about any topic using a standard format representation that is called bias card (see Figure 1). The web environment, specifically a web application, can be executed by any browser. Indeed, the only requirements for the Mybias activity are to have one device per team member (PC, laptop, tablet, mobile phone) and an internet connection.

Figure 1. two examples of bias cards, made by two participants during the preliminary test of the tool.

4.2 Process
Mybias activity is divided into two main parts: the individual part and the collective one.

4.2.1 Definition of topics
Before starting the activity, the team should decide the words that are more significant to discuss to create a shared knowledge. Within the activity those words are called topics.

4.2.2 Phase 1: individual task, the making of the bias cards
When the team knows the topic, the individual phase starts: the participants are asked to individually represent their biases about the topic by describing it using:

- Three pictures
- Text up to 140 characters

This personal brief description is the bias card (see Figure 1). To do this task, no requirements, restraints or rules are given. The participants are free to fill in the card as they please. Though a lecture was given to explain the tool purpose and application, and some examples were shown, as alter explained in paragraph 5. After this process, the team has one bias card made by each member about each decided topic.

4.2.3 Phase 2: team task, storytelling and sharing of understanding
In the collective phase, each participant explains her representation to the teammates, talking in English. The description should include subjective experiences that led the bias's representation process. The rest of the team should ask questions to better understand the presented bias.

This step is crucial to build mutual understanding. The asking-answering process is necessary to comprehend the viewpoint of the others and where it comes from (i.e. cultural biases, previous experiences, different backgrounds). Additionally, it is fundamental to understand the meaning behind the words and the pictures selected by the others.

4.3 Output

At the end of the activity, the team has a set of bias cards but, above all, has a shared understanding on what each discussed topic means to each group member. These outputs are very context-related, which means that they are valid to that team in the moment in which the activity took place. The cards can become part of the research material of the team and they can possibly be useful for following parts of the design process (i.e. brainstorming, idea generation). Nevertheless, these implications are not discussed in this paper.

5   Testing the tool

Between March and May 2017, a prototype of Mybias was designed and preliminary tested during two short workshops involving 6 postgraduate students. The qualitative analysis of the preliminary test showed the potential of Mybias. Moreover, all the participants of the preliminary tests gave us positive feedback on the tool. However, we only simulated the design teamwork within these short design workshop and we therefore needed to test the tool. Yet, the prototype required extra testing on a wider audience, therefore, a second testing was conducted with 79 students of two classes of the first year Design Studio of the Master course coming from different study paths and parts of the world (see figure 2).

The aim of the Design Studio is to develop an innovative design product from the conceptual to the engineering phase. Students work in heterogeneous teams of three to four students. This semester, the specific design brief was "*to design an innovative anti-theft mechanical device*".
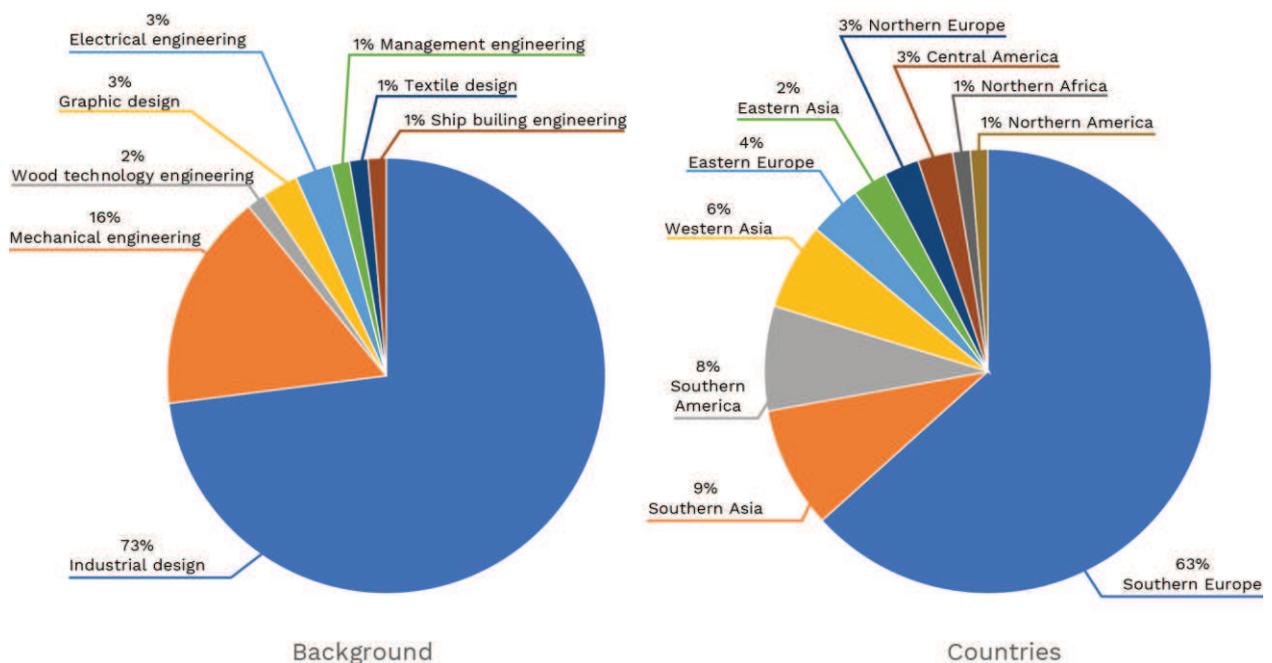

Figure 2. charts of the students' backgrounds and native countries.

Firstly, the students filled the initial questionnaire that was aimed at understanding the inclination of students towards teamwork, design teamwork and heterogeneous teams. Then, during a brief lecture, we explained how to use Mybias and we provided two topics, strictly related to the design brief: "*means of transportation*" and "*anti-theft*". The lecture aims were to clarify the practical use of the web tool and to guide the students before the bias cards making process. We therefore showed the tool, we provided various examples of several bias cards and we commented them. As a general rule, we explained that the bias card should be the representation of their genuine thoughts about the given topics. We prompted them to select the three images that would have first popped up in their minds while thinking of the topic. Regarding the text, the students were asked to give their personal definition of the topic at hand, according to their personal way of framing it.

The participants, divided in 21 groups of 3 or 4 students, did the activity autonomously off-class during the following week. To evaluate the impact of the tool, the students were asked to deliver a brief report of the use of the tool, particularly about the storytelling, and to fill a final questionnaire.

6   Results

The answers to the initial questionnaire were necessary to understand that most of the students perceived teamwork as very important in the design process, even if some of them do not really like it. Most of them also considered heterogeneous teamwork as an added value for the outcome, because of the wide range of point of views. Nevertheless, some of them highlighted that heterogeneity is often a barrier for mutual understanding during teamwork.
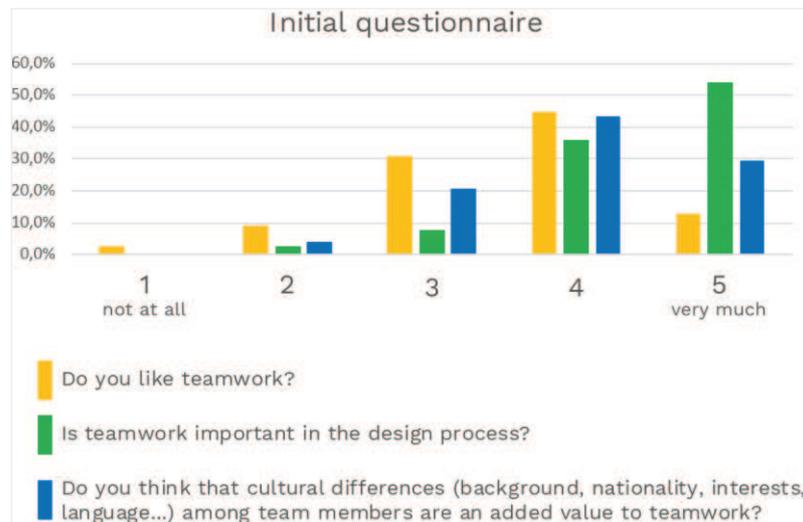

Figure 3. the chart shows the percentage of answers to the initial questionnaire answers. The students also justified the third answer (the blue one in the chart) by inputting a short text.

After using the tool, participants gave some important qualitative feedbacks about the use of Mybias in their reports. Firstly, several teams wrote that the use of Mybias stimulated students to build a shared knowledge

> *"All in all, the second topic (means of transportation) triggered more curiosity about the cultural backgrounds and, overall, the group discussed about their own experiences"*
> *(Class 1, Group 6)*

The students understood that, even though analogies in the definition of topics exist, the differences are always present, and they are fundamental to understand the world in its complexity.

> *"To sum up we can say that we have perceived this topic through different shades."*
> *(Class 1, Group 1)*

Mybias was also useful for them to acknowledge the importance of building a shared cognition within the team and therefore we expect them in the future to be promoters of this key process for teambuilding.

> *"With Mybias we could compare the different point of view, we understood the different thoughts of each member of the group and we also learned that a collective knowledge is more useful than a personal opinion." (Class 1, Group 7)*

Moreover, Mybias triggered some students' reflections about the language issue, which was also identified as one of the issues related to heterogeneous design teams.

"None of the group members' mother tongue is English, so there is a language barrier while communicating. Spending more time is important for the group to be sure that everyone is on the same page" (Class 2, Group 8)

Surprisingly, Mybias was triggering some interesting reflections about biases also in less heterogeneous teams.

"All the team members have a pretty similar cultural background: all of us come from the same Country indeed. This aspect came out during the talk among us; most of thoughts and outcomes happened to be really close to each other. This means that most of the pictures and biases were almost the same. [...]. After the activity, we understood that what we take for granted in our everyday routine might be perceived as unusual by someone else. It means it is quite essential, to work successfully in a team, to listen to the opinion and to the feelings of every member. What sounds weird can be therefore accepted and, eventually, it can enrich the outcome of teamwork"
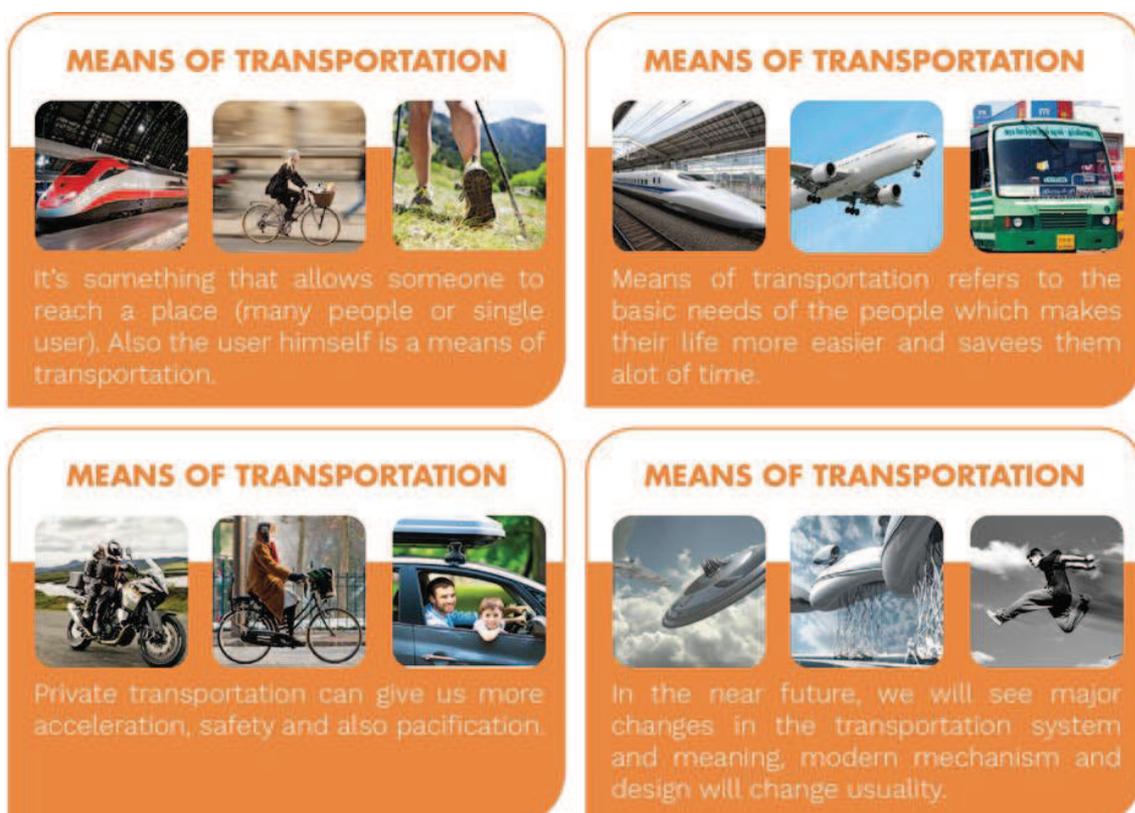
(Class 2, Group 2)

Figure 4. four examples of bias cards made by four different students with Mybias during the test.

From the final questionnaire answers the students confirmed that they personally found analogies and differences among their cards (see figure 5) and only few of them wrote that their cards were "not at all" or "very much" different from their team fellows 'one. We interpreted this data as a positive result because it means that the team members can build connections (analogies), but at the same time they experience a certain level of differences which stimulate the process of building a shared cognition. From their individual feedbacks we can infer that Mybias was useful for them to build mutual understanding among team fellows.
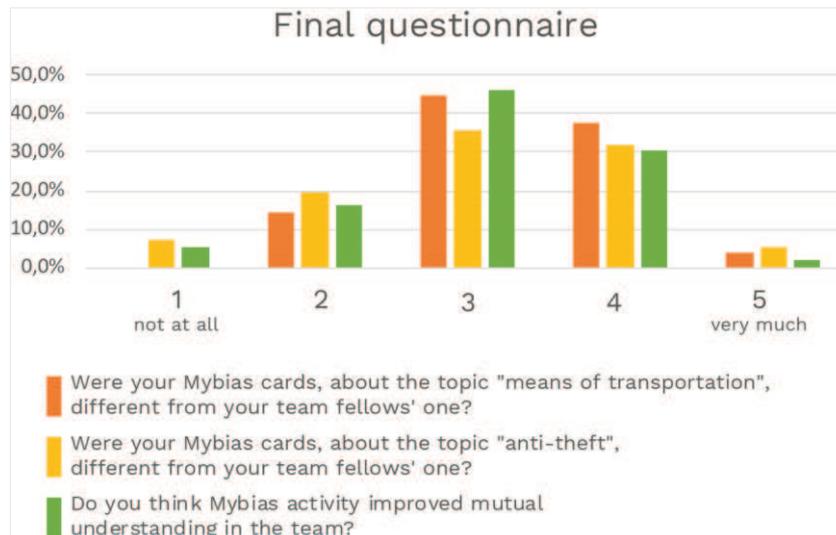
Figure 5. the chart shows the percentage of answers to the final questionnaire answers. The students also justified the third answer (the green one in the chart) by inputting a short text.

7   Discussion

The test revealed the potential of the tool. To share biases was a useful exercise for the majority of the participants. The observations confirmed that Mybias is useful tool to create a safe positive space for people to build connections and mutual understanding. The students' feedbacks highlighted how Mybias was effective to firstly acknowledge the differences among team member's viewpoints. The collective phase of the activity, which was divided into the storytelling and the discussion about different or similar definitions of each topic, was fundamental to understanding others. The results of their discussions can be summarized into some recurrent team attitudes:

- Agreement on some analogies in definitions
- Initial incomprehension of differences, followed by inquiry and collective redefinition
- Interest to make further research about some insights (analogies or differences)

The first two aspects observed are the symptoms of the shared-cognition building. It was interesting to observe that they were present also in less heterogeneous teams (i.e. Class 2, Group 2). Therefore, we suppose that Mybias could be an effective tool to inform students about the subjectivity of their interpretations. It is also highly positive that Mybias triggered curiosity in certain situations because it fosters deeper understanding of others, possibly leading to higher empathy and cohesion in the team.

Concerning the third aspect, it could add value to start the divergent thinking because Mybias can act as a divergence booster. However, it should be investigated whether these interesting insights could have some latent negative effects, for instance if they determine strong fixations for the team. The fact that the tool is web-based proved to be effective, because it let students work together when and where it was most convenient for them.

8   Conclusion and Further Development

The paper has sought to clarify the role of biases in the design process, with special attention given to their impact on heterogeneous teams' dynamics. The acknowledgement of some issues related to this context led us to the identification of the need to manage biases in the design thinking process. In this paper we presented the development and evaluation of a bias sharing tool, which enhance designers' reflective practice in relation to bias managing in heterogeneous teams. The tool is identified as a trigger to stimulate the building of mutual understanding among team members, especially in educational design Studios.

One of the main limits of this research is that during the described test, the topics were selected by us, but we do believe this degree of freedom might have an impact on the use of the tool.

Future research should examine the effects of the tool on the following phases of the design process, to understand its influences on the overall designing experience. Even though the use of the tool is positive for teamwork dynamics, future studies should clarify which is the effect of Mybias on creativity and idea generation. Indeed, the way a higher mutual understanding in heterogeneous teams affects the creative outcomes should be contextualised in the wider academic debate on creativity. Indeed, the authors believe it is necessary to verify the role of the tool in the design process, as regards for the creative aspects. Our actual ongoing testing is aimed at investigating this aspect. We are also exploring the use of Mybias by testing the tool on students coming from different fields of expertise (e.g. management and economics). Indeed, the tool could be used in other fields in which teamwork takes place, since biases and low mutual understanding are common features of the majority of heterogeneous team. These tests are now under investigation. Additionally, we should investigate the possible role of Mybias in professional design practice, to clarify the potential of bias-sharing practice for practitioners and companies. Data collected from a broader testing of the tool could provide novel insights on different ways used by people to individually and collectively conceptualise.

9 References

Barron, Brigid. 2000. "Achieving Coordination in Collaborative Problem-Solving Groups." *The Journal of the Learning Sciences* (9): pp. 403-436.

Bernal, M., J. R. Haymaker, and C. Eastman. 2015. "On the role of computational support for designers in action." *Design Studies 41* 163-182.

Buck-Coleman, Audra. 2010. "Navigating cross-cultures, curriculum and confrontation: Addressing ethics and stereotypes in design education." *Visible Language* 44.2: pp. 187-206.

Cardoso, Carlos, Petra Badke-Schaub, and Ozgur Eris. 2016. "Inflection moments in design discourse: How questions drive problem framing during idea generation." *Design Studies* Vol 46 (C): pp. 59-77.

Christensen, Bo T., and Linden J. Ball. 2016. "Creative analogy use in a heterogeneous design team: The pervasive role of background domain knowledge." *Design Studies* (46): 38-58.

Crilly, Nathan, and Carlos Cardoso. 2017. "Where next for research on fixation, inspiration and creativity in design?" *Design Studies* Vol. 50 (C): pp. 1-38.

Cross, Nigel. 2011. *Design Thinking: Understanding How Designers Think and Work.* Oxford: Berg Publishers.

Design Council. 2007. "Eleven lessons: managing design in eleven global companies." London.

D'souza, Newton. 2016. "Investigating design thinking of a complex multidisciplinary design team in a new media context: Introduction." *Design Studies* (46): 1-5.

Gribbin, J., M. Aftab, R. Young, and S. Park. 2016. "Double-loop Reflective Practice as an Approach to Understanding Knowledge and Experience." *Proceedings of DRS 2016, Design Research Society 50th Anniversary Conference.* Brighton, UK.

Harvard Business School Publishing. 2017. *Global Business Speaks English.* https://hbr.org/2012/05/global-business-speaks-english.

Haselton, Martie G, Daniel Nettle, and Damian R. Murray. 2005. "The evolution of cognitive bias." *The handbook of evolutionary psychology* (Wiley) pp. 724–746.

Hoyos, Carlos Montana, Lisa Scharoun, and Justine Poplin. 2015. "The Importance of cross-cultural learning in the design disciplines: a case study reviewing a series of short term study tours designed to support cross-cultural exchange in the Asia-Pacific region." *International Journal of Arts & Sciences*, pp. 435-442.

IDEO.org. 2015. *The Field Guide to Human-Centered Design.*

Jenkins, Jennifer. 2014. *English as a lingua franca in the international university: The politics of academic English language policy.* Routledge.

Kahneman, Daniel. 2011. *Thinking, Fast and Slow.* New York: Macmillan.

Kozlowski, Steve W.J., and Daniel R. Ilgen. 2016. "Enhancing the Effectiveness of Work Groups and Teams." *Psychological Science in the Public Interest* Vol 7 (Issue 3): pp. 77 - 124.

Krippendorff, K. 2005. *The semantic turn: A new foundation for design.* CRC Press.

Larrick, Richard P. 2016. "The Social Context of Decisions." *Annual Review of Organizational Psychology and Organizational Behavior* (3): 441-467. doi:10.1146/annurev-orgpsych-041015-062445.

Lauring, Jakob, and Jan Selmer. 2010. "Multicultural organizations: Common language and group cohesiveness." *International journal of cross cultural management* 10(3): pp. 267-284.

Maciver, F, J. Malinsa, J. Kantorovitch, and J. Liapis. 2016. "United We Stand: A critique of the design thinking approach in interdisciplinary innovation." *Proceedings of DRS 2016, Design Research Society 50th Anniversary Conference.* Brighton, UK, 27–30 June 2016.

Mougenot, Céline, Carole Bouchard, Ameziane Aoussat, and Steve Westerman. 2008. "Inspiration, images and design: an investigation of designers' information gathering strategies." *J. Design Research* Vol. 7 (No. 4): pp.331–351.

Peña, Manuel Fernández , Divina Gracia Conesa, Houcine Hassan, and Enrique Ballester. 2009. "Multidisciplinary and International Projects." *EAEEIE Annual Conference.* pp. 1-4.

Plocher, Tom, Pei-Luen Patrick Rau, and Yee-Yin Choong. 2012. "Cross-Cultural Design." In *Handbook of Human Factors and Ergonomics*, by Gavriel Salvendy, 162-187. John Wiley & Sons, Inc.

Salas, Eduardo, Nancy J. Cooke, and Michael A. Rosen. 2008. "On Teams, Teamwork, and Team Performance: Discoveries and Developments." *Human Factors* Vol. 50 (Issue 3): pp. 540 - 547. doi:10.1518/001872008X288457.

Toh, Christine A., and Scarlett R. Miller. 2015. "How engineering teams select design concepts: A view through the lens of creativity." *Design Studies* (No. C): pp. 111-138.

Van den Bossche, Piet, Wim H. Gijselaers, Mien Segers, and Paul A. Kirschner. 2016. "Social and Cognitive Factors Driving Teamwork in Collaborative Learning Environments." *Small Group Research* Vol 37 (Issue 5): pp. 490 - 521.

Wardak, Dewa. 2016. "Gestures orchestrating the multimodal development of ideas in educational design team meetings." *Design Studies* Vol 47 (No. C): pp. 1-22.

Zeynep, Aycan, and Michele J. Gelfand. 2012. "Cross-Cultural Organizational Psychology." *The Oxford Handbook of Organizational Psychology*, July. doi:10.1093/oxfordhb/9780199928286.013.0033.

About the Authors:

Francesca Mattioli, MSc, is a research collaborator at Politecnico di Milano, Department of Design. Her main research interest is about how to improve collaboration among design team members. She designed Mybias and she presented it during several workshops.

Silvia D. Ferraris, PhD, is Assistant Professor at Politecnico di Milano, Department of Design and School of Design. Her research interests focus on product design innovation, with emphasis on tools and methods for new products development, from research to concept, integrating Basic Design principles. She develops new tools for transferring knowledge of visual perception to product design practice.

Venere Ferraro, PhD, Assistant Professor at Politecnico di Milano, Department of Design. Her research interest is identified according to two areas: user-centered design and interaction design. Member of the Experience and Interaction Design Research Lab, she participated at several International and National researches also as Coordinator.

Lucia R. E. Rampino, PhD, Associate Professor at Politecnico di Milano, Department of Design. Her core field of research is product design, with a focus on theories of design and the nature of design processes, in particular as they pertain to product innovation.