From Big Bang to Big Gap?
Potential Links Between Agency-Communion Orientation and Perception of Creativity in Computer Science*

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A R T I C L E   I N F O

A B S T R A C T

This study provides preliminary data on the dynamic role of participants' agency-communion orientation in their perception of fictional students' agency, communion and creativity, depending on descriptions of stereotypical and unstereotypical traits and behaviours. I propose that a stereotypically masculine description (i.e. more agentic) will boost the male's - but not the female's - perceived creativity. Polish students majoring in computer science (N = 108) read short stories about male and female interns at an IT company. Participants assessed the interns' agency, communion and creativity. The results demonstrated that the image of the agentic man as well as the participants' agentic-orientation are significant predictors of a male's perceived creativity. The findings are discussed in terms of the gender-based nature of the agency-communion concept.

In 2015 CBS aired the ninth season of the popular American comedy television series "The Big Bang Theory" in which STEM scientists are presented as socially awkward guys and gender stereotypes are strongly emphasized. In the same year the LEGO company announced its *Ada Lovelace & Charles Babbage set* to celebrate Ada Lovelace's 200th birthday. The set comprises the Analytical Engine, a Charles minifigure and two Adas (one as a student, the other as a female scientist). The designer of this set dedicated it to his father, "who started his career off as a mechanical engineer. He bought our first family computer, a Commodore VIC-20, in 1981 and nurtured my love for technology every day thereafter." At the LEGO ideas project website, we can read that the set "(…) hopefully will inspire a whole new generation of computer programmers."

The past few decades have seen a burgeoning interest of the male-dominated computer science field in the social, educational and cultural context (Kwaśnik & Karwowski, 2015).

However, despite numerous new ideas intended to scrutinize the "boy's clubhouse" phenomenon (Margolis & Fisher, 2002) and educational projects focused on promoting positive role models, there is still a deep and wide gap. This provokes one into posing the recurring question: Why are there so few women in computer science? There is a wide body of research explaining the origins of women's underrepresentation in the computing-related field focused mainly on the role of computer self-efficacy (Bush, 1995; Cassidy & Eachus, 2002; Saleem, Beaudry, & Croteau, 2011), stereotypes related to gender and computer science (Cheryan, Plaut, Davies, & Steele, 2009; Cheryan, Master, & Meltzoff, 2015) and computer anxiety (Chua, Chen, & Wong, 1999; Whitley, 1997). These explanations, however, are frequently concerned with the masculinity versus femininity dimension and rarely refer to the gender-linked agency-communion orientation and perception of creativity. Recent studies, though, provide convincing evidence indicating that perceived creativity is associated with stereotypically masculine-related (agentic) traits rather than with stereotypically feminine-related (communal) attributes (Proudfoot, Kay, & Koval, 2015). Moreover, regardless of the identical outcome of their work (creative output) men were assessed as more creative than women.

Based on these results and assumptions that computer science is a domain specifically related to creativity (Saunders & Thagard, 2005) and is influenced by gender-related beliefs and stereotypes (Cheryan, Plaut, Handron, & Hudson, 2013), this study examines whether the agency-communion orientation underlines and predicts social perception of creativity in a male-dominated field, i.e., among computer science students. In this article, I briefly present links between the gender-related agency-communion orientation and perception of creativity. Later, I describe the social context of the defined relation in the domain of computer science. Finally, I demonstrate results from a partially exploratory pilot study that examined three hypotheses regarding relationships between perceived agency-communion and perceived creativity (hypothesis 1 and 2) and expected links between social orientation and creative mindset (hypothesis 3).

BIG TWO AND BIG GAP - RELATIONSHIPS BETWEEN THE AGENCY-COMMUNION AND THE MASCULINITY-FEMININITY DIMENSIONS

In the social cognition paradigm, researchers have emphasized the role of agency and communality as two fundamental dimensions of the social perception of oneself and others (Abele & Wojciszke, 2014; Bakan, 1966; Helgeson, 1994; Wojciszke, 2005). The agency-communion orientation is often defined and presented in terms of various psychological constructs, e.g., individualistic versus collectivistic, masculine versus feminine (Abele, 2003), competence versus warmth (Fiske, Cuddy, & Glick, 2006), task-oriented versus relation-oriented, the independent versus interdependent self (Markus

& Kitayama, 1991) or intellectually good-bad versus socially good-bad (Rosenberg & Sedlak, 1972). Wojciszke and Abele (2007) point out, that people also perceived agentic traits as masculine, competent, individualistic and considering self-directed behaviour. Instead, communality is seen as feminine, moral, collectivistic and reflecting concern for others. There are plenty of studies, rooted in this "Big Two" concept, specifically reporting relationships between social orientations and the masculinity-femininity dimension (e.g., Abele, 2003; Eagly & Steffen, 1984; Wojciszke & Abele, 2007; Abele & Wojciszke, 2014). Additionally, results from two meta-analyses have demonstrated several interesting effects regarding the agency-communion dimension as a gender-related concept. Firstly, communion has remained higher among women, unlike agency, which has systematically increased over time (for both sexes) and the "agentic gap" between men and women is getting smaller (Twenge, 1997). Secondly, women differ in their agency, in particular in assertiveness related to agency, due to their status and roles (Twenge, 2001). It has been demonstrated that when women and men hold supervisory roles, they assess themselves in terms of agentic, dominant behaviours; conversely, in supervisee roles they provide descriptions suggesting submissiveness (Moskowitz, Suh, & Desaulniers, 1994). In turn, communal self-description depends not on roles, but on the participants' sex.

The dynamic nature of agency-communion was also examined in the context of career success (Abele, 2003). In line with predictions, a reciprocal relationship between social orientation and the of role enactment was observed, however only for agency content. As expected, agency boosts career success and career success improves agency. However, there was no reciprocal impact for communion orientation. Strikingly, discussion of these results in relation to potential domain-specific achievements and career choices shines a new light on the relationships described.

THE BIG TWO IN A BIG BANG WORLD - POTENTIAL LINKS BETWEEN AGENCY-COMMUNION AND PERCEPTION OF CREATIVITY IN COMPUTER SCIENCE

Furthermore, it should come as no surprise that researchers are applying the agency-communion dimension as a gender-related concept to test hypotheses regarding female gender stereotypes, in STEM fields in particular (Diekman, Brown, Johnston, & Clark, 2010). As recent work shows, people tend to perceive men and scientists as being highly agentic, while women as being highly communal, passive, and, in consequence, less akin to scientists than men (Carli, Alawa, Lee, Zhao, & Kim, 2016). Moreover, comparison of interclass correlations has revealed that all academic fields besides psychology were generally seen as masculine. These results, discussed in terms of role-congruity (e.g. Eagly & Diekman, 2005; Diekman & Goodfriend, 2006) and lack-of-fit theory (Heilman, 1983), can be thought-provoking and empirically useful for understanding how social ori-

entation might predict perception of creativity, particularly in male-dominated fields and for high-status occupational roles.

If computer science is related to creativity (Saunders & Thagard, 2005) and computer scientists as well as programmers or computer engineers are defined as creative occupations - or, to be more specific - if they represent the so-called Super-Creative Core of the creative class (Florida, 2002), then we can expect that agency-communion will predict the perceived creative potential in this male-dominated, domain-specific context. However, to consider the pattern of potential relations, several crucial findings regarding perception of creativity need to be addressed.

First, people vary in the perception of creativity and their implicit theories of creativity. For instance, different beliefs regarding creativity are strongly domain-specific. Tang, Baer and Kaufman (2013) compared implicit theories about computer scientists held by students of psychology and computer science in the United States and China. Cultural and domain-specific differences were observed: computer science students rated creative computer scientists more likely to be "smart/effective" than students of psychology. Moreover, Chinese participants described "creative thinking" as more crucial for creativity in computer science than did American participants. The authors explain, that cultural values might impact the perception of occupations in terms of the most prototypically creative. One's perception of creativity might also have a strong impact on judging one's own creativity. Previous studies (Kaufman, Pumaccahua, & Holt, 2013) demonstrated that self-assessments of creative potential differ by major. For instance, STEM majors (science, technology, engineering, mathematics) rated themselves less creative than did art and literature majors even if they did not obtain lower scores in creativity tasks. To sum up, domain-specificity may greatly determine perception and self-assessment of creativity.

Second, despite the lack of gender differences in average creative abilities (Baer & Kaufman, 2008) and a higher variability in certain aspects of creative ability among both males (originality, uniqueness) and females (adaptiveness) (Karwowski, Jankowska, Gralewski, Wiśniewska, & Lebuda, 2016), gender-based conceptions still shape the perception of one's own and others' creative potential (Gralewski & Karwowski, 2013; Karwowski, Lebuda, Wiśniewska, & Gralewski, 2013; Karwowski, Gralewski, & Szumski, 2015). The gender-specific aspect of students' perception of creativity was revealed in a study conducted among teachers (Gralewski & Karwowski, 2016): if teachers defined a creative student in terms of incremental, adaptive characteristics, they assessed female students' creativity more accurately. On the other hand, perceiving a creative student as an innovator resulted in more accurate assessments of males' creativity. These findings demonstrate that teachers' perception of creativity is matched to the adaptor-

innovator continuum with its specific gender-related characteristics. The perceived stereotypically female profile of creative work matched the characteristics of the adaptor, while the perception of male creativity is more related to radical creativity and innovativeness (Bianco, Harris, Garrison-Wade, & Leech, 2011; Gilson & Madjar, 2011). Thus, these results confirm that schematic gender roles may relate to the structure of implicit teachers' theories of creativity and differences in perception of their students' potential. All these findings suggest the presence of some relationship between the dimension of masculinity-femininity, agency-communion and gender-based judgments of people's traits and behaviours. Recently, in a series of studies (Proudfoot, Kay, & Koval, 2015) it has been demonstrated, that a male's perceived creativity is boosted by stereotypically masculine behaviour; however, when a female's behaviour is more agentic, it doesn't bolster her perceived creativity. All in all, people have stereotypical expectations about the various propensities of males and females and how they should enact certain forms of agency. Moreover, these expectations play a crucial role in forming judgments about their creativity. Based on the theoretical approach presented above and the results of studies, I predict:

Hypothesis 1: Stereotypical masculine description (more agentic) will boost men's but not women's perceived creativity.

Hypothesis 2: Agency and perceived agency are predictors of perceived creativity.

The exploratory question tested in this study is related to the potential role of the creative mindset. Karwowski (2014) defined the creative mindset as "beliefs about the stable versus-malleable character and the nature of creativity" (p. 62). The first study, testing the interplay between the creative mindset and the individualism-collectivism dimension among Polish and German students, confirmed the predicted hypotheses (Tang, Werner, & Karwowski, 2016). In general, it has been demonstrated that individualism is positively associated with a fixed mindset, and collectivism is related to a growth mindset. Moreover, studies demonstrated that individualism strongly correlated with masculinity ($r = .60$), while collectivism is positively related to femininity ($r = .35$) (Abele & Wojciszke, 2014). Thus, I predict that people with higher agency will perceive creativity as more stable and people higher on the community dimension will perceive creativity in terms of its growth nature.

Hypothesis 3: Communion will be positively related to the growth creative mindset and agency will be positively related to the fixed creative mindset.

The Present Study

The purpose of the present study was to test three hypotheses about the role of the gender-based agency-communion orientation in the perception of creativity in male-dominated fields associated with creativity. For Hypothesis 1, I tested whether gender-

related agentic and communal descriptions of fictional characters determine males' and females' perceived creativity. For Hypothesis 2, I examined whether participants' agency and perceived agency predict males' and females' perceived creativity. For Hypothesis 3, relationships between dimensions of agency-communion and creative mindset were tested.

METHOD

Participants and procedure. One hundred and eight Polish students (15 women) who were computer science majors aged between 20 and 43 ($M = 25.24$, $SD = 11.11$) participated in this study. Participants first read two short stories about computer science students interning at an IT company during their summer break. The stories were presented randomly and included the students' characteristics indicating their sex (a woman named Ania; a man named Kuba), their agency-communion orientation (agentic, communal) and creativity. Descriptions were presented in pairs in random order. Thus, there were four conditions (groups) in this study: (1) agentic woman versus communal man, (2) communal woman versus agentic man, (3) agentic woman versus agentic man, (4) communal woman versus communal man. What is worth underscoring, is that descriptions concerning their creative potential were similar and described each person in terms of high problem-solving skills, their unique ability to "think different" and their mastery of programming skills. The students' descriptions of agency-communality were based on items selected from the Polish version of Agency and Communion Orientation Questionnaire (Wojciszke & Szlendak, 2010). After each description, participants rated how agentic, communal and creative they found the described student on a scale ranging from 1 = strongly disagree to 5 = strongly agree. Participants also indicated which student they would choose (forced choice) in four types of situations related to agency-communion and creativity. Finally, participants completed the Creative Mindset Scale and the Agency and Communion Orientation Questionnaire.

Measures

The creative mindset. To assess participants' beliefs about the nature of creativity, the Creative Mindset Scale (CMS; Karwowski, 2014) was used. CMS is composed of 10 items, five of which measure the growth creative mindset, $\alpha = .47$ (e.g.," It doesn't matter what creativity level one reveals - you can always increase it") and five measure the fixed creative mindset, $\alpha = .81$ (e.g., "Some people are creative, others aren't - and no practice can change it"). Previous studies (Karwowski, 2014) reported a stable factor structure and appropriate properties of the CMS. A five-point Likert scale ranging from 1 = definitely not to 5 = definitely yes was used.

Agentic and Communal Orientations Questionnaire. To assess social orientation, the Polish version of the agentic and communal orientation questionnaire (Wojciszke

& Szlendak, 2010) was used. This self-assessment scale consists of 15 agentic (e.g., active, determined, efficient) and 15 communal (e.g., helpful, tolerant, trustworthy) trait names. This questionnaire presents a two-factorial structure, with high reliability of each subscale: agency (α = .89) and communion (α = .92). A seven-point Likert scale ranging from 1 = definitely not to 7 = definitely yes was used.

Choice task: perceived agency and communality in context of creativity. The participants' task was to choose (forced choice) one of the two fictional students in each of four categories: (1) related to the agentic orientation and creativity context (i.e. who would they like to invite to make a speech to students about creative problem-solving in computer science), (2) related to the communion orientation in creativity context (i.e. who would you like to go to an escape room with), (3) related to agency (i.e. who would you like to invite to a unique workshop for programmers if you won a voucher) and (4) related to communion (i.e. who would you like to share a desk in the office with). Participants could only choose one described person for each situation.

Perceived agency and communion. Participants were asked to evaluate the described students on a five-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree. Six items consisted of two scales (a) agency (α = .61): self-confident, competent, ambitious, (b) communion (α = .89): forgiving, understanding others, sensitive to others.

Perceived creativity. Participants were asked to rate the presented persons' creativity on a five-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree. Three items formed this scale (α = .84): can think and perform in creative way, has creative abilities, is creative.

RESULTS

Relationships between participants' agency - communion and fixed - growth creative mindset. Significant differences between participants' agency versus communion, and fixed versus growth creative mindset were observed. Students assessed themselves as more communal (M = 5.16, SD = 0.94) than agentic (M = 4.8, SD = 0.92), $t(104)$ = -3.59, p = .001, d = .39. Moreover, they obtained significantly higher scores for growth creative mindset (M = 3.86, SD = 0.63) than for fixed creative mindset (M = 2.56, SD = 0.90), $t(107)$ = -10.30, p < .001, d = 1.67.

To test hypothesis 3, a correlation analysis was conducted. Participants' agency orientation was negatively related to fixed-type creative mindset (r = -.25), and the same pattern was observed for the relationship between communion and the fixed creative mindset (r = -.25). Communion was positively correlated with the growth creative mindset (r = .26; see Table 1).

Table 1

Intercorrelation Between Participants' Agency-Communion Orientation and Fixed and Growth Creative Mindset

Variable	*N* = 108		1	2	3	4
	M	*SD*				
1 Agency	4.8	0.92	-	0.41**	-0.25**	0.12
2 Communion	5.17	0.94		-	-0.25**	0.26**
3 Fixed Creative Mindset	2.56	0.90			-	-0.45**
4 Growth Creative Mindset	3.86	0.63				-

Note. $*p < .05$, $**p < .01$. $***p < .001$

To test hypothesis 1, I conducted a 4 (condition: agentic woman and communal man, agentic man and communal woman, agentic man and agentic woman, communal man and communal woman) by 2 (gender: male, female) mixed measures ANOVA with repeated measures on the last factor. Analyses were conducted separately for perceived agency, community and creativity.

Males' and females' perceived agency. Analysis examining ratings of perceived agency revealed a main effect of condition, $F(3,104) = 11.83$, $p < .001$, $\eta^2 = .26$, and a significant interaction effect $F(3,104) = 13.12$, $p < .001$, $\eta^2 = .27$. In unstereotypical (agentic woman, communal man) and stereotypical (agentic man, communal woman) conditions, ratings of males' and females' perceived agency resembled characteristics presented in the story. Between-group comparison demonstrated that the woman was perceived as more agentic in condition 3 (agentic woman, agentic man) than in condition 1 (agentic woman, communion man), $p = .002$, condition 2 (communion woman and agentic man), $p = .04$ and condition 4 (communion woman, communion man), $p < .001$. Similar analysis conducted for males demonstrated that participants perceived the man as more agentic when he was characterized as agentic (condition 2 and condition 3) than when he was described as communal (condition 1, $p < .001$, condition 4, $p < .001$).

Males' and females' perceived communion. For ratings of communion a similar pattern was observed. A main effect of the condition, $F(3,104) = 79.46$, $p < .001$, $\eta^2 = .70$, and a significant interaction effect, $F(3,104) = 154.49$, $p < .001$, $\eta^2 = .82$ was obtained. Participants perceived the man as more communal than the woman in condition 1, when he was described in terms of communal traits, $p < .001$. Similarly, the woman was perceived as more other-oriented than the man when she was characterized as commu-

nal (condition 2), Moreover, between-group comparisons showed significant differences in the woman's perceived communality. Participants perceived the female described in terms of communal characteristics (in condition 2) as more communal than the woman in condition 1, *p* < .001 and 3, *p* < .001. The same pattern of results was obtained for differences between group 4 and 1 and 3. Similar differences were observed for the male's perceived communality. When the male computer science student was described as communal (condition 1 and 4), he was perceived as more other-oriented, relative to groups in which he was described as agentic (condition 1 and 3).

Males' and females' perceived creativity. Although the obtained results for the perception of agency and communion were expected and may be considered a manipulation check, the ratings of males' and females' creativity play a crucial role for hypotheses 1 and 2. Contrary to expectations, however, no main effect for the condition, $F(3,104) = 1.32$, $p = .27$, $\eta^2 = .04$, nor any interaction effect, $F(3,104) = 1.33$, $p = .27$, $\eta^2 = .04$ was found. Table 2 provides the results obtained for female's and male's agency, communion and creativity in each condition.

Table 2

Comparisons of Females' versus Males' Perceived Agency, Communion and Creativity among Four Groups

Variables	Group 1 N = 28		Group 2 N = 23		Group 3 N = 28		Group 4 N = 29	
	female M (SE)	male M (SE)	female M (SE)	male M (SE)	female M (SE)	male M (SE)	female M (SE)	male M (SE)
Perceived Agency	4.25 a c (0.11)	3.61 b (0.13)	3.68 b (0.14)	4.43 a (0.15)	4.38 a c (0.09)	4.36 a (0.11)	3.57 b d (0.12)	3.51 b c (0.14)
Perceived Communion	2.26 b (0.12)	4.48 a (0.08)	4.45 a (0.11)	2.17 b (0.16)	2.23 b (0.13)	2.19 b (0.14)	4.24 a c (0.11)	4.24 a c (0.10)
Perceived Creativity	4.09 a (0.09)	4.11 a (0.97)	4.11 a (0.11)	3.97 a (0.17)	4.21 a (0.08)	4.38 a (0.11)	4.09 a (0.09)	4.21 a (0.12)

Note. Means with different letters are significantly different at *p* < .05 or higher (comparison in rows with Sidak adjustment for multiple comparisons); Group 1 = agentic woman & communal man; Group 2 = agentic man & communal woman; Group 3 = agentic woman & agentic man; Group 4 = communal man & communal woman

Perceived agency, communion and creativity - nomination for tasks. A chi-squared test was performed to examine the potential relation between the decision for choosing the described male or female for a specific task and condition,

χ^2 (1, 106) = 18.73, *p* < .001. About 82.6% of the participants nominated the communally-oriented female student as the person who they would like to invite to make a speech to fellow students about creative problem solving in computer science. This result showed up when the man was described as agentic (condition 2). Conversely, when both the male and the female were characterized as agentic, 77.8% of participants chose the man for this specific task. For the more communal task (choose a person who you would like to share a desk in the office with) a chi-squared analysis revealed a significant association between the conditions and the male/female gender of the described person, χ^2 (1, 106) = 21.40, *p* < .001. The communal male described in condition 1 (unstereotypical) was indicated by 89.3% of the participants, and the communal female characterized in condition 2 (stereotypical) was nominated by 69.6%, Table 3 provides the results obtained for the chi-squared analysis.

Table 3
Percentage of Participants' Choices for Four Tasks in Four Groups

Task	Gender	Group 1 *N* = 28	Group 2 *N* = 23	Group 3 *N* = 28	Group 4 *N* = 29
Lecture	Female	48.9%	82.6%	22.2%	47.2%
	Male	51.9%	17.4%	77.8%	52.8%
Desk	Female	10.7%	69.6%	59.3%	51.7%
	Male	89.3%	30.4%	40.7%	48.3%
Escape room	Female	17.9%	8.7%	63%	51.7%
	Male	82.1%	91.3%	37%	48.3%
Programming training	Female	17.9%	69.6%	48.1%	44.8%
	Male	82.1%	30.4%	51.9%	55.2%

Note. Group 1 = agentic woman & communal man; Group 2 = agentic man & communal woman; Group 3 = agentic woman & agentic man; Group 4 = communal man & communal woman Lecture = who you would like to invite to make a speech to students about creative problem solving in computer science; Desk = who you would like to share a desk in the office with; Escape room = who you would like to go to the escape room with; Programming training = who you would invite to the unique training for programmers if they won a voucher

Correlation between perceived females' and males' agency, communion and creativity. To investigate the potential relationship between perceived agency, communion and creativity, a correlation analysis was conducted separately in each group. Importantly, the female's perceived creativity was positively related to the female's perceived agency (*r* = .42) and the male's perceived creativity was positively related to the male's agency (*r* = .45) and community (*r* = .43), however, this only holds true when persons were described stereotypically (condition 2). In condition 4, where male and female characteristics were more communally-oriented, the female's perceived creativity was related to her perceived communality (*r* = .40), while the male's perceived creativity was

strongly related to his perceived communality ($r = .56$) as well as agency ($r = .62$).

Additionally, when both male and female computer science students were described as agentic, a positive correlation between perceived agency and creativity was observed only for the female, $r = .49$.

Table 4 shows the correlations obtained in each condition.

Table 4

Correlations among Variables in Four Conditions (Groups)

Agentic Woman & Communal Man	1	2.	3.	4.	5.	6.
Females' Perceived Agency	-					
Females' Perceived Communion	-.21	-				
Females' Perceived Creativity	.32	-.08	-			
Males' Perceived Agency	-.08	-.08	.43*	-		
Males' Perceived Communion	.37	-.02	.44*	.23	-	
Males' Perceived Creativity	.23	.27	.33	.04	.19	-
Agentic Man & Communal Woman						
1. Females' Perceived Agency	-					
2. Females' Perceived Communion	.21	-				
3. Females' Perceived Creativity	.42*	.26	-			
4. Males' Perceived Agency	.25	.56**	.35	-		
5. Males' Perceived Communion	.64**	-.00	.24	.15	-	
6. Males' Perceived Creativity	.33	.30	.20	.45*	.43*	-
Agentic Man & Agentic Woman						
Females' Perceived Agency	-					
Females' Perceived Communion	-.35	-				
Females' Perceived Creativity	.39*	-.24	-			
Males' Perceived Agency	.68**	-.23	.34	-		
Males' Perceived Communion	-.34	.59**	-.10	-.48*	-	
Males' Perceived Creativity	.11	-.35	.67**	.01	-.08	-
Communal Man & Communal Woman						
Females' Perceived Agency	-					
Females' Perceived Communion	.27	-				
Females' Perceived Creativity	.23	.40*	-			
Males' Perceived Agency	.37**	.20	.40*	-		
Males' Perceived Communion	.10	.39*	.56**	.23*	-	
Males' Perceived Creativity	.46*	.31	.71**	.62**	.54**	-

Predictors of females' and males' perceived creativity. To examine hypothesis 2, I conducted a regression analysis which predicted perceived creativity (separately for descriptions of male and female computer science students) through two independent variables. For the female's perceived creativity, the model was significant, $F(2,105) = 8.85$; $p < .001$, and explained a robust portion of variability ($R^2 = .15$, adjusted $R^2 = .13$). The female's perceived agency ($\beta = .29$; $p = .002$) and growth mindset ($\beta = .21$; $p = .02$) significantly predicted her perceived creativity. For the perception of the

man's creativity, a different pattern was obtained. The male's perceived agency (β = .39; p < .001), community (β = .25; p = .01), and participants' agency (β = .26; p = .004) predicted the man's perceived creativity, F (3,104) = 15.83; p < .001 (R^2 = .21, adjusted R^2 = .18).

DISCUSSION

A link between social orientation and creativity perception in computer science might be one potential explanation behind the gender gap in this male-dominated field. Hence, agency and communion, the so-called Big Two, might play a crucial and dynamic role for the social perception of creative potential embedded in computing and programming proficiency. The presented study confirmed that people, specifically students representing computer science, perceived creativity in a domain-specific context as related to stereotypically masculine characteristics. Overall, in line with previous studies (e.g. Proudfoot, Kay, & Koval, 2015), it has been shown that perceived agency - defined in terms of being self-directed, independent and task-oriented - is a relevant predictor of males' and females' perceived creativity. Participants' agency positively predicted the perception of creativity, however only in the case of male computer science student's ratings. These findings suggest that agency is associated with masculinity in terms of participants' orientation and perception of stereotypically masculine characteristics. In consequence, the gender-based nature of agency was reflected in ratings of males' creativity. These results are evidence for the male-oriented specificity of computer science. Cheryan, Master and Metzloff (2015) argued that stereotypes about the culture of the field, as well as stereotypes about abilities, are a powerful social factor perpetuating gender disparities in computer science. Hence, when STEM fields are portrayed in social perception as domains dominated by "nerdy" and socially clumsy guys, e.g. in "The Big Bang Theory," then these fields have bad (Carli, Alawa, Lee, Zhao, & Kim, 2016) and salient (Cheryan, Plaut, Davies, & Steele, 2009) reputations, which may inhibit STEM interests and career choices among girls and women. However, it is worth noting, that in the present study, agency was not the only key factor. Surprisingly, perceived communion was identified as a significant predictor of the males' perceived creativity. Additionally, participants' communion orientation was positively related to the growth creative mindset, which in turn predicted the females' perceived creativity. These results are interesting and should be taken into consideration for designing future studies, including, for example, a revised perspective of role congruity theory (Diekman et al, 2010). Specifically, the mediating role of communal-goal endorsement and affordances seems to be fruitful for attempts to explain the social perception of the STEM field.

To sum up, it is worth noting, that hypothesis concerning the impact of stereotypical masculine characteristics for increased ratings of men's, but not women's, perceived creativity was not confirmed. Thus, this lack of expected results, might be explained in terms of possible methodological limitations of the pilot study discussed in the next section. However, the obtained results illustrate that scrutinizing specific associations between social orientation and perception of creativity in computer science might provide a valuable piece of the gender gap puzzle.

LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

The study was the first attempt to empirically examine relationships between the agency - communion orientation and perceived creativity in a male-dominated field, and its results should be read in the light of several limitations. First, the descriptions of fictional persons was extremely agentic or communal. Thus, in future studies, more mixed, natural and ambiguous characteristics could prove to be useful for examining gender biases and links with the perception of creativity.

Moreover, future research designs should be stronger and include two more experimental conditions (agentic woman vs communal woman; agentic man vs communal man) and a control baseline. Methods, specifically measurements of perceived agency, community and creativity need to be validated and examined in future studies. Applying more executive, behaviour-oriented tasks could provide more robust data. Although the results concerning perceived agency and community confirmed the impact of this manipulation, these effects should be replicated.

Second, although the results concerning potential relationships between social orientation and the creative mindset seem to be promising, future studies should replicate and expand on these findings. In the study at hand, the low reliability of the growth scale might be caused by group homogeneity or the pattern of participants' responses. Finally, the sample in this study was small and specific. Thus, conclusions drawn from the results obtained - with regard to the participants' sex in particular - are limited and definitely not generalizable. To capture gender differences, future research should include a similar number of female and male participants. Moreover, a study conducted among social science students - or any other non-STEM field - would be a useful comparison, much like studies with participants of different levels of education and occupation.

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